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A VM-20 Mortality and Credibility Factor Observation

By Tim Cardinal

Many questions have been asked regarding VM-20[1] and reserves over the past decade. Will our company's reserves be lower or higher, and by how much? The answer "it depends" isn't as clean or easy as a "yes/no and by a lot." Mortality is an obvious driver to answering the yes/no/how much question. A second series of related questions is: what is our mortality assumption? What is our credibility factor? How much do reserves change with a higher credibility factor? This article presents graphical results[2] to answer the last question.

The VM-20 mortality assumption splits the policy period into three periods: Period 1—based on company tables plus margin; Period 2—grades linearly from company to industry; and Period 3—based on an industry table plus industry margin. Margins for the company tables are determined via one of two permissible credibility methods to determine a credibility factor—Bühlmann and Limited Fluctuation. For both methods the factor is used as a table lookup to determine a vector of margins; the column is based on the credibility factor and the margins in rows vary by attained age. These margins are applied to company tables. Another dimension to credibility is how long—the sufficient data period—which VM-20 defines as the last duration in which there were more than 50 claims. The sufficient data period along with the credibility factor is used to determine the length, start and end of each of the three periods. The details of the mortality assumption process are beyond the intent and scope of this article.

Figures 1–3 present deterministic reserve results for a 10/20 year term cohort using Bühlmann credibility factors for 11 of the VM-20 margin table's 24 columns—corresponding to the columns 33–37%, 48–52%, 58–62%, 68–72%, 78–82%, 83–87%, 90–91%, 92–93%, 94–95%, 96–97%, and 98%. The margin decreases as one moves across the table from left to right. To avoid the possible confusion that the 11 results are consecutive columns (they are not) I use the word "trial" as a label rather than "column." The margins at ages 0–45 for these 11 trials are shown in Table 1.

The 10/20 year term cohort consists of one year of issues—40 percent 10 Year, 60 percent 20 Year—using LIMRA sales mix data. Reserves are on a direct basis.

Deterministic reserves depend on a myriad of other assumptions and modeling methods. Without knowledge of all assumptions, one cannot and should not read too much into the values. However, in this article, we are interested in change. Changing an assumption would simply shift all the results by nearly the same amount. In the figures, the trials alternate between dark/light and use different dash-dot patterns. Since VM-20 requires a comparison of the deterministic reserve (DR) plus the due and deferred premium asset (DPA) to the net premium reserve (NPR), the analysis considers DR + DPA. As expected, DR + DPA decreases across all policy years as the credibility factor increases, meaning a column further right in the VM-20 table is used resulting in lower margins for the company table.

Table 1
11 Margin Trials

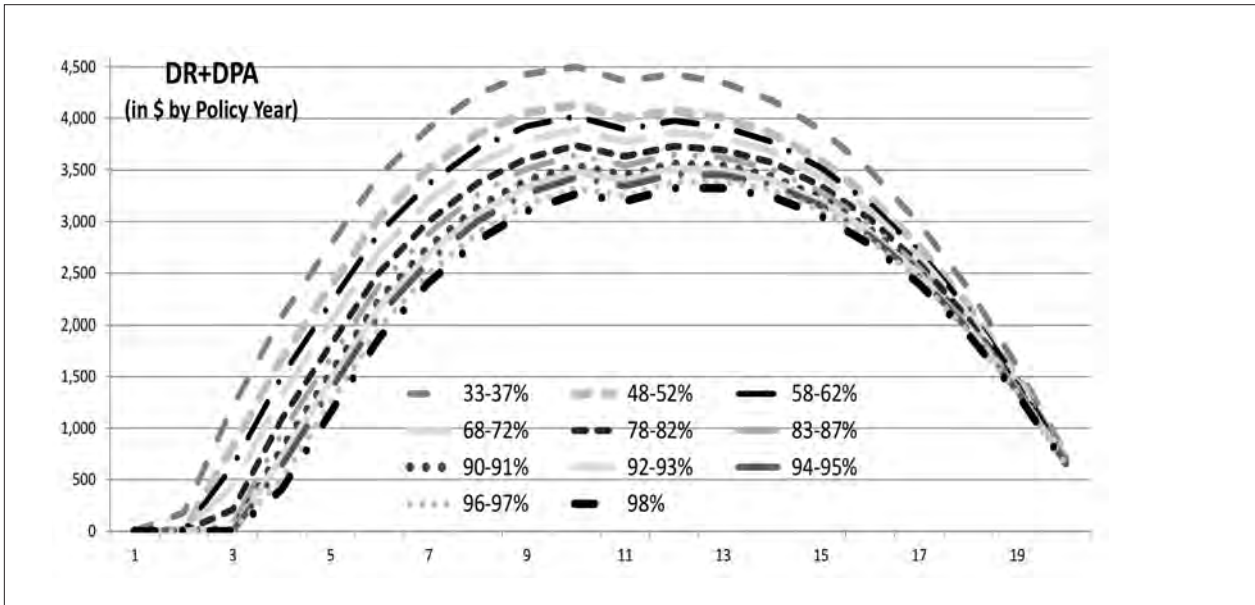| 33–37%	48–52%	58–62%	68–72%	78–82%	83–87%	90–91%	92–93%	94–95%	96–97%	98%
18.6%	16.3%	14.6%	12.7%	10.3%	8.9%	7.3%	6.5%	5.7%	4.6%	3.3%

Figure 1
Projected DR + DPA by Policy Year

Figure 2
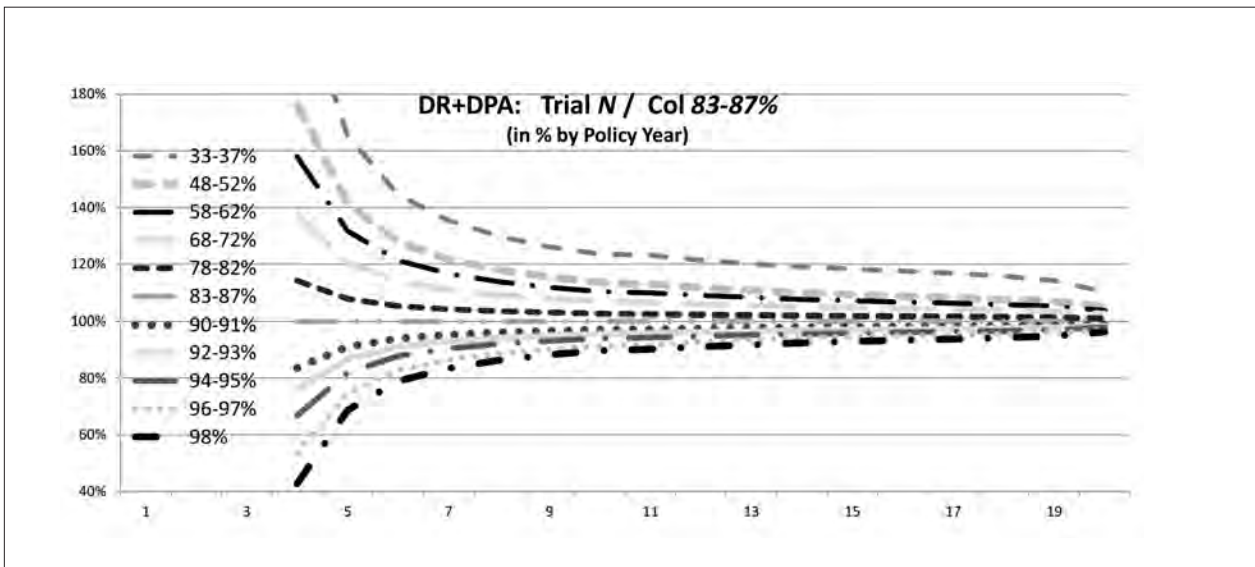The Ratio of Individual Trials to the Middle Trial

Figure 3
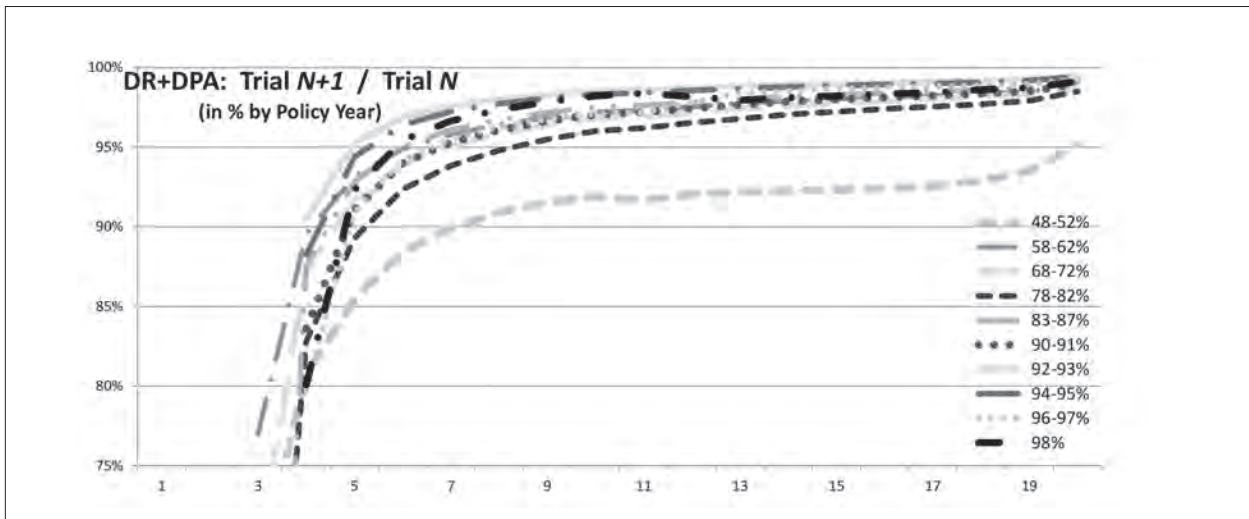The Ratio of Individual Trial's DR + DPA to Prior Trial

Figure 2 uses the middle trial—the 83–87% column—as a central point of comparison. The percentage differences in DR + DPA are not immaterial between consecutive trials and are significant between many trials (and hence many VM-20 table columns). Values for policy years 1–3 are not shown because DR + DPA is zero or small, resulting in undefined and/or very large ratios.

Figure 3 compares the percentage change from one trial to the next. In policy years three to five, the change is greater than 10 percent between each trial.

COMMENTS

Without turning this article into a monograph and a proliferation of graphs, results using the Limited Fluctuation method are similar as are blocks with slightly different assumptions. Blocks with a higher percentage of 10-year term have larger changes than blocks with more 20-year term. UL and ULSG VM-20 deterministic and stochastic reserves show similar patterns but tend to have smaller percentage impacts.

Do not read too much into the precision of the values or ratios in Figures 1–3—the general observation is that, yes, as suspected, mortality credibility factors do materially impact deterministic reserves. VM-20 permits companies to exercise actuarial judgment in determining the assumption and the relevant data. For example, VM-20 permits internal and external sources of data such as reinsurers, LIMRA and MIB. Widening the quantity and quality of underlying data leads to higher credibility. The data

> ## Widening the quantity and quality of underlying data leads to higher credibility.

needs to share similar characteristics, but VM-20 defines neither "similar" nor "characteristics." Companies and actuaries alike will be looking for solutions to the challenges in developing and setting mortality assumptions. One of the challenges materially impacting deterministic reserves is credibility. ■

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ENDNOTES

1 National Association of Insurance Commissioners. Valuation Manual. April 2016. Accessed online: *http://www.naic.org/documents/cmte_a_latf_related_val_adopted_160829_with_changes.pdf.*

2 The PBR Consortium—Actuarial Compass LLC, AADicke LLC, and Mangini Actuarial and Risk Advisory LLC. Voyager m2Lab PBA Training. 2015 revised 2016.