



SOCIETY OF ACTUARIES

Article from:

# Health Watch

January 2016 – Issue 76

ISSUE 74 JANUARY 2014

# Health Watch

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## Getting Started with Advanced Analytics: The How and Why

By Gregory Pence

**A**ctuaries are experts at estimating the financial risks and opportunities of future contingent events. They are trained to use complex data to gain insight into well-defined business challenges.

However, they are very often seen as tacticians, rather than strategists who do deep analysis on a narrow set of issues. In many insurance companies, an increasing number of strategic projects are going to professionals with data and analytic backgrounds, not actuaries. The issue is not related to competence but to firming up skills and broadcasting them in the right way, with solid analytics to back them up.

General knowledge of an enterprise's strategic challenges is needed to identify the data and analytics necessary. I see two steps to remedy this.

1. Be comfortable accessing, integrating and building complex data sets from big and broad sources of information to study the value of multidimensional drivers of change
2. Shape the strategic dialogue by making and sharing the economic value of a full range of strategic options

In this article, I will address the first step.

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## Be comfortable

It will take some time to become comfortable accessing, integrating and building complex data sets from big and broad sources of information. But getting comfortable is about taking the time to understand new vendors and tools that allow you to access the newer and bigger world of Big Data and the Big Table.

In health care, the new world is about integration of a broad range of information, including claims, enrollment, electronic health records, clinical charts, diagnostic laboratory, prescription drugs, care coordination, clinical trials, socio economic status, satisfaction surveys, provider-service patterns, benefit designs, provider payment and social media.

Most of the big data challenges are analogous to using the structured relational data sets typically available in many organizations. Like the puritans that sought a better life in the new world, you will need to make a leap. However, the leap you must make is away from corporate IT and toward vendors familiar with these new approaches. While security is a concern, many of these vendors know how to satisfy Health Insurance Portability and Accountability Act (HIPAA) and business security needs. In fact, some are able to meet federal defense contractor requirements.

Start your use of advanced analytical tools by casting a broad net to find and mine the right data sources. This is because the tools you work with often follow the available data. There are many tools that can make the actuary effective and efficient in finding and using data, which in turn make the challenge of communication easier.

## Favorite Mixed Model

One of my favorite approaches to making analytical work fun and useful is combining a decision tree model to mine data and a durational model for establishing and valuing the contingencies historically and to test various scenarios.

In health care, for example, this approach makes it easy to create a multidimensional model of cost and utilization trends and to study assumptions about the potential impacts of targeted clinical interventions.

I like decision tree models because they are very good at:

- Developing the best categorization with a hierarchy structure for the questions you are asking
- Discovering data problems
- Creating a model structure related to the factors underlying change

The decision tree model is so named because it is based on a branching structure typically used to assess decision-making strategies using probabilities. It could also be named the “branching” model.

I have used them to categorize health care risks with hierarchies based on their significance. These structures are unlimited but you start with something you are comfortable with. For example, I have defined the most significant patient risk cohorts, the most credible factors driving change, the sources of the most variation in patterns of care and the highest quality providers. Patient cohorts could be defined first at a high level like catastrophic claims, and then refined down to diagnostic profile or risk score. The factors of change could be those catastrophic cohorts that have changed by the largest cost. The sources of variation could be variation around physician value per service. The decision tree model allows you to test many categorization possibilities for one question but then to come back and do it differently for another question.

During the categorization, you are also testing for quality problems. When looking at catastrophic claims by major diagnostic profiles, you will likely find some profiles with little data. This then will lead you to testing for credibility and setting assumptions that account for the lack of information



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Ultimately, the combination of the decision tree and durational models is a very powerful tool for an actuarial review and is used widely by those who understand them.

in these categories. The challenge then is to find the best categorizations that will stand on their own except for outliers, which you will have to adjust for and additionally address in your durational model.

With categorization done, you will then look at how the categories have changed over time. If you do not like the results, go back and revisit the categorizations. The process is iterative, ending when your model seems to hold together with the data and assumptions you have developed—or when you are fed up enough to move on.

The next stage is to develop durational models, which are the most familiar to most actuaries. They are excellent for valuing contingent patterns for your categorization structure, and as the basis for assumptions about future change such as clinical care initiatives. They are also called survival models because they were first developed for mortality. However, think of them as patterns of events over time reflecting contingent patterns with related values, patterns of care, outcomes, etc. In retirement work, this is essentially what is used to project cash flows and calculate actuarial present values. The same concepts are working here.

Durational models can be prepared for every category in your decision tree or a single aggregate model can be developed that is adjusted based on your assumptions as to the sensitivities of each categorization you want to value.

Ultimately, the combination of the decision tree and durational models is a very powerful tool for an actuarial review and is used widely by those who understand them. For example, in actuarial attestations of clinical innovation grants by HHS, this combination of models is very useful to value the impact in a narrow risk cohort to an aggregate across a diverse population.

## Anorexia Nervosa

An interesting case in behavioral medicine, which seemed to show a bizarre spike in cost and an unusual number of deaths, was found around

the cost and quality of care for members with an anorexia nervosa diagnosis.

We solved the problem with the mixed decision tree and a durational model. The decision tree model helped us to focus on the diagnosis and the durational model helped us to understand how much of the experience was unusual and could be reduced.

The initial finding was that the providers did not track these patients, who bounced around the system when they were in crisis and only got care when hospitalized. Death could occur after multiple admissions and months of in-patient care because, in some cases, the patients presented to the hospital when their organs were failing. The solution was to establish a care coordination structure and a patient registry to track any and all cohorts with this diagnosis, and to contract a narrow network of specialists with a clear history of success with these patients.

## Add Monte Carlo Simulation

In situations where it was hard to make the assumptions necessary using raw data directly, I have sometimes added a Monte Carlo simulation of underlying contingent probability estimates of various outcomes. Some of the problems I have or know of being addressed in this manner include:

- Expectations of enrollment risks on the health insurance exchanges in 2014
- Impact of developing narrow or broad networks on cost and quality
- Capitated health care risks and opportunities using Medicaid provider networks
- Impact of HHS risk-adjustment structures under healthcare reform
- Impact of pricing too high or too low on exchanges
- Incentives designed to change patient health care behavior



## Getting Started is Easy and Counts for CE

First of all, I suggest you plan to do some homework. When I investigate new models or get deeper into ones I have developed, I set aside continuing education time. I record as much as half my required CE to doing this.

When getting started, I looked for free models to download, usually from academic work. In addition, programming tools like R have a lot of modules you can pull from for just about any model you can imagine. An emerging tool worth considering is PowerPivot; a lot of analytical expertise is being developed with this tool, and a lot of models are becoming available to use with it.

Other excellent tools I have used are available from organizations like SAS or SPSS, who have built environments for easy flow of data and assumptions between models. These tools allow rapid cycling from beginning to end for scenario testing. Despite their expense, these environments are built and vetted by some very smart PhDs. As a profession, before they understand what we do, we need to take advantage or they will do our work for us too. ■