What's Going on with LEs at Higher Ages?

Vince Granieri, Predictive Resources, LLC

Last year brought many changes to the Life Expectancy underwriting space. Well-known LE providers have modified their mortality tables and/or underwriting processes after many years. These changes bring new questions to the industry. In particular, the LEs we see at older ages seem quite long; why is that? I'd like to explore and better understand these observations.

Mortality at the oldest ages has been a challenge to actuaries and demographers for many years. This is especially true for actuaries attempting to build mortality tables based on insured lives. Proxies, such as the Social Security database, have been used to derive insured mortality, primarily due to lack of data at those ages. This is clearly suboptimal, but necessary, due to aforementioned limitations.

Researchers also attempted to fill this void. For many years now, a triennial gathering, called The Living to 100 and Beyond Symposium, recognized the need to more closely study mortality at upper ages. This need was met by highly qualified researchers, who presented numerous papers dealing with this issue. An important conclusion frequently presented is that the Gompertz Model applies over a range of ages stretching from the very young to those living well beyond 100.

For example, in the 2014 and 2017 symposia, Gabrilov and Gabrilova presented strong evidence that the Gompertz Model applies to human longevity beyond age 105 and perhaps even beyond age 110. In part, they concluded, "Hazard rate estimates (mortality rates) after age 110 continue to grow with almost linear trajectory in semi-log coordinates suggesting that Gompertz law is still valid at this age."

However, the most recent VBT Tables do not reflect this result. Instead, they assume mortality levels off at certain ages above 110. Further, the deceleration of mortality in anticipation of a fixed ultimate mortality rate in those tables is reflected much earlier than age 100, which could lead to unintended consequences for those relying on these tables to generate LEs. It is possible to mitigate this issue, but it may be difficult or impossible to alleviate it, given the level ultimate mortality rates in the VBT.

Some LE providers in life settlement market use the VBT as a basis for standard mortality. At Predictive Resources, we developed proprietary mortality tables that reflect our understanding that senior mortality was based on Gompertz' Law. In recent months, it became clear that our life expectancies, especially at ages 90 and above, were shorter that those of competitors with VBT-based mortality tables. This led us to examine mortality rates at upper ages in those tables.

Our tables utilize a Gompertz Model in their derivation, with omega for male/female at 118/122. The VBT have no omega, but instead level mortality beginning at age 110 (08 VBT) and 112 (15 VBT). Interestingly, for the nonsmoker tables, the ultimate mortality rate is higher in the later table, which is inconsistent with observed mortality improvement over that time period.

Below, I compare actual ultimate mortality rates from the 2008 and 2015 VBT to those derived from an application of Gompertz law to those same VBT at upper ages. I found significant discrepancies and discuss a way to alleviate them without significantly compromising either approach.

Methodology

I used the ultimate mortality rates from the 08 and 15 VBT, beginning at age 80; ultimate rates were chosen to avoid allowing the selection effects to impact the slope of the curve and invalidate the analysis. I took the natural logarithm of mortality rates at each age and graphed them in Microsoft Excel. I also placed a linear trend line on the graph representing Gompertz law, using the first few years mortality as the basis for the slope of the trendline. I extended the line and then compared it to the log of the mortality rates for ages 80 – 115 and 90 – 115.

Results

The results of this exercise are shown in Figures 1 – 4. Figure 1 is the 08 VBT from age 80 – 115. The log of mortality rates follows a linear pattern from age 82 roughly age 93, at which point it begins to decelerate in anticipation of leveling to a zero slope at age 110. The discrepancy between Gompertz mortality and the 08 VBT becomes particularly large beyond age 104.

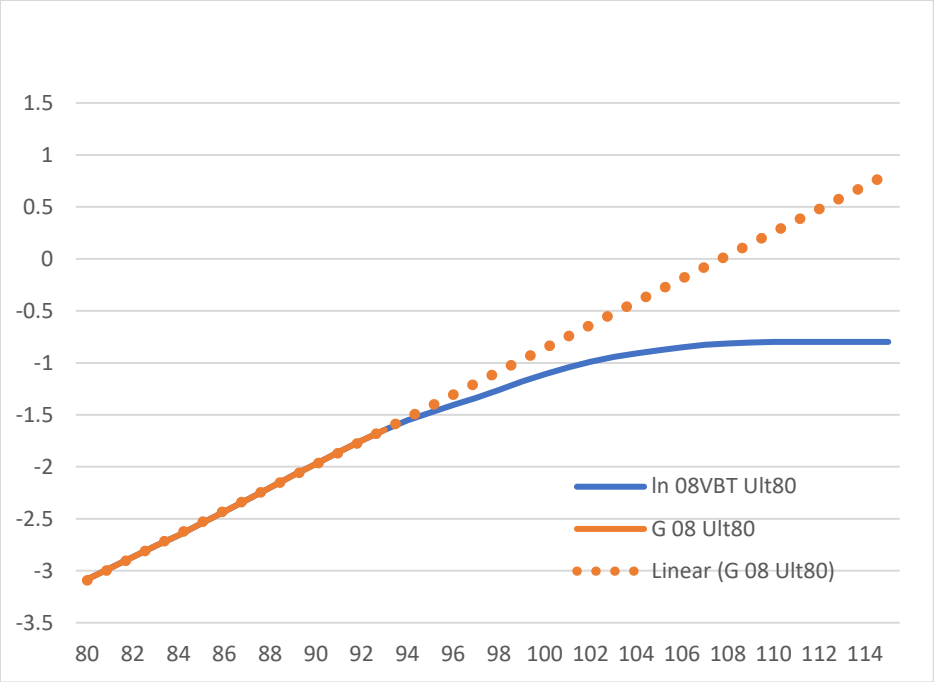

Figure 1 Age 80 Ultimate Mortality VBT08

Figure 2 is the same analysis for the 15 VBT. Because the slope of ln(qx) is steeper in the 15 table, the Gompertz omega is quite low, somewhere around age 105. The discrepancy relative to Gompertz is not as great because the ultimate mortality rate is higher in the 15 table.

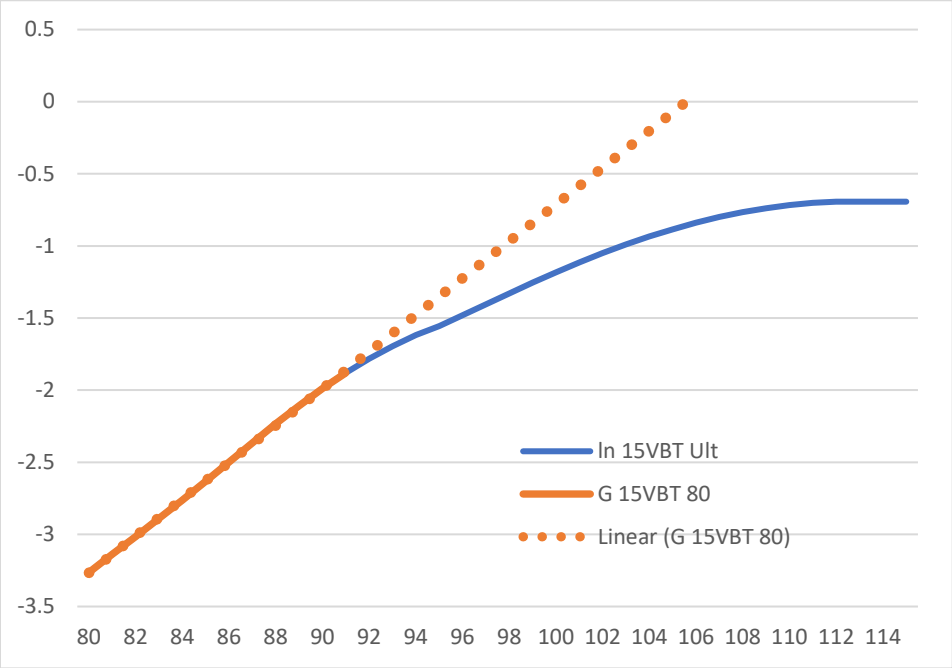

Figure 2 Age 80 Ultimate Mortality VBT15

Figures 3 and 4 repeat the above analyses, beginning at age 90. The same commentary generally applies, except the slope of the 15 trendline is not as steep, relative to the 08 table, producing a more reasonable omega. Also, the discrepancy relative to Gompertz is much less severe due to the shallower slope of the first few durations beyond age 90 of ln(qx) for the 15 VBT.

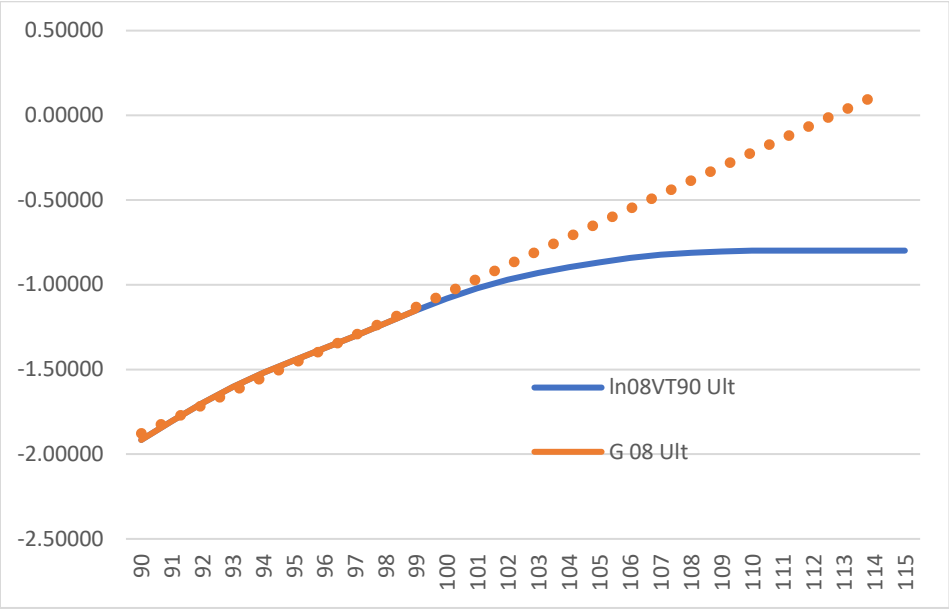

Figure 3 Age 90 Ultimate Mortality VBT08

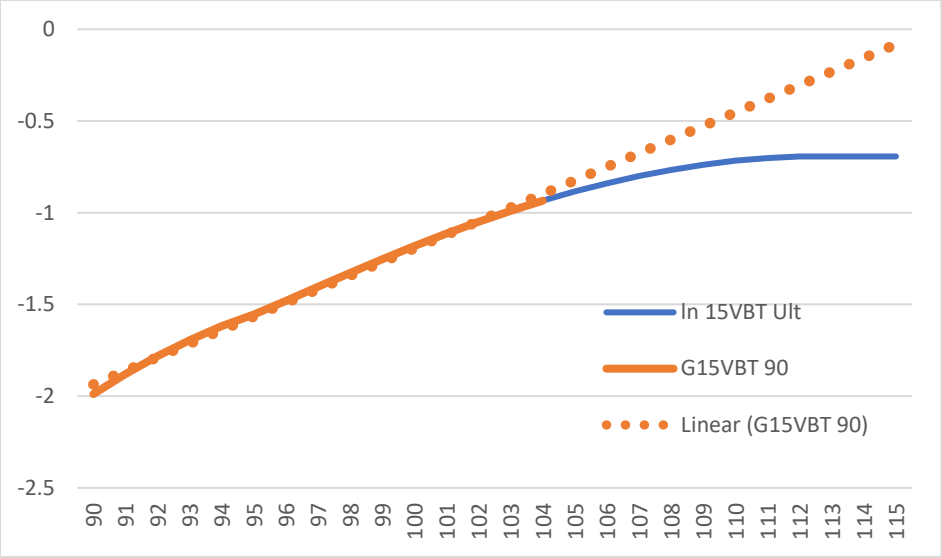

Figure 4 Age 90 Ultimate Mortality VBT15

Discussion

When reviewing the graphs, it is easy to see how discrepancies can arise between using a Gompertz model to derive life expectancy at upper ages and using the VBT. Life expectancy using the Gompertz trendlines will be shorter than those derived from use of the VBT. These discrepancies arise due to the leveling ultimate mortality rates under the VBT that were referenced above. One might expect some deceleration of mortality as age approaches the point on the graph where VBT mortality levels off. It is a natural consequence of the latter's level ultimate mortality rate. However, it may be unreasonable to expect this deceleration to occur many years in advance, as seems to be the case.

This phenomenon leaves practitioners who want to forecast senior mortality or longevity with the dilemma of which curve to believe. We at Predictive Resources feel comfortable that the existent research clearly favors the Gompertz approach. That may concern some industry players, but the research appears irrefutable.

Conclusion

Despite researchers' best efforts, the lack of data regarding mortality at the highest ages continues to be a challenge. Differences between research supporting the Gompertz model and observed mortality rates in accepted VBT-based mortality tables can create consistency issues. Further study is needed to find ways to reconcile these disparate methods data becomes sufficient to provide a more definitive conclusion. In the meantime, life settlement industry players will have to choose between competing philosophies in setting mortality assumptions.