Health Actuaries and the Short-term Prediction Problem

By Kurt Wrobel

The health actuarial profession has a very real structural problem that is not often discussed—the inherent challenges in making predictions where the results are known in a short period of time. As I will discuss, this short-term prediction problem creates challenges that can cause serious reputational damage to our profession and impact our career progression. In addressing this problem, I will first describe the features of developing predictions under different pricing systems and then discuss the inherent challenges with short-term predictions particularly under complex systems. This article will conclude with a discussion of strategies that we could use to improve our professional standing.

A Comparison of Pricing Systems

The short-term prediction problem can be best illustrated by comparing different pricing systems. The chief differentiating feature among these features is the timing of the prediction process and the degree of complexity of the underlying model.

- Static cost accounting process that involves no prediction.
- A short-term prediction process that involves either a simple or a complex system.
- A long-term prediction process that involves either a simple or a complex system.

The key differentiating feature between simple and complex systems is the degree of accuracy one could expect from using traditional statistical models and the potential impact of unforeseen randomness beyond the parameters of the model. In addition, complex systems are more likely to be profoundly impacted by the results of a prediction error. Although I won't discuss this system specifically, we also have predictions that can never be proven or disproven—for example, the effectiveness of a program that could have multiple factors that influence its ultimate outcome.

Cost accounting with no future predictions. In this system, the underlying cost structure is developed using detailed cost accounting that estimates the internal cost for producing a product. Following the development of this internal cost estimate, the final product price and ultimate margin is developed based on a budgetary process or a more sophisticated technique to maximize profit. In this case, the work product can be produced relatively easily with no obvious uncertainty beyond clearly articulated assumptions. Once the work is completed, the organization can move on to selling the product.

Short-term predictions with simple systems. Whether it involves pricing systems or the expected behavior of consumers with credit cards, this system involves using meaningful statistical techniques to estimate the future with a very small chance that this system will be unexpectedly impacted by unforeseen random events. In one example, the credit card company Capital One used demographic and payment history to segment their customers and then used this information to develop programs to specifically target the most profitable customers. The chief feature was that consumer credit card payment behavior was relatively simple to estimate and then measure. Although this process involves some prediction, the estimation process is simple enough that standard statistical techniques can be used to reliably predict the future.

Short-term predictions with complex systems. This system largely describes our work as health actuaries. Other professions that make predictions about complex systems and then receive feedback in a short period of time including portfolio fund managers, economists, and stock or bond traders. For health actuaries, we are charged with using historical data and estimates of future utilization and unit cost to project future claim costs. In addition, we must account for several other factors including a wide array of plan designs, the accuracy of complex underlying data, and a typically very complicated rating model. The inherent complexity of predicting future health care costs in a relatively short time frame—particularly when a system is undergoing significant dislocation (a recession or a significant change in regulation, for example) and

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with other potential for significant randomness—leads to our most salient challenges:

- Multi-year prediction accuracy. The inherent variability makes multiple year prediction accuracy nearly impossible—especially in a rapidly changing environment. (This same challenge is faced by other professions engaging in short-term predictions.) The irony, of course, is that our actuarial models could have vastly better prediction results over the long term relative to less sophisticated models. In addition, the outcome could have been part of an expected distribution of potential outcomes.

- The Narrative Bias Problem. The real excitement occurs after an inaccurate prediction cycle. Depending on the environment, people not related to the process will jump in to create a simplifying narrative on why the prediction was inaccurate. Even if the result could have occurred given a potential distribution, the simplifying explanation ("narrative bias") will often create a narrative that the actuarial team missed something. As I will discuss in the next section, the process has a very real impact on our profession's reputation.

Long-term predictions with simple models. This would include prediction models made far into the future (10 or 20 years), but also change slowly over time and are less likely to be dramatically impacted by exogenous factors. Mortality tables would be an example of this long-term simple model. Because of the relatively simple and slow moving nature of these predictions, incremental changes can be made over time and the actuary can make adjustments without having to be consistently accurate on a year to year basis.

Long-term predictions with complex models. This process is by far the most difficult and the most likely to be completely futile. These include grand predictions far into the future—estimates of health care spending in 20 years or the expected deficit in 20 years. In many cases, these long-term predictions are biased by a particular philosophy rather than the pursuit of a more absolute truth. The chief advantage, however, is that the individual predicting the far off result will likely be long gone before

Pricing Process	Prediction Technique	Management Challenge
Simple Cost accounting	Basic accounting; no specific prediction required	Clearly articulate the underlying assumptions
Short-term Simple	Standard statistical techniques	Develop accuracy predictions consistent with the statistical techniques
Short-term Complex	More sophisticated techniques could be used, but the accuracy of the modeling will be more limited.	Clearly articulate the limits of estimating complex systems; guard against the narrative bias problem; consider the impact of the outcomes as well as the prediction.
Long-term Simple	Standard statistical techniques that can be adjusted over time	Set appropriate expectations and allow for adjustments in the process.
Long-term Complex	Typically little more than a guess; often impacted by a particular philosophy	Usually the analyst is gone by the time the results are seen.

the actual result of the prediction is seen or could easily blame a missed estimate on a wide potential set of unexpected causes.

The Implications for Health Actuaries

We need to first clearly define our challenges—we work in a field where we make short-term prediction of highly complex systems and these predictions are not likely to be correct over multiple periods. Unfortunately, this process becomes most advantageous to people who sit on the sidelines and create simplifying narratives of why an event occurred usually with simple data analysis, short definitive statements prescribing a solution, and with a few memorized data points. This ultimately puts our profession on the defensive as we try to explain an ex-post result that could have occurred based on a wide range of potential outcomes of a complex system. As a profession, our career prospects are ultimately limited simply because the consistent success necessary to progress is extremely difficult in a multiple prediction cycle situation.

How to Respond to the Challenge

As a profession or on an individual basis, I truly hope that we don't respond in the most expedient way—stand on the sidelines and criticize those making predictions by developing simplifying narratives of why a prediction was incorrect. I think the long-term solution is to first understand our challenge and then respond accordingly, including:

- Discuss actuarial predictions in distributional terms rather than in point estimates. We need to resist the temptation to say an expected result will be a given number and, instead, develop a discussion that highlights a wide range of potential outcomes. Although somewhat more difficult to explain, this exercise highlights the potential for a single point estimate to be wrong and helps maintain our reputation if we do have an inaccurate prediction period.

- Consider the outcomes of particular events rather than just the prediction of the event. We need to consider the state of the business and the financial outcome over a wide range of possible outcomes rather than focus on a single point estimate. This exercise is particularly important in a relatively low margin insurance business—any miss can have a profound impact on the aggregate margin for the organization.

- Openly discuss the narrative bias problem. We need to always be aware and call out this problem. By allowing other people and professions to call us to task for the result of a complex system, we damage our reputation as actuaries and limit our own career progression.

- Quickly identify and explain the inappropriate use of data. We need to be constantly vigilant of poor data analysis—particularly where an analyst uses random data to prove a point rather than honestly using data to discover a particular result.

In the parlance of Nassim Taleb, the author of "The Black Swan" and several other books on randomness, we are unfortunately in a very fragile business—our profession and careers are adversely impacted by unexpected results from complex systems. Ironically, individuals who can avoid the business of predicting complex systems and just

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provide comments on these results face a much better payoff—they can benefit if our predictions are wrong by suggesting that they knew our predictions were going to be wrong and face no loss if the predictions are correct.

As a profession, I think that we too often approach these situations with a degree of naïveté that ultimately hurts our profession. To the extent possible, we need to educate and be vigilant of a system where we have this potential for adverse events. We need to set appropriate expectations, consider outcomes as well as make predictions, and guard against the narrative bias problem.

In the end, of course, if all else fails, we can follow Taleb's advice in how to respond to randomness:

"Wear your best for your execution and stand dignified. Your last recourse against randomness is how you act—if you can't control outcomes, you can control the elegance of your behavior. You will always have the last word." ■

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