TWO: DEVELOPMENT OF DEMOGRAPHIC ASSUMPTIONS

MORTALITY RATES

What is the Mortality Rates Assumption and How Do We Use it?

The Mortality Rates assumption is primarily used to estimate how long pension benefits will be paid after retirement. We also use these assumptions to determine the probability that a member will survive until retirement. This assumption is generally gender and age based.

The goal of this assumption is to estimate the probability of death in a given year for both the member and any eligible survivors. We also set assumptions for how we expect mortality rates to improve over time.

High-Level Takeaways

In general, we are still observing improvements in mortality (i.e., members living longer). To project future improvements in mortality, we use a mortality improvement scale. Based on the results of our study, we believe the long-term MP-2017 rates provide a better fit and predictor of long-term mortality improvement. The long-term MP-2017 rates predict an approximate 1 percent per year improvement for both males and females over most ages. By comparison, our current assumption of Scale BB estimates mortality improvement for certain age groups in excess of 1 percent.

To determine appropriate mortality rates for our plans, we start with a published mortality table as a base and adjust it to reflect our experience. Our latest experience supports updating to the newer Pub.H-2010 tables.[1] The Pub.H-2010 tables we select by system may vary depending on the type of jobs that comprise the system. From there, we apply appropriate age adjustments, if necessary, to better tailor the mortality rates to the demographics of each system. For most systems, we found age adjustments are no longer necessary with our updated tables with the exception of some public safety plans. In other words, our experience generally indicated that the mortality rates for the populations of the Washington State retirements systems are similar to aggregated nationwide public retirement systems experience studied by SOA when establishing these tables. The following table summarizes the new base mortality tables and age offsets used by system.

New Healthy Mortality Assumptions by System			
System	Base Table	Offsets Males	Offsets Females
PERS	PubG.H-2010 (General)	0	0
TRS	PubT.H-2010 (Teachers)	0	0
SERS	PubG.H-2010 (General)	0	0
PSERS	PubS.H-2010 (Safety)	0	0
LEOFF	PubS.H-2010 (Safety)	(1)	0
WSPRS	PubS.H-2010 (Safety)	(1)	0

Consistent with our prior methodology, we chose to apply age offsets directly to the Pub.H-2010 tables and use the long-term MP-2017 generational improvement scale to project mortality rates every year thereafter. Another approach would be to apply age offsets after the projected mortality improvements.

[1] *Released in January of 2019, these tables are the most recent publication from SOA on the mortality rates of public retirement system plan participants at the time of this study.*

MORTALITY RATES *continued*

Our new mortality assumption – incorporating the updated base tables, age offsets, and mortality improvement scale – predicts both lower and higher rates of mortality than the old assumption dependent on the system, gender, and age examined. Illustrated below is an example of how assumed life expectancy, as of 2018, changes under two different ages in the PERS Plan 2.

Difference in Life Expectancy Under Select Ages				
	Age 45		Age 65	
	Male	Female	Male	Female
New Assumptions	85.9	89.4	85.8	88.8
Old Assumptions	86.9	89.2	86.8	89.0
Difference	**(1.0)**	**0.1**	**(1.0)**	**(0.2)**

Note: Age 45 Life Expectancies under the New Assumptions rely on PERS 2 retirement rates. Differences may not agree due to rounding.

Data and Assumptions

We looked at 34 years of data, from 1984-2017. No special data was added for this assumption, but some data was removed. Consistent with prior studies, we removed valuation years 2001 and 2007 because the valuation date changed in those years. Including data for 2001 and 2007 would lead to valuation periods of unequal length.

Law Changes

No law changes impacted our analysis of this assumption.

General Methodology

Actual mortality rates are calculated as follows. For each year and retirement plan, we counted the number of deaths during the year and divided it by the number of members alive at the beginning of the year. This underlying data serves as the basis for setting our mortality assumptions.

We approached this analysis in three steps.

- First, we looked for a trend in the data to determine how mortality rates are improving over time. The results of this analysis, outside expert opinions, and our own professional judgment were used in selecting a mortality improvement scale.
- Next, we reviewed published base mortality tables to determine which tables would be the best fit for our retirement systems.
- Finally, we compared our actual mortality rates during the 2006-2017 period to our new base tables (projected to the mid-point of the period) for purposes of establishing age offset assumptions for each retirement system.

At each step of the process we gave consideration to our amount of data. Data is considered more credible the larger the available sample size. When very precise assumptions are set, such as a mortality rate at a specific age, full credibility in the data becomes harder to obtain. With insufficient credibility, analysis of the data can be a misleading or an inaccurate representation of the population as a whole. To increase the reliability of our results, we used a published mortality table as a basis for our mortality tables, grouped our data when appropriate, and withheld making individualized assumptions for certain plans.

MORTALITY RATES *continued*

Results

Healthy Mortality

Mortality Improvement Scale

We considered our expectations for the future and how those expectations may impact the observed trends. Then, we compared our conclusions with the available mortality scales and picked the scale that, in our opinion, best reflects long-term mortality trends for the Washington State retirement systems. For this study we elected to replace our current assumption of Scale BB with RPEC's MP-2017 long-term rates applied using a generational approach.

We agree with RPEC that underlying mortality rates can vary by year of birth in addition to gender. We also agree that anticipated rates of mortality improvement can change with the addition of new experience data. However, our analysis indicated that the greater precision of the two-dimensional scale will not always provide additional value. For example, from 2008 to 2017 we found the long-term rates were better a predictor of mortality improvement than the variable rates in the full MP-2017 table that varies by year. In addition, the high level of complexity of the two-dimensional scale could pose problems. The precision of the scale can create a false sense of accuracy, and it hinders an actuary's ability to summarize the effects of mortality. It also has the potential to introduce volatility in actuarial measurements when the scale is updated annually. Furthermore, the reasons behind these periodic changes can be unclear and difficult for the actuary to explain.

MP-2017 Long-Term Rates					
Age	Male & Female	Age	Male & Female	Age	Male & Female
<86	0.0100	95	0.0085	105	0.0043
86	0.0099	96	0.0081	106	0.0038
87	0.0097	97	0.0077	107	0.0034
88	0.0096	98	0.0072	108	0.0030
89	0.0094	99	0.0068	109	0.0026
90	0.0093	100	0.0064	110	0.0021
91	0.0091	101	0.0060	111	0.0017
92	0.0090	102	0.0055	112	0.0013
93	0.0088	103	0.0051	113	0.0009
94	0.0087	104	0.0047	114	0.0004
				>114	0.0000

Base Table

Based on our analysis, we selected the headcount-weighted public plan mortality tables with separate rates for employees, retirees, and contingent survivors differing by the primary job categories in each system for our healthy populations. The Pub-2010 tables were developed using more recent data than our current base table of RP-2000 and focus on public plan data. Within the Pub-2010 tables, we considered the use of liability weighted tables but found the headcount weighted tables provided a better fit to our plan experience, even when measuring liability experience. For more information on our considerations, please see the **Mortality Rates Appendix**.

For PERS and SERS, we selected the general headcount-weighted public plans mortality tables, PubG.H-2010. As expected, the general mortality tables provided the best fit for our experience in PERS. For SERS, we selected the PubG.H-2010 tables for two primary reasons: (1) the general public plan mortality table provided a better fit to SERS experience, and (2) the PubT.H-2010 tables were developed using experience from instructors only, not general school employees. We will continue to monitor this assumption and may make a change in the future.

For TRS, we selected the teachers headcount-weighted public plans mortality tables, PubT.H-2010. Teachers tend to live longer than other occupations and the PubT.H-2010 tables reflect longer assumed lifespans.

MORTALITY RATES

continued

Lastly, for the public safety systems, PSERS, LEOFF, and WSPRS, we selected the public safety headcount-weighted public plans mortality tables, PubS.H-2010. Since our data is limited for PSERS and WSPRS, we relied on LEOFF experience and the list of occupations that make up the various Pub-2010 tables. A large portion of PSERS is correctional officers. We concluded the PubS.H-2010 would be a better predictor for PSERS, compared to the general population table, because correctional officers were included in the experience data SOA used to establish this table. We will continue to monitor this assumption and may make a change in the future.

The following table illustrates the new assumed life expectancies, by system, of a 65-year-old retiree using the Pub.H-2010 tables.

New Assumed Retiree Life Expectancy as of 2018		
	Age 65	
	Male	Female
PERS & SERS (PubG.H-2010)	85.7	88.7
TRS (PubT.H-2010)	87.8	90.3
PSERS (PubS.H-2010)	85.4	87.9
LEOFF & WSPRS (PubS.H-2010)*	86.3	87.9

**Includes a (1) age offset for males.*

The base mortality tables we selected for beneficiaries across all retirement systems blend the Pub.H-2010 single contingent survivor table and the retiree mortality rates corresponding to the member's retirement system. We believe mortality is generally higher for widow(er)s, which is consistent with the contingent survivor table developed by RPEC that was based on survivor data after the death of the primary annuitant. However, since our valuation system requires a single table to model beneficiary mortality both before and after a member's death, we created blended tables for beneficiary mortality. More weight is given to the Pub.H-2010 contingent survivor table at older ages, whereas, more weight is given to the system specific retiree mortality rates at younger ages. This approach is used to approximate a method of applying different rates of mortality before and after a member's death (that is currently unavailable due to software restraints).

MORTALITY RATES *continued*

Age Offsets

Generally, we observed the Washington State retirement systems' mortality experience as similar to nationwide public plans mortality experience. For some of the public safety plans, we observed the mortality experience was similar to those in the new base table (projected to 2011) who are a year younger ([1] age offset). Some plans had relatively little experience in terms of total deaths over the period. As a result, we relied on their general relationship to the larger plans where appropriate when setting these assumptions for males and females.

The following table summarizes the new age offset assumptions. For active members, we assume the gender of the beneficiaries is of the opposite sex as the member. Please note that a comparison to the prior age offset assumptions is less relevant because we changed the underlying base mortality tables.

Offset Assumptions						
Analysis of Mortality Table Offsets	**PERS All Plans**		**TRS All Plans**		**SERS Plan 2/3**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Old Assumption	(1)	(1)	(3)	(2)	(1)	(1)
New Assumption	0	0	0	0	0	0
Analysis of Mortality Table Offsets	**PSERS Plan 2**		**LEOFF All Plans**		**WSPRS Plan 1/2**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Old Assumption	(1)	(1)	(1)	1	(1)	1
New Assumption	0	0	(1)	0	(1)	0

When selecting our assumptions, we gave careful consideration to the credibility of our data. The results of our analysis for larger systems, such as PERS and TRS, are more reliable than the smaller systems with less experience. As such, we believe we have insufficient data to set experience-based mortality tables for all systems.

For PERS, the largest system, we selected our age offsets based on our analysis which indicated no age offset for both males and females would provide the best fit. Likewise, our analysis for TRS, the second largest system, indicated the use of no age offset for males and females provides the best fit as well. Although the age offset selection is the same for PERS and TRS, the general employee base mortality rates are higher than the teachers' base mortality rates. In other words, we still expect members of TRS to live longer than members of PERS. For example, a 65-year-old female retiree in TRS is expected to live 1.5 years longer than a 65-year-old female retiree of PERS.

For SERS, we believe the current assumption (i.e., applying the same age offsets as PERS) remains reasonable and our limited experience supports this conclusion. However, we will continue to monitor this assumption and may make a change in the future when we have sufficient data for SERS.

For LEOFF, we selected a (1) age offset for males and no age offset for females. Our experience indicated that male members of LEOFF live longer than suggested by the PubS.H-2010 tables. Contrary to males, the observed mortality rates for LEOFF females over our study period is slightly higher than expected under the PubS.H-2010 table. However, this difference decreases when excluding survivor experience. With this in mind, and given the limited amount of LEOFF female member data, we decided to apply no age offsets for LEOFF females.

We believe we have insufficient data to set experience-based mortality tables for WSPRS. However, we expect members in this system to have similar rates of mortality to law enforcement members of LEOFF given the occupational similarities. This notion is supported by the limited amount of data we do have for WSPRS and law enforcement officers in LEOFF. Therefore, we selected a (1) age offset for males of WPSRS and no age offsets to females.

MORTALITY RATES *continued*

Similar to WSPRS, PSERS lacked sufficient experience to set experience-based mortality rates. However, we see less similarity in the job duties between PSERS and LEOFF members than between WSPRS and law enforcement officers in LEOFF. We have little reason to believe PSERS mortality rates will differ from those predicted by the general public safety PubS.H-2010 base table and selected no age offsets. Similar to SERS, we will continue to monitor this assumption and may make a change in the future when we have sufficient data.

Examples

The following examples will help illustrate how we combine the mortality improvement scale with the base mortality rates adjusted for age offsets. Let's calculate the mortality rate as of the year 2011 for a male LEOFF employee aged 25 and a male LEOFF retiree aged 70, reflecting the selected age offsets for that system. Note that this concept can be extrapolated for each year in the future.

A (1) age offset means an age 25 male LEOFF employee is assumed to have mortality experience consistent with a 24-year-old male public safety employee; similarly, the age 70 male LEOFF retiree with that of a 69-year-old male public safety retiree. As of the year 2010, the age 24 (= 25 - 1) male employee and age 69 (= 70 - 1) male retiree mortality rates are 0.0430 percent and 1.5440 percent, respectively. This means that we expect there is a 0.0430 percent chance that a LEOFF male employee age 25 would die by the end of the year, while the LEOFF male retiree age 70 is assumed to have 1.5440 percent chance of dying before the end of the year.

The MP-2017 long-term mortality improvements for both of these example members is 1 percent per year. In other words, the mortality rate at these same ages is expected to decrease by 1 percent each year in the future. The following shows one year of this calculation. Projected to 2011, an age 25 male LEOFF employee and an age 70 male LEOFF retiree will have corresponding mortality rates of: 0.0426% [= 0.0430% x (1 - 1%)] and 1.5286% [= 1.5440% x (1 - 1%)].

Disabled Mortality

Similar to the healthy mortality base tables, in order to reflect more recent experience in mortality, we updated our disabled mortality assumption to the Pub.H-2010 disabled tables. We selected two sets of assumptions dependent on whether the system is public safety or not. Giving consideration to the amount of data available on disabled mortality, we opted to use no age offsets in these assumptions.

Fit of Pub.H-2010 Disabled Tables (2006-2017)			
System/Table	**LEOFF 1**	**LEOFF 2, WSPRS**	**PERS, SERS, TRS**
General PUB.H Disabled	0.56	0.48	1.17
Safety PUB.H Disabled	0.94	1.11	1.88
Number of Deaths (2006 - 2017)	**1,059**	**42**	**2,204**

For PERS, TRS, and SERS, we selected the PubG.H-2010 disabled table with no age offsets as the new disabled mortality assumption. For our public safety plans, LEOFF, PSERS, and WSPRS, we selected the PubS.H-2010 disabled table with no age offsets.

Since we chose to use MP-2017 long-term rates with the healthy mortality tables, and in light of our limited actual disabled mortality experience, we decided to apply the same mortality improvement rates for all disabled mortality. Persons with disabilities are subject to the same factors that drive mortality improvement in a healthy population such as new medical technology and innovation, new treatments of diseases, changes in nutrition, etc. Put another way, we expect they will experience higher rates of mortality than the non-disabled population, but we still expect their rates of mortality to improve in the future consistent with our long-term improvement assumption.

Please see the **Mortality Rates Appendix** for additional information on how we set this assumption.