



RESEARCH COMMENTARY

The Layers of Mortality Improvement

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Research Commentary

In the 2001 computer-animated comedy film *Shrek*, there is an infamous exchange between the lovable characters Shrek and Donkey. As an ogre amongst all the other fun-loving fairy-tale creatures featured in the film, Shrek struggles to explain to Donkey the complex world in which he lives. As Shrek stretches to find the right comparison, he uses the following analogy:

Shrek: Ogres are like onions...

Donkey: Oh... You leave them out in the sun, they get all brown and start sprouting little white hairs?

Shrek: No... Onions have layers. Ogres have layers. You get it? We both have layers.

To Shrek's point in the movie, to understand the true complexity and nature of both ogres and onions one must peel back and analyze the subject layer by layer. Each layer may have its own story but also helps to give the complete yet complex full picture.

The same concept of layers is decidedly true not only for ogres and onions but with the study of population mortality trends. With the recent release of the Society of Actuaries report "Developing a Consistent Framework for Mortality Improvement"¹ and the tools that allow review of historical mortality in the United States and an ability to analyze mortality improvement trends, it becomes clearer all the time that layers of mortality are involved. The Mortality Improvement Model as well enables actuaries to begin to apply commonly used mortality improvement modeling techniques at subpopulation levels to see how the socioeconomic layers of the U.S. population form the full population picture.

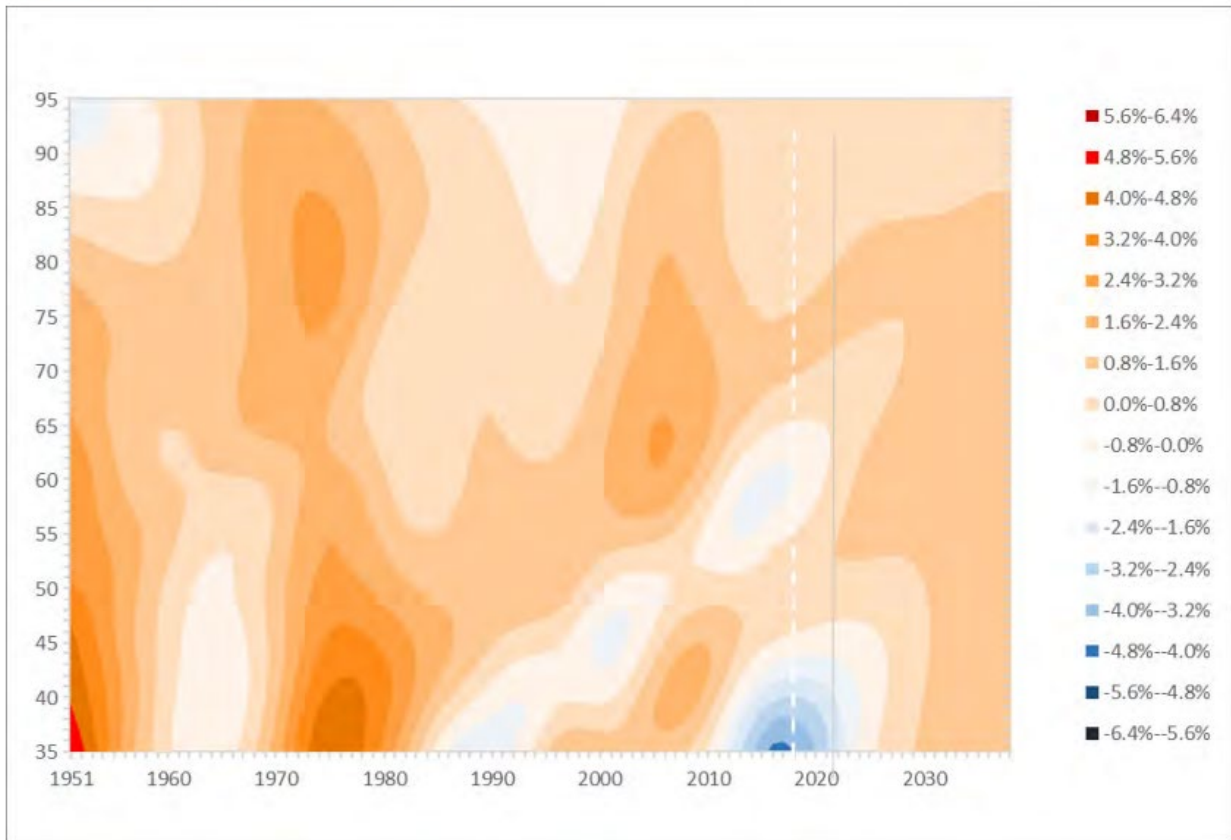
As an example, take the following heat map that is being a more common reference in actuarial work to describe past mortality improvement and future modeling in the full U.S. population. This heat map represents past and

¹ <https://www.soa.org/resources/research-reports/2021/developing-consistency-framework/>

future modeled mortality improvement for females in the United States using base assumptions from the most recent Mortality Improvement Scale MP-2020 from the SOA.²

Figure 1

SCALE MP-2020 HEAT MAP: FEMALES



Some very large pension plans may have a breadth of participants across income levels, job types, geographic areas and education levels to make the full U.S. population trends derived from past U.S. Social Security mortality data be a reasonable assumption. The heat map shows general trends across time including various levels and intensity of period and cohort mortality improvement effects.

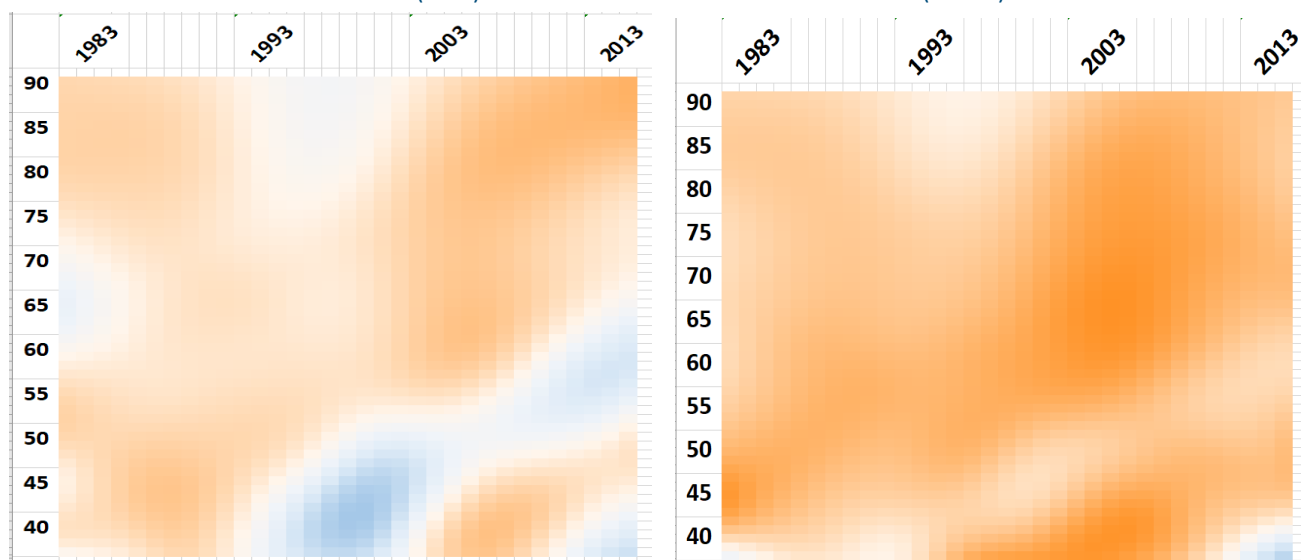
The U.S., however, is a large, economically developed country. Over 330 million people live in the United States across age groups and genders, but also with a lot of socioeconomic differences that influence health, morbidity and mortality trends. Only by looking at the layers of the population might we understand better where different mortality improvement levels and trends lie. Actuaries may encounter employee retirement and welfare plans that may show different socioeconomic characteristics than the full population. They may also be looking to make mortality improvement assumption for insured cohorts driven by underwriting and selection that can impact the level of mortality improvement. That’s where the information and tools from the “Developing a Consistent

² <https://www.soa.org/resources/experience-studies/2020/mortality-improvement-scale-mp-2020/>

Framework for Mortality Improvement” project can help shed additional light. The tools allow an actuary to look at subdivisions of the population down to quintiles and deciles created through applying a socioeconomic index score to U.S. counties and then tracking how mortality by these scores changes over time. The results of these deeper analyses are very much akin to peeling back the layers of the onion to get a better look at how to understand a complex mortality topic. By layering together the slices of mortality into socioeconomic deciles, it can show how all the small pieces come together to form the larger complete puzzle, and also give the actuarial profession another tool in their toolkit to further improve their forward mortality improvement estimations.

As an example, the following “slices” of mortality improvement are related to the full female population mortality trends seen in scale MP-2020 above, but look at the lowest and highest socioeconomic scores from the recently released mortality improvement tool.

Figure 2
U.S. FEMALE MORTALITY IMPROVEMENT
LOWEST SOCIOECONOMIC DECILE (LEFT) AND HIGHEST SOCIOECONOMIC DECILE (RIGHT)



The data above, combined with the eight other socioeconomic decile layers, help form the full MP-2020 picture from 1983 towards the current point in time but certainly with different levels of mortality improvement. The lowest socioeconomic decile shows lower improvement and can be seen to have some more distinct cohort patterns. The highest socioeconomic decile has generally higher improvement levels and perhaps more muted cohort effects. Depending on the actuarial application, there may be a desire to use these or other mixes of socioeconomic layers across time to get a look at what current and forward assumptions may be fit for the purpose.

It’s helpful to see this and other next steps in the evolution of mortality improvement emerge for use in the actuarial profession. We’ve seen many actuaries evolve predictive analytics tools that have taken very detailed personal data and help shape mortality and improvement assumptions. These SOA reports and tools that look at data through socioeconomic scales additionally help give the profession information it can use.

Let’s face it... Just like ogres and onions, mortality is complex. Recognizing that layers need analyzed in mortality helps give a better perspective and a deeper understanding of the historical and emerging trends.

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