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# The Actuarial Paradigm

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*“And new Philosophy calls all in doubt, the element of fire is quite put out; the Sun is lost, and the earth, and no man’s wit can well direct him where to look for it.”*

—John Donne

**W**e live in an age of hype and melodramatic overstatement. Every problem is A CRISIS! Every unfortunate event is A TRAGEDY! Every new development is A PARADIGM SHIFT! And so we trivialize the world.

In this article I skip the melodrama as I discuss the actuarial paradigm and how paradigm shifts (in the nontrivial sense in contradistinction to PARADIGM SHIFTS!) might occur.

## A FEW REFERENCES

The first reference is Thomas Kuhn’s seminal essay on paradigms—*The Structure of Scientific Revolutions*, originally published in 1962.<sup>1</sup> This is the essay that originated our use of “paradigm” to mean our worldview of any particular area of study.

When reading Kuhn’s work, realize that not every philosopher of science agrees with his epistemology. Nevertheless, Kuhn has some important and influential things to say about how we perceive the world.

The next reference is the article “Generalized Models of the Insurance Business (Life and/or Non-Life Insurance)” by Dr. W.S. Jewell, published in 1980.<sup>2</sup> The late Jewell was an internationally recognized expert in risk analysis and professor of operations research at Berkeley University. He was a recipient of the Halmstad Memorial Prize, as well as active in the International Actuarial Association.

This paper applied Kuhn’s concept of paradigms to actuarial science, although his focus and intent were somewhat different from mine. Professor Jewell wanted to highlight the scope of actuarial work in various life and nonlife insurance settings, as well as how academic research was affecting practice in each of these areas.

In one way, however, Jewell was a victim of his time. In his paper, he recommends the use of APL by actuaries. The symbolic logic



nature of APL has seduced many actuaries into the same recommendation, but clearly these actuaries were never responsible for code maintenance—or even thought about code maintenance.

Finally, there is the article, “Current Actuarial Modeling Practice and Related Issues and Questions” by Dr. Angus Macdonald, published in 1997.<sup>3</sup> In this article, Macdonald points out that in actuarial science, our paradigm is reflected in our models. In addition, he provides his views on the hierarchy of models and how that points to the need for software that matches our intentions.

## THE ACTUARIAL PARADIGM

The actuarial paradigm consists of applying probabilistic discounting of cash flows based on assumptions, often of a long-term nature, developed from observational techniques, only without recourse to a causal model in order to determine the value of future contingent benefits.

In practice, the probabilistic discounting is typically rudimentary and is sometimes dispensed with for simplicity when inclusion has an immaterial effect.

The lack of a causal model is something I seldom see mentioned in actuarial literature, perhaps because it seems so usual to us. But to those in other disciplines, this is one of the defining features of actuarial science and is often considered to be a highly flexible and desirable feature.

In “Clinical Versus Actuarial Judgment,” Robyn Dawes, David Faust and Paul Meehl study the application of the actuarial paradigm in psychology. In this study, the actuarial approach to diagnosis and prediction of behavior was found to be superior to clinical judgment.<sup>4</sup>

In an essay from *The University of Chicago Law Review* titled “The Shaping of Chance: Actuarial Models and Criminal Profiling at the Turn of the Twenty-First Century,” Bernard Harcourt makes this statement about the actuarial approach in criminal law:

One intriguing and recurring hypothesis is that the late twentieth century ushered in a new probabilistic or actuarial paradigm. The idea is that there was a shift toward a new mode of bureaucratic management of crime involving a style of thought that emphasizes aggregation, probabilities, and risk calculation instead of individualized determination—a new probabilistic episteme modeled on an actuarial or risk analysis approach to crime management. Although this thesis captures an important aspect of the way we think about criminal law at the beginning of the twenty-first century, it is crucial to emphasize that the turn to probabilistic thinking pre-dates the twentieth century and in fact helped bring about the era of individualization that marked the early twentieth century.<sup>5</sup>

It should be noted that Harcourt believes the actuarial method in criminal law has been an unfavorable development.

Author David Wick recounts how physicist Imre Fényes regrets the insouciance with which actuaries simply take a statistical view of the world without bothering about the “why.”<sup>6</sup>

### SEEING OUTSIDE THE CONFINES OF THE PARADIGM IS HARD WORK

Because the paradigm guides us in how we understand the world as well as what is considered of importance and worthy of study, it is extremely difficult to comprehend the boundaries of our paradigm. No matter how many times we are admonished to think outside the box, it’s just not so simple to do so.

Joseph Priestley, the discoverer of oxygen, believed it to be “dephlogisticated air.” To us, this phrase is meaningless because our paradigm does not include any reference to phlogiston. Priestley, on the other hand, was never able to conceive of oxygen as being a gas in its own right because his paradigm did not include this concept.

Kuhn tells of an experiment in psychology<sup>7</sup> in which the subjects were shown short, controlled exposures to playing cards, then asked to identify them. Some of the cards were the wrong color—for instance, the ace of spades was red, and the four of diamonds was black.

For the unorthodox cards, recognition took considerably longer than for the orthodox cards. Most of the subjects were able to identify the unorthodox cards after extended exposure

to such cards, but a few subjects could never make the mental adjustment and experienced severe distress from viewing the unorthodox cards. One subject is recorded as saying, “I can’t make the suit out, whatever it is. It didn’t even look like a card that time. I don’t know what color it is now or whether it’s a spade or a heart. I’m not even sure now what a spade looks like. My God!”

The effect of the paradigm is so pervasive that Kuhn makes the following observation:

... something like a paradigm is prerequisite to perception itself. What a man sees depends both upon what he looks at and also upon what his previous visual-conceptual experience has taught him to see.

To a large extent, we see only what we expect to see. We see what our worldview (paradigm) has taught us to look for.

Kuhn believes that there is an objective reality, but that our ability to perceive it is limited by our mental constructs. Our epistemology is always smaller than reality. Furthermore, because reality is too large for random investigations, our paradigms guide our investigations only to those areas of reality mapped by our paradigm.

However, both Jewell and Macdonald make the point that regular contact and discussions with those from other fields, who have different ways of thinking about problems and issues, help us to understand where the boundaries of our own paradigm are, and what shape our paradigm might take if we have a true paradigm shift.

This sort of intellectual cross-fertilization is difficult for working-stiff actuaries. For now, such activity appears to be mainly confined to academic actuaries.

### WHAT CAUSES NEW PARADIGMS TO EMERGE?

Kuhn makes it clear that new paradigms do not emerge from old paradigms, nor are they in any way a reinterpretation of data from the existing paradigms.

A new paradigm emerges when there are systematic anomalies between reality and the expectations created by the existing paradigm. Furthermore, these anomalies must be of such a degree that there is a failure of extended attempts to adjust or refine the existing paradigm to address the anomalies.

Such failures result in attempts at alternate explanations of the anomalies. Whenever a successful explanation occurs, and when enough people come to see reality in a new way, then we have a paradigm shift.

It should be clear that Kuhn sees paradigm shifts as being in some ways analogous to the operation of Hegel's historical dialectic. As such, paradigm shifts will only occur at times of intense intellectual turmoil.

### HISTORICAL EXAMPLE OF A PARADIGM SHIFT

One of the early modern paradigms of chemistry was the phlogiston paradigm. In this view, phlogiston was one of the basic types of matter and was involved in burning. Burning substances released phlogiston, which was absorbed by the air. Wood, for example, was viewed as a combination of ash and phlogiston. When burned, all that was left was the ash, with phlogiston released into the air.

This explained why many materials lost weight when burned—the phlogiston component of the material had been released. However, when it became clear that some substances gained weight with burning, chemists attempted to adjust the phlogiston theory by concluding that phlogiston was lighter than air, or that it had negative weight.

To a large extent, we see only what we expect to see. We see what our worldview (paradigm) has taught us to look for.

It wasn't until Antoine-Laurent de Lavoisier discovered that combustion requires oxygen and that oxygen has mass, that the phlogiston theory began to be replaced by the oxygen theory of burning.

We mustn't conclude that the proponents of the phlogiston theory were simpletons. Many of them were brilliant men. However, they were trapped in their paradigm, and it wasn't until anomalies in the phlogiston theory appeared that they were forced to think outside of their paradigm.

### WHAT ARE NEW PARADIGMS LIKE?

A new paradigm is not cumulative—that is, it is not a new development based on what has come before. It is something entirely new such that we cannot even make analogies between the two worldviews.

Much that was important in the old paradigm is either trivial or of no interest in the new paradigm. For example, if we develop a new accounting framework, it may cause much wailing and gnashing of teeth, and it may cause significantly different

financial results. But it is not a paradigm shift because we recognize it as still based on double-entry bookkeeping with debits on the left and credits on the right. We are still concerned about assets, liabilities and profits.

A paradigm shift occurs when we develop an entirely different way to think about commercial activity. Rather than a new and better accounting framework, we will have some novel way to measure and allocate changes in material welfare. We should expect such terms as “profits” and “assets” to become meaningless when such a paradigm shift occurs.

Whatever the new paradigm consists of, we can be sure that there is nothing in the existing paradigm that points toward the new paradigm. Perhaps the best we can do is to ponder what is missing from the current accounting paradigm, much like Sherlock Holmes noticing that the dog did NOT bark.

This is how all paradigm shifts work—new developments occur as improvements of what has come before. Then the ground shifts under our feet without warning, and we wake up in an entirely new world. The times of such changes are often stressful and angst-ridden since significant psychic energy is required to accustom one's self to the new world.

### HOW MIGHT NEW ACTUARIAL PARADIGMS EMERGE?

Attempting to prognosticate about new paradigms is almost certainly guaranteed to be wrong. However, there is something oddly satisfying in making an attempt to see the future.

Jewell, in his paper, states that his judgment is that progress in actuarial science will be evolutionary rather than revolutionary—meaning that he expected no paradigm shifts in actuarial science in the foreseeable future.

I believe this judgment is correct as long as we consider actuarial science to be hermetic and unaffected by emerging technology or by other professional and academic disciplines. Once we admit the effects of emerging technology or developments in financial economics, then the possibility of a paradigm shift in actuarial science appears much more possible.

The possibilities that I consider are based on potential changes in technology as well as possible developments in theoretical constructs that will affect insurance and risk transfer in general.

The first possibility is that our paradigm will change because some replacement for money is developed. Perhaps biometric tracking will improve to the point where a person's cumulative productive activity net of economically dissipative activity can

be used to determine his share of available material welfare. In such a case, the term “cash flow” will be meaningless. It is difficult to visualize what form of benefits will be provided by insurance in such a case, or even what form insurance will take in this scenario.

Just as it was discovered that money had more functions than merely a medium of exchange, when we reach an abstraction of money, it seems likely that we will discover that this abstraction has more functions than money has. Such an abstraction is likely to open up large new fields of economic endeavor. It is clear that if insurance remains a viable and needed activity, the actuarial paradigm will undergo drastic changes to meet this eventuality.

A second possibility is that our understanding and conception of mortality, morbidity, accident, disaster and other insured events reach a point where we can incorporate causal models into our paradigm. The effects of such a change would reduce the statistical elements of actuarial science, but whether the reduction is a little or a lot will depend on the nature of the causal models. Perhaps these models will be generated by some form of artificial intelligence, in which case perhaps the statistical elements will also be generated by artificial intelligence, leaving actuaries with only a monitoring and oversight role.

A third possibility is that biometrics and biometric analysis advance to the point where the cost of risk can be assessed atomistically—that is, actuarial values are determined for each basic unit of risk based on such unit’s individual characteristics rather than based on statistics developed from group averages.

This possibility seems to me to be the most likely since much of what we today call artificial intelligence can be termed correlation engines. These programs are typically weak at imputing cause and effect, but work well for finding hidden or unnoticed correlations.

## CONCLUSION

Paradigm shifts do not occur often, but when they occur, they are accompanied by intellectual turmoil and result in a change in our worldview. When such a shift occurs, much of what we were concerned about in the old paradigm will become unimportant or meaningless. Likewise, the things that are important in the new paradigm are things that were either unimportant or were not noticed under the old paradigm.

Because of advances in technology and changes in areas such as financial economics, actuarial science might experience a paradigm shift in the foreseeable future. ■



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## ENDNOTES

- 1 Kuhn, Thomas S. 1996. *The Structure of Scientific Revolutions*, 3rd ed. Chicago: University of Chicago Press.
- 2 Jewell, W.S. 1980. Generalized Models of the Insurance Business (Life and/or Non-Life Insurance). *Transactions of the 21st International Congress of Actuaries, Zurich and Lausanne S*, 87–141.
- 3 Macdonald, Angus S. 1997. Current Actuarial Modeling Practice and Related Issues and Questions. *North American Actuarial Journal* 1, no. 3:24–37.
- 4 Dawes, Robyn, David Faust, and Paul Meehl. 1989. Clinical Versus Actuarial Judgment. *Science* 243:1668–1674.
- 5 Bernard E. Harcourt. 2003. The Shaping of Chance: Actuarial Models and Criminal Profiling at the Turn of the Twenty-First Century. *The University of Chicago Law Review* 70, no. 1:105–128.
- 6 Wick, David. 1995. *The Infamous Boundary—Seven Decades of Controversy in Quantum Physics*, 78. Boston: Birkhäuser.
- 7 *Supra*, note 1, pp. 62–64.