U.S. Mortality Improvement Trend Deep Dive

By Nikolai Serykh and Alex Yang

In January 2019, the Society of Actuaries (SOA) published "U.S. Population Mortality Observations—Updated with 2017 Experience,"[1] which highlighted a slowdown in the U.S. population's mortality improvement over the past several years. The following discussion aims to address a key question:

How can actuaries use population mortality trends to set future mortality improvement (FMI) assumptions for an individual life insurance portfolio?

In this paper, we will discuss two key dimensions often analyzed by insurance practitioners when using population mortality data:

- causes of death (COD)
- socio-economic status (SES)

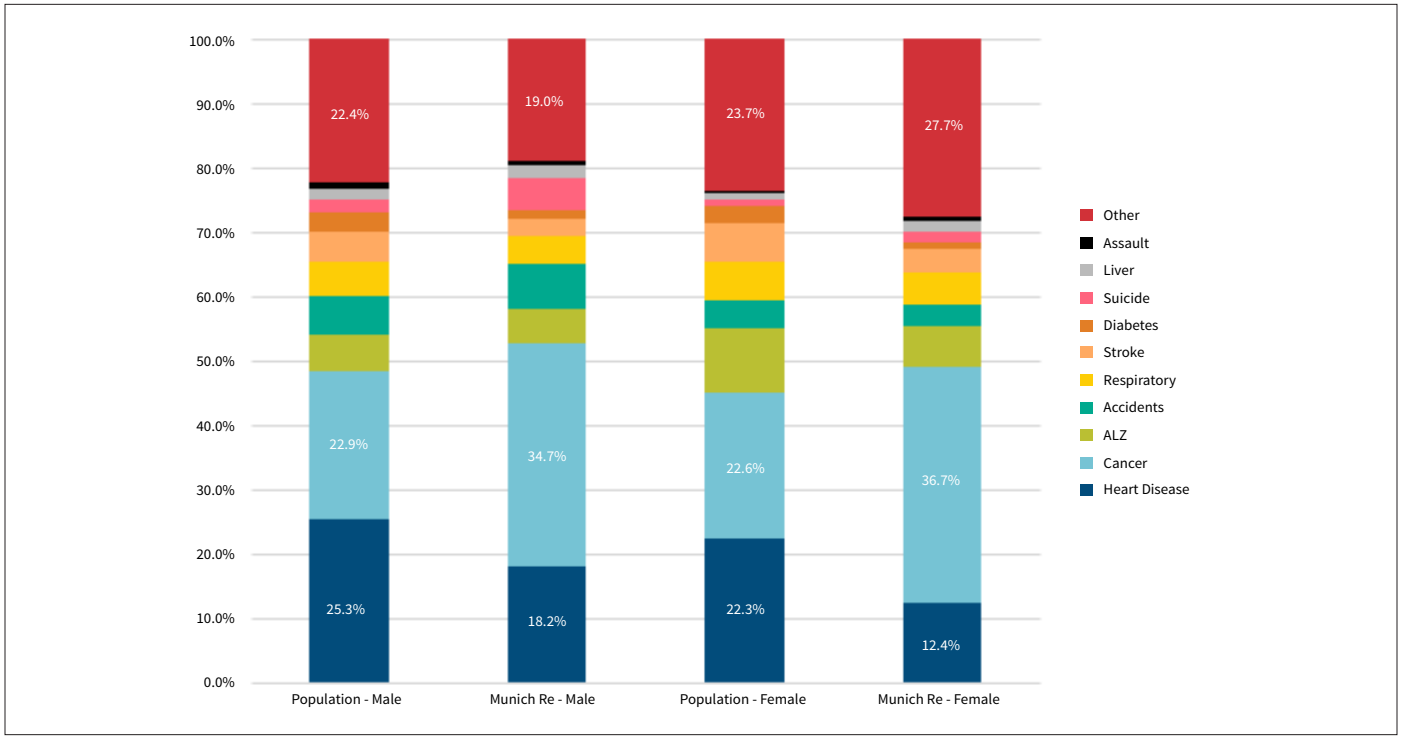
CAUSES OF DEATH

As highlighted by the SOA report, mortality trend is not homogenous across different CODs. In order to understand the difference in mortality trend between general population and insurance population, we need to identify the prevalence of each COD within the two populations.

Chart 1 compares the COD distribution between general population and Munich Re US Life's individual life portfolio claims by count from 2007–2017. The Munich Re experience is filtered for durations 1–20, single life, fully underwritten, automatically reinsured, excluding substandard and term conversions.

We observed that the Munich Re insurance portfolio deaths have a significant skewness towards more cancer and less heart disease compared to general population. One possible explanation for this

Chart 1
U.S. 2007–2017 COD Distribution—Population vs. Munich Re



skewness is that life insurance underwriting is more effective at filtering out potential cardiovascular disease than cancer. Traditional underwriting methods such blood test and family history can be highly effective in determining the risk of heart disease, thereby excluding high risk individuals from the insurance pool. In comparison, cancer is less predictable through current underwriting methods.

When actuaries are looking to review mortality experience and set FMI assumptions, it is important to take the underwriting impact and the resulting COD prevalence into consideration. As underwriting methodology evolves, many companies are starting to remove fluid tests and introduce accelerated underwriting tools. It is important to understand the selective features of these underwriting tools, beyond measuring the protective value using a traditional A/E analysis. For example, even if a new underwriting method can fully offset the mortality A/E impact from removing fluid tests, it may still have a secondary impact on mortality improvement trends, because it may be identifying a different portfolio of individuals compared to the traditional fluid test.

For our full COD analysis, which includes a deeper dive into the face amount and gender impact on COD distribution, please go to: *https://www.munichre.com/us-life/en/perspectives/mortality-studies/analyzing-ind-life-ins-mortality-trends-cause-of-death.html*

SOCIO-ECONOMIC STATUS

Another dimension that differentiates insurance population from general population is the SES. When analyzing U.S. population data for mortality trends, it is important to account for the fact that insurance population is heavily skewed towards the more affluent population.

The challenge with segmenting mortality experience by SES is that key indicators such as income, net worth, and education attainment are not always available or accurate. In this paper, we will discuss two approximation methods.

The first method is to segment the population mortality data by county using county-level income. Under this approach, we ranked all U.S. counties by historical per-capita income, and analyzed mortality data from CDC WONDER by percentile of county-level income. The main limitation of this approach is that counties do not have a uniform distribution of income within their population; in fact, some counties in the U.S. could have extreme wealth disparity that leads to 20–30 years[2] of life expectancy difference. Categorizing by county-level income can misclassify lives that have a different income profile than the rest of the county.

The second method is to proxy SES using education attainment levels. Education has been included as an element of death certificates in most U.S. states since 1989. Additionally, the total population estimates (i.e., the exposure) by education attainment can be retrieved from the U.S. Census Bureau. Combining these two sources allows us to conduct mortality studies for the U.S. population by different education attainment levels.

Using these methods, we segmented population data into four subgroups:

- By county income: Top 15 percent vs. bottom 15 percent
- By education: Bachelor's or higher (BA+) vs. less than Bachelor's (BA-).

We compared the mortality rate of the four population segments in Charts 2 and 3 on page 6.

Chart 2
Male 2013–2017 q'x as a Percentage of all CDC Male Population

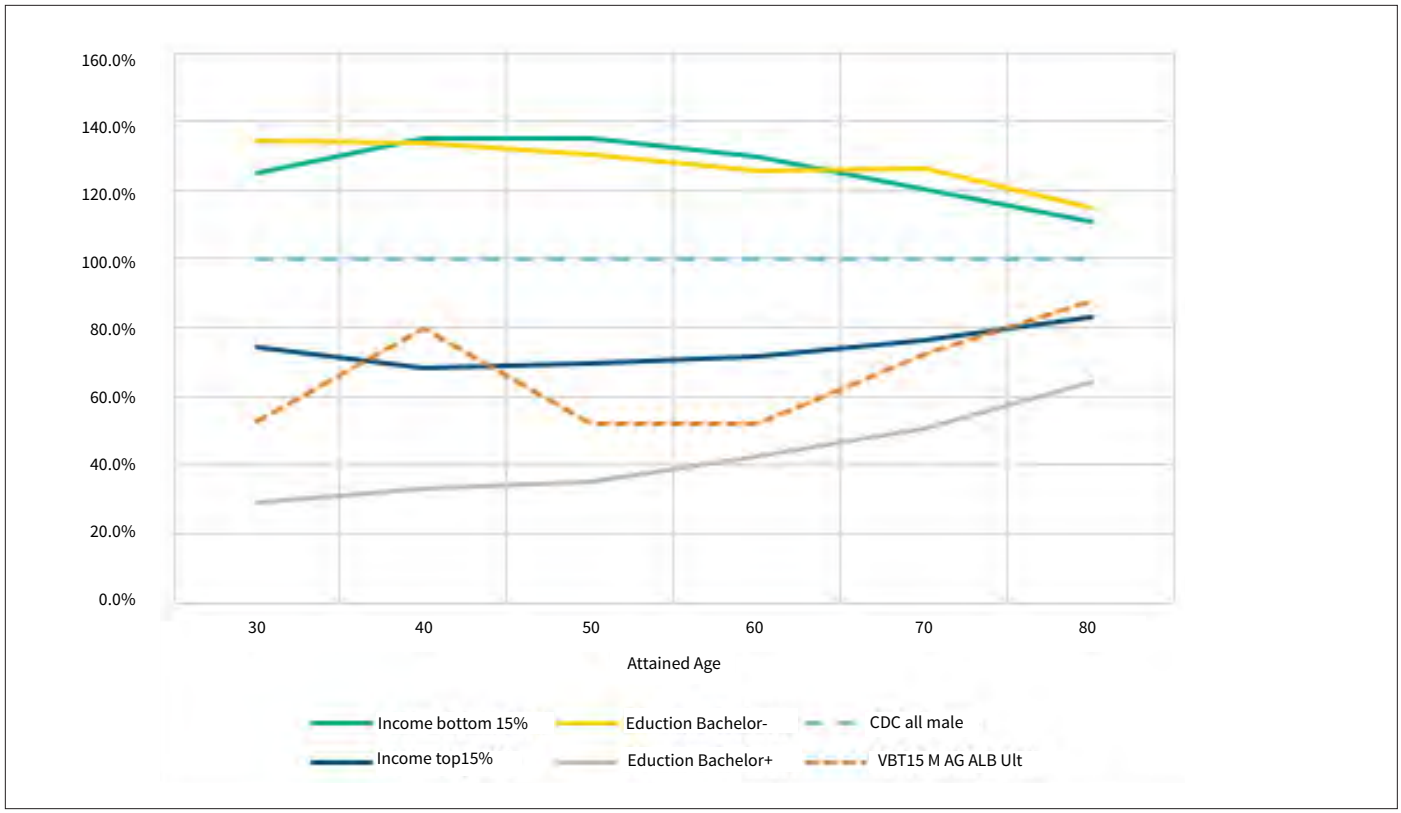
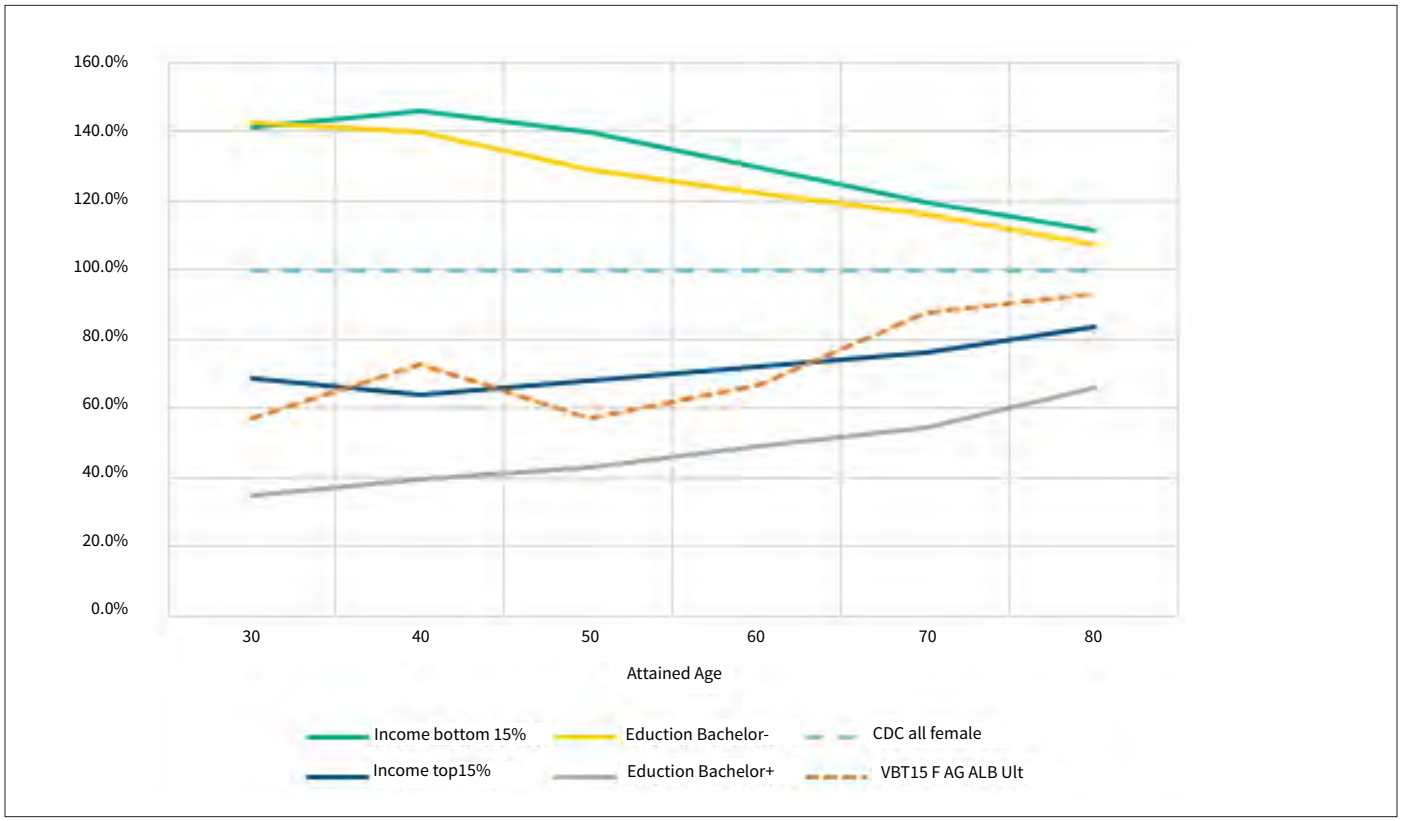


Chart 3
Female 2013–2017 q'x as a Percentage of all CDC Female Population



The following observations were made:

- **Both county income and education attainment can distinctly segment U.S. population's mortality.**
- **The mortality gap is wider at younger ages** with one exception that under the county income approach, the gap appears more narrow at age 30 than age 40.
- **Education attainment provides a stronger segmentation than county income.**
- **Higher SES is a good proxy for life insurance population.** For most attained ages between 30–70, the insured population's mortality (proxied by VBT15) is between or close to the "Top 15 Percent Income" and "Education BA+" mortality.

In charts 4, 5 and 6 (pg. 8), we then compared the observed MI rates for each subgroup, over the short-term (2011–2016) and long-term (2000–2016).

Chart 4
M&F Average MI By County Income

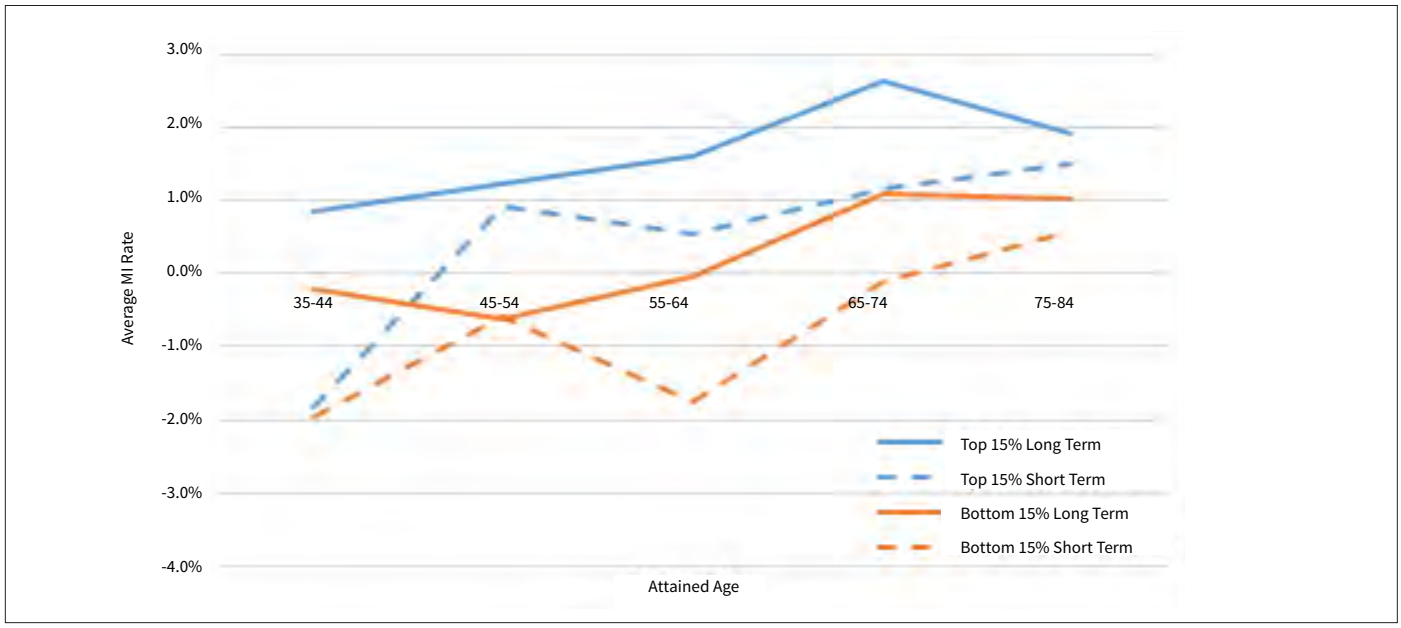


Chart 5
Male Average MI By Education

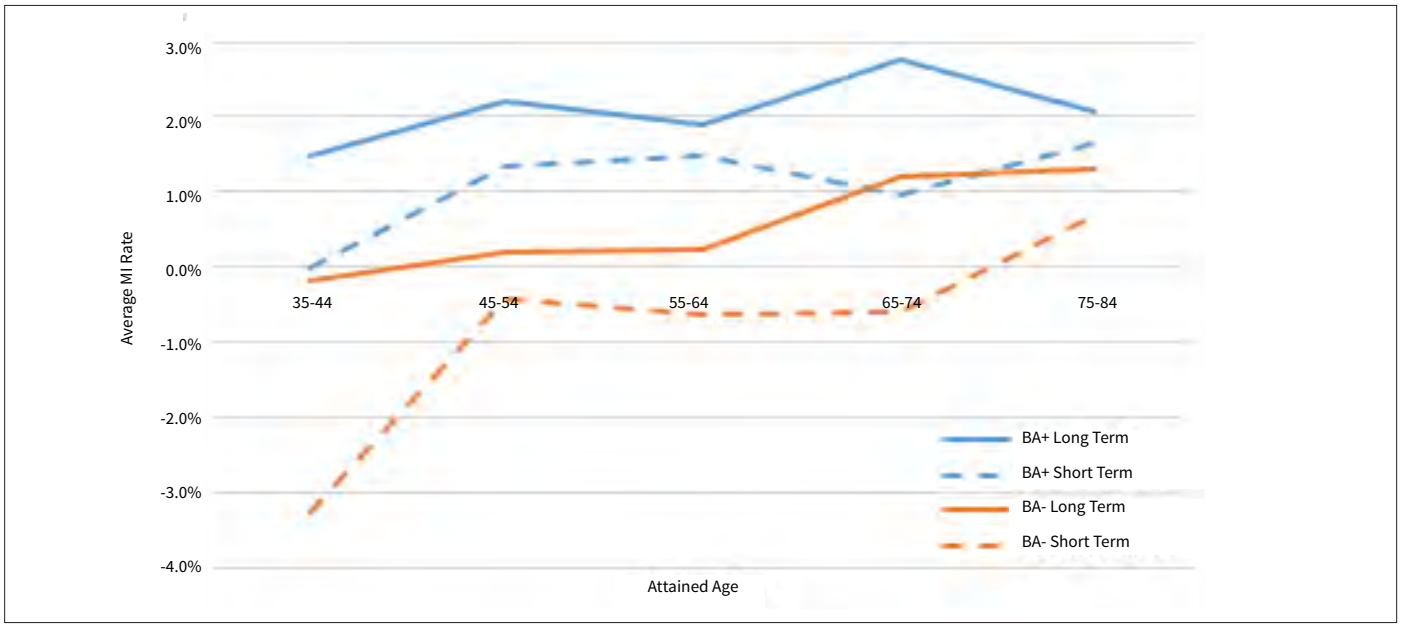
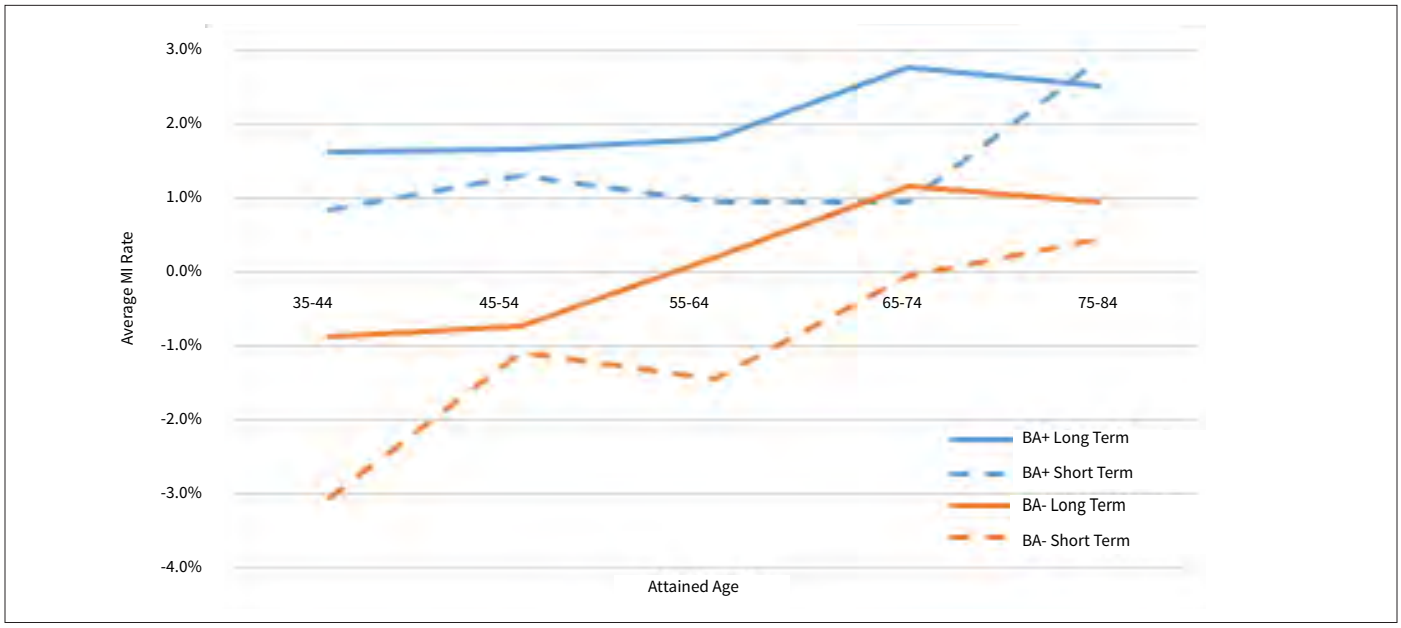


Chart 6
Female Average MI By Education



The following observations were made:

- **Mortality improvement is faster for higher SESs**, over both long-term and short-term.
- **Difference in mortality improvement between SESs is across all ages.**
- **Bachelor's or higher educated population has similar or better mortality improvement than those from top 15 percent income counties**, this is reasonable since we previously concluded that BA+ provides a stronger segmentation than Top 15 percent.
- **MI has slowed down in the short term, but materially positive MI can still be observed for the higher SESs.**

For more details on our mortality analysis by SES, please refer to the full whitepaper at the link below: *https://www.munichre.com/us-life/en/perspectives/mortality-studies/analyzing-individual-life-insurance-mortality-trends-socioeconomic-status-impact-report.html*

KEY TAKEAWAYS

Over the past few years, speed of mortality improvement has slowed amongst the general population. When actuaries develop long-term MI assumptions for life insurance using the population data, it is important to understand the difference between the general population and the population of an insurance portfolio. The two methods demonstrated in this article provide ways for actuaries to take these differences into consideration. ■

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REFERENCES

1 U.S. Population Mortality Observations Updated with 2017 Experience Society of Actuaries, January 2019 *https://www.soa.org/globalassets/assets/Files/resources/research-report/2019/us-population-mortality-observations.pdf*

2 Large Life Expectancy Gaps in U.S. Cities Linked to Racial & Ethnic Segregation by Neighborhood, https://www.cityhealthdashboard.com/story/1092