THREE: APPENDICES

MORTALITY RATES

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.

Analysis

Mortality Improvement Scale

To select a mortality improvement scale, we relied on our professional judgment, expert opinion, and analysis on historical mortality improvement. Due to the volatility of mortality improvement over the past few decades, it is insufficient to rely on historical experience alone when setting this assumption.

We began our analysis by reviewing our actual mortality experience from 1984-2017 and looking at the improvement in mortality by age. We primarily focused our analysis on data combined from all systems. We also examined PERS and TRS separately, since those two systems accounted for more than 90 percent of deaths across all time-frames studied.

We found that the experienced rate of mortality improvement, or decrease in mortality rates, has varied significantly over time. There was a noticeable peak in mortality improvement in the early 2000s followed by a steady decline. This mirrors the trend seen in national data.[1] Below is an illustration on how annual mortality improvement for Washington plans has changed under various time frames. For more information on historical trends in mortality, please see the **Brief History of Mortality Improvement**.

All Observations		
Data Range		Annualized Improvement
1984	**2017**	0.86%
1990	**2017**	0.96%
1996	**2017**	1.36%
2002	**2017**	1.48%
2008	**2017**	1.03%

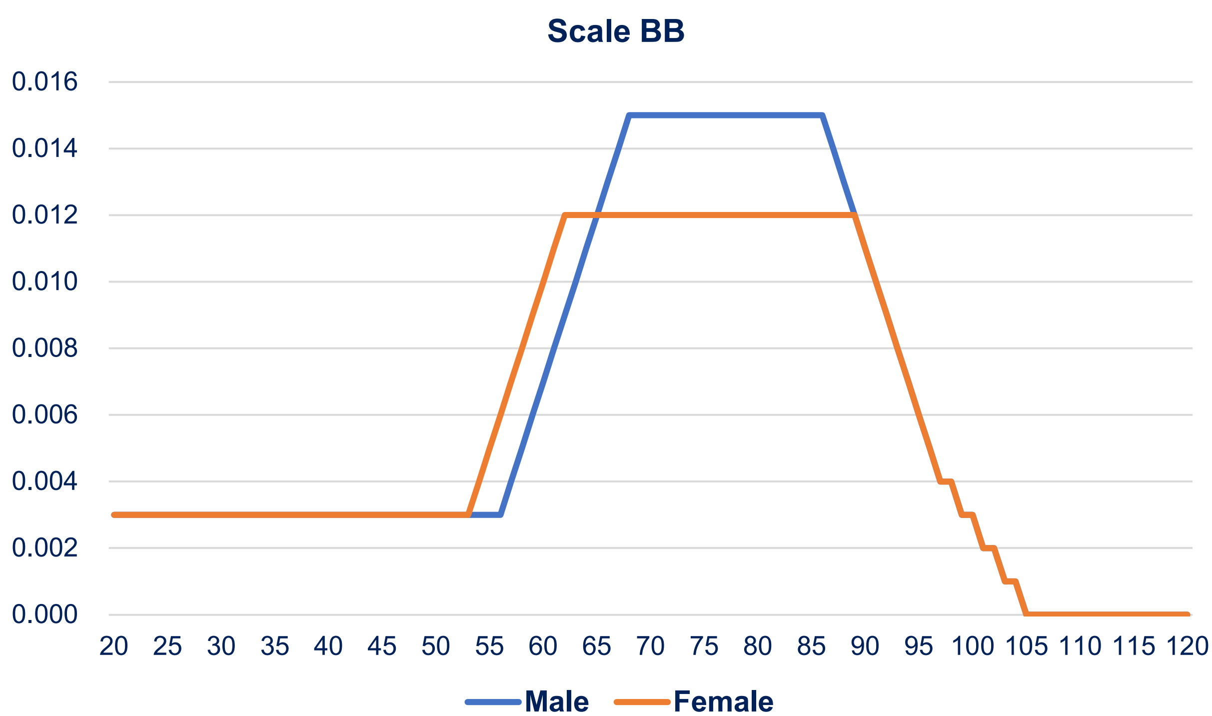
[1]*Institute and Faculty of Actuaries, Longevity Bulletin: Is the tide turning? (July 2017).*

MORTALITY RATES *continued*

After examining the mortality improvement in our data, we compared the results of our analysis to our current assumption of Scale BB and the more recent published scales by SOA.

The SOA's Retirement Plans Experience Committee (RPEC) has developed numerous scales including: Scale AA, Scale BB, and a series of yearly two-dimensional (i.e., rates that vary by age and calendar year) mortality improvement scales. At the time this study began, the MP-2017 Scale was the most recently published scale.

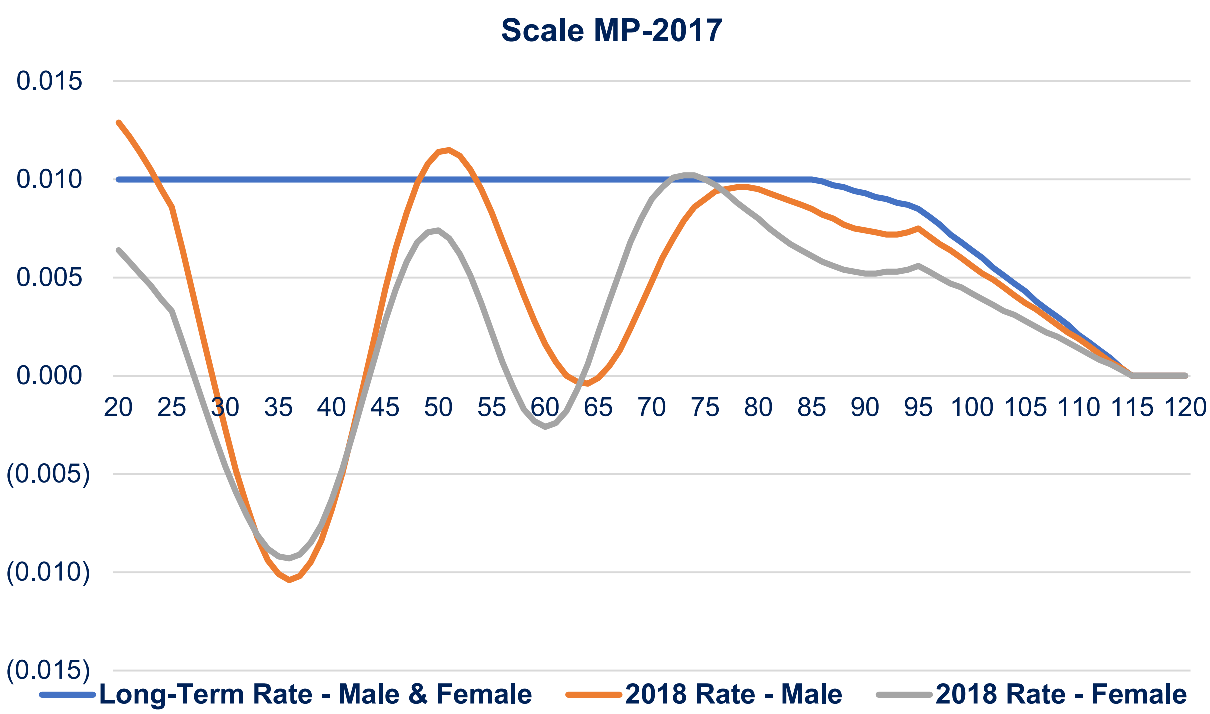
Scale BB was published in 2012 to provide a temporary replacement of Scale AA. This was considered necessary because the rates of mortality improvement in the US differed significantly from those predicted by Scale AA in the early 2000s. RPEC developed Scale BB to provide an intermediary improvement scale before the publication of the two-dimensional MP-2014 scale.[2] The rates predicted by Scale BB differ depending on a person's age and gender. Below is an illustration of the annual mortality improvement rates predicted by Scale BB over various ages.



The newest two-dimensional mortality improvement scales project future mortality improvement by gender, age, and calendar year before merging into a single long-term expected rate by age.[3] The short-term mortality improvements in the MP-2017 scale rely more heavily on recent experience, and the long-term rates are based on expert opinion. The convergence from short-term to long-term rates is done over a time period of 20 years.[4] The two-dimensions of the short-term MP-2017 rates are a change from less recent scales which only differentiated by age and gender. The mortality improvement rates for each calendar year can fluctuate from the long-term rate as illustrated below. For more information on the history of mortality improvement scales, please see the **Brief History of Mortality Improvement**.

[2] *SOA, Mortality Improvement Scale BB Report (September 2012).*
[3] *SOA, Mortality Improvement Scale MP-2017 (October 2017).*
[4] *SOA, Mortality Improvement Scale MP-2014 Report (October 2014).*

MORTALITY RATES *continued*



In selecting the appropriate mortality improvement scale for our systems, we examined how our historical trends compared to Scale BB, the long-term rates predicted by MP 2017, and the two-dimensional MP-2017.

We focused our historical analysis on ages 40 to 94, the ages in which more than 90% of deaths occur. We performed our analysis by looking at the average annualized mortality improvement over several time periods weighted by the number of deaths at each age. To compare our results to the two-dimensional MP-2017, we took the predicted average mortality improvement over the applicable time frame. We considered our result at each age in addition to grouped ages by increments of five. We determined that the difference between the two approaches would not change our conclusions.

For the one-dimensional Scale BB and MP-2017 long-term rates, we compared how well the scales fit actual mortality improvement in our data using the five-year incremental grouping technique. Below is a chart of the various fits over different time frames. Please note that an A/E ratio less than 1.00 indicates actual mortality improvement was less than predicted by the applicable scale, and an A/E ratio greater than 1.00 indicates actual mortality improvement outpaced the rates of the applicable scale.

MORTALITY RATES *continued*

All Observations			
Data Range	Annualized Improvement	Actual/ Expected Scale BB	Actual/Expected MP-2017 Long-Term Rate
1984 2017	**0.86%**	80%	85%
1990 2017	**0.96%**	91%	96%
1996 2017	**1.36%**	123%	137%
2002 2017	**1.48%**	130%	148%
2008 2017	**1.03%**	80%	103%

The past performance of the full MP-2017 scale to actual experience offers less insight into future performance. The yearly calendar rates are based on actual year-to-year performance of mortality improvement based on social security data. However, future predictions made by the MP-2017 scale do not have this benefit of hindsight. Therefore, the fit of this scale to our actual experience can indicate whether actual experience matches that of the nation as a whole, but it does not offer much insight into future performance. We found the fit of the two-dimensional scale comparable to the fit of the one-dimensional scales summarized in the prior table. To determine whether a two dimensional scale would be an appropriate scale for Washington State plans, we considered our analysis, expert opinion, and the drawbacks of using a more complex scale.

Based on our analysis, and additional considerations, we selected the long-term MP-2017 rates as our new mortality improvement scale. Using the long-term MP-2017 rates incorporates expert opinion on long-term trends without the downside of using an overly complex two-dimensional scale. Additionally, we found the simpler long-term rates did a better job predicting mortality improvement than the two-dimensional scale in recent years.

Over the course of our study, SOA published the MP-2018 Scale. The long-term improvement rate of 1 percent, however, remains the same between MP-2017 and MP 2018. Due to the reasons outlined above, we determined our final recommendation would not change if we updated our analysis to examine the fit of the MP-2018 Scale. For more information on our selection, please see the **Results** section below.

Once a mortality improvement scale is selected, it can be applied in one of two ways. The first, a “static” approach, anticipates a fixed level of mortality for all current and future annuitants receiving benefits from a retirement plan. The second, a “generational” approach, assigns a unique mortality table to every future year that reflects the forecasted improvements. There is a general trend in the retirement industry of moving more towards the latter approach. We apply our current mortality improvement scale on a generational basis and will continue to do so.

MORTALITY RATES *continued*

Base Mortality Table

Since our prior experience study, SOA has published two new groups of mortality tables. These newer tables both incorporate the more recent nationwide experience in mortality but differ in the populations studied. The first publication in 2014 was the RP 2014 Mortality Tables (RP-2014) Report. This study was based on data collected from private sector entities only.[1] As a result of comments received, RPEC initiated a new study of US public pension plans in January 2015 to develop tables based exclusively on public-sector pension experience.[2] The final publication of the Pub-2010 Public Retirement Plans Mortality Tables Report was in January 2019. In our analysis we examined the use of our old RP-2000 tables and the RP-2014 tables, but primarily focused on the new Pub-2010 tables developed using nationwide public plan mortality experience. For more information on the RP-2014 tables, please see the **Additional Considerations**.

To determine the overall fit of the different mortality base tables to our observations, we compared the number of actual deaths by age to the amount of expected deaths using the various base mortality tables. If the actual deaths match closely to the expected deaths as predicted by the table, it means the table is a good fit for our population. We observed how well the base table matched our mortality experience from 2006 to 2017. To take into account mortality improvement during this window, we projected the base mortality table to the mid-point of the time period using our selected mortality improvement scale.

The Pub-2010 group of tables contain rates developed under both a “headcount” weighted basis, denoted with an addition of H in the name (Pub.H-2010), and a “liability” weighted basis with no additional notation. The headcount-weighted tables give equal weight to each observed death. The liability-weighted tables, however, give more weight to the deaths of retired members who received larger benefits or active members with higher salaries. A liability-weighted table therefore could potentially be a better representation of how liabilities are impacted by mortality. For instance, if members with larger benefits lived longer, on average, than members with smaller benefits, a liability-weighted table could be a better match for predicting the amount of funds needed to provide future benefits to members. The mortality rates themselves will differ under these two methods but not the way in which the mortality rates are applied. We considered using a liability-weighted table but determined the headcount-weighted tables are more appropriate.

The Pub-2010 tables also vary by a number of factors, including:

- The type of retirement system employment: teachers, public safety, or general;
- The status of the plan participant: employee, retiree, or contingent survivor; and
- Whether the table is applied to a member with a disability.

[1] *SOA, RP-2014 Mortality Table Report (October 2014).*

[2] *SOA, Pub-2010 Public Retirement Plans Mortality Tables Report (January 2019).*

MORTALITY RATES *continued*

When developing the new Pub-2010 tables, RPEC observed a significant difference in mortality based on the participants' job type.[2] As such, they developed separate employee and retiree mortality tables for teachers, public safety, and general employees detonated with a T (PubT-2010), S (PubS-2010), and G (PubG-2010), respectively. The contingent survivor tables are the same across the three job categories. The table below outlines the types of data used by RPEC in the development of each category.

Pub-2010 Tables	
Table	**Job Categories**
PubT-2010	School teachers and college/university professors
PubS-2010	Police officers, firefighters, and correctional officers
PubG-2010	All other types of public plan members

We reviewed the fit of the various tables to our systems to find the best overall fit. To analyze these tables, we calculated an A/E ratio to understand how they compare to plan experience during our study period. The "actual" represents the actual number of deaths we observed during the study period, and the "expected" represents the number of deaths predicted by the applicable table based on the number of members (exposures). When calculating a total A/E ratio for each job category, we applied the employee mortality table to our active and term-vested experience, the retiree table to our retiree experience, and the contingent survivor table to our survivor experience. In general, an A/E ratio less than 1.00 indicates lower actual rates of death relative to the mortality predicted by the tables. We see a ratio above 1.00 when the number of deaths are higher than predicted by the tables.

Fit of Pub.H-2010 Tables (2006-2017)*				
System/Table	**PERS**	**TRS**	**SERS**	**LEOFF**
PubT.H-2010	N/A	99%	128%	N/A
PubS.H-2010	N/A	N/A	N/A	96%
PubG.H-2010	102%	81%	99%	93%

PSERS and WSPRS have limited mortality experience. For a discussion on setting those systems' assumptions, please see the **Results section.*

RPEC also noticed a notable difference in mortality rates for members of the same age dependent on their member status.[2] Most significantly, retired members tended to have higher rates of mortality than employed members of the same age. We reviewed the use of either separate tables for employees, retirees, and contingent survivors or a single blended table by age. We concluded separate tables are most suitable for our plans.

When developing the contingent survivor table, RPEC used data from beneficiaries after the death of the retiree. We examined whether these rates were appropriate to use for all beneficiaries and determined a blended table of retiree and contingent survivor mortality rates would provide a more reasonable fit. Please see the **Additional Considerations** section for more details.

The Pub-2010 disabled mortality rates vary by whether the member disables from a public safety job or not. The disabled mortality rates for former members of public safety jobs is generally lower. This may seem unintuitive at first, but public safety jobs tend to have lower requirements for disability due to the higher physical demands needed to perform the job duties. We examined the appropriateness of each table to our disabled mortality experience and found the job-delineated tables are reasonable. This includes LEOFF 1 in which we previously assumed healthy mortality rates for disabled retirees. We found the new public safety specific disabled mortality table provided a better fit than using healthy mortality rates.

[2] *SOA, Pub-2010 Public Retirement Plans Mortality Tables Report (January 2019).*

MORTALITY RATES *continued*

Age Offsets

Age offsets are the result of analyzing the difference between our actual mortality experience and the underlying base tables to produce a better fit of our population demographics. In other words, we use our new Pub.H-2010 base tables as a base reference point, then adjust the table to better model our experience. For example, we might determine that the experience of our plans is more similar to the rates in the new base table of individuals who are a year younger (a negative age offset).

To analyze the fit of different age offsets, we project the base Pub.H-2010 tables to the midpoint of the 12-year study period (2011) using the chosen mortality improvement scale. Similar to selecting our base tables, we calculated an A/E ratio to understand how our assumptions compare to plan experience in our study period. In general, an A/E ratio less than 1.00 indicates lower actual rates of death relative to our assumption. We see a ratio above 1.00 when the number of deaths are higher than we assume. The following table provides a high-level overview of the A/E experience under a variety of age offsets.

Weighted Average A/E Experience*							
PERS (PubG.H-2010 Base Tables)				TRS (PubT.H-2010 Base Tables)			
Offsets	Male	Offsets	Female	Offsets	Male	Offsets	Female
(1)	1.12	(1)	1.16	(1)	1.11	(1)	1.12
0	1.00	0	1.04	0	0.98	0	0.99
1	0.90	1	0.93	1	0.88	1	0.88
SERS (PubG.H-2010 Base Tables)				LEOFF (PubS.H-2010 Base Tables)			
Offsets	Male	Offsets	Female	Offsets	Male	Offsets	Female
(1)	1.13	(1)	1.11	(2)	1.11	(1)	1.18
0	1.01	0	0.98	(1)	0.99	0	1.07
1	0.90	1	0.87	0	0.89	1	0.96

**Age offsets applied uniformly to each employee, retiree, or contingent survivor table.*

Note: We did not include PSERS and WSPRS in this table due to the lack of data.

It is useful to consider the amount of data we have available when selecting age offsets by system. Please note that the analysis for larger systems, such as PERS and TRS, have more data than the smaller systems such as WSPRS and SERS. For more information on our considerations into the credibility of our analysis, please see the **Results** section.

The following table outlines the number of deaths during our 2006-2017 study period.

Observed Deaths in Non-Disabled Population							
2006-2007	PERS	TRS	SERS	PSERS	LEOFF	WSPRS	Total
Male	15,197	5,241	860	28	1,091	146	22,563
Female	18,858	7,527	1,368	9	791	62	28,615
Total	**34,055**	**12,768**	**2,228**	**37**	**1,882**	**208**	**51,178**

We also conducted this analysis for our disabled mortality using the selected base mortality tables. We examined LEOFF 1 independently because we historically found the published disabled retiree tables were not a good fit for this system. This no longer is the case with the public plan tables. For more information, please see the **Base Mortality Table** section. The following table illustrates a high-level overview of the A/E experience under a variety of age offsets.

MORTALITY RATES *continued*

Weighted Average A/E Experience - Disabled Retiree Tables							
LEOFF 1 (PubH.S-2010)		LEOFF 2 & WSPRS (PubH.S-2010)		PERS, SERS, & TRS (PubH.G-2010)			
Offsets	Male	Offsets	Male	Offsets	Male	Offsets	Female
(2)	1.14	(2)	1.36	0	1.16	0	1.17
(1)	1.04	(1)	1.25	1	1.10	1	1.10
0	0.95	0	1.16	2	1.03	2	1.03
1	0.86	1	1.05	3	0.97	3	0.97
Deaths	**1049**		**41**		**1009**		**1195**

The following table shows the counts of actual deaths of members with disabilities in the plans between 2006 and 2017.

Observed Death of Persons with Disabilites							
2006-2017	PERS	TRS	SERS	LEOFF 1	LEOFF 2	WSPRS	Total
Male	824	135	50	1,049	27	14	2,099
Female	899	223	73	10	0	1	1,206
Total	**1,723**	**358**	**123**	**1,059**	**27**	**15**	**3,305**

Brief History of Mortality Improvement

For many decades, there has been a steady decline in mortality rates. However, the actual rate of mortality improvement has been volatile and difficult to predict based on historical experience. In an attempt to pin down future mortality rates, numerous mortality improvement scales have been published in recent history.

Scale AA was the first mortality improvement scale used to capture future mortality improvements for Washington State plans. First developed by SOA in 1994, it has been widely used in recent years to forecast improvement for the RP-2000 tables. Scale AA was based entirely on the historic mortality experience of the Social Security Administration and the Civil Service Retirement System (CSRS) between 1977 and 1993.[1]

In September 2012, RPEC released a paper with Scale BB based on data up to 2007. An analysis performed by RPEC showed "that the rates of mortality improvement in the U.S. over the recent past have differed quite substantially from those predicted by Scale AA."[1] In particular, a study published by SOA in November 2011, Report of the Group Annuity Experience Committee Mortality Experience for 2003-06, found that overall mortality rates improved 2.5 percent faster than Scale AA from 2001 to 2006 by lives.[2] In response, RPEC wished to provide a short-term alternative to Scale AA based on more recent data, and newly developed techniques, before the release of the next generation two-dimensional pension mortality improvement scales.[1] Scale BB is the mortality improvement scale used for Washington State plans prior to this study.

Using the same conceptual framework as Scale BB, RPEC released MP-2014 in October 2014 as a companion to the RP-2014 mortality tables.[3] The MP-2014 table varies by both gender and calendar year. Developed using the CMI Mortality Projections model, the new mortality improvement scale was based on three key concepts:

- "Recently observed experience is the best predictor of future near-term mortality improvement rates.
- Long-term rates of mortality improvement should be based on 'expert opinion' and analysis of longer-term mortality patterns.
- Near-term rates should transition smoothly into the assumed long-term mortality improvement rates over appropriately selected convergence periods."

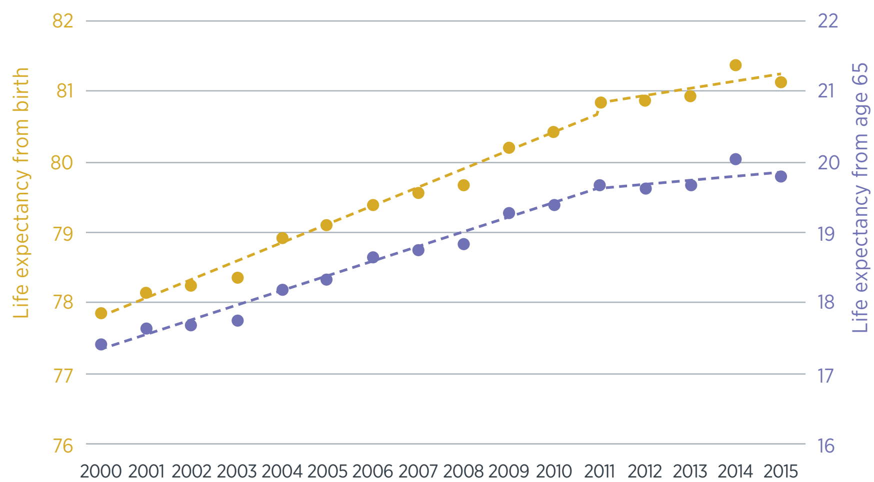
[1]*SOA, Mortality Improvement Scale BB Report (September 2012).*
[2]*Report of the Group Annuity Experience Committee Mortality Experience for 2003-06; November 2011.*
[3]*SOA, Mortality Improvement Scale MP-2014 Report (October 2014).*

THREE: APPENDICES

MORTALITY RATES *continued*

Since 2014, RPEC has released annual updates to the two-dimensional scale that incorporates newer data provided by SSA. The most recent scale at the time of this study, MP-2017, reflects historical U.S. population mortality experience through 2015.[4]

Recent national data shows a trend of mortality improvement slowdown. In 2017, SOA, the Institute and Faculty of Actuaries (United Kingdom), and the Canadian Institute of Actuaries jointly published a study on recent mortality improvement, Longevity Bulletin: Is the tide turning?[5] The study found that mortality improvement was significantly slower from 2011-2015 compared to 2000-2011. In the U.S., it was reported that average annual rise in life expectancy for age 65 fell 66 percent between these two time frames. Below is a table from the report illustrating changes in life expectancy and how mortality improvement in the U.S. has slowed in recent years.



Note: Table shows U.S. period life expectancy at birth and age 65, males and females combined, based on 2000 to 2015 data from the Human Mortality Database.

The mortality improvement slowdown reinforces our decision to move to the long-term rates of MP-2017 given the high mortality improvement predicted for some ages under Scale BB.

[4]*SOA, Mortality Improvement Scale MP-2017 (October 2017).*

[5]*Institute and Faculty of Actuaries, Longevity Bulletin: Is the tide turning? (July 2017).*

MORTALITY RATES *continued*

Additional Considerations

Mortality Improvement Scale

We ultimately selected our new mortality improvement scale based on combined data for all of the retirement systems. However, we also examined PERS and TRS separately as our two largest systems. We concluded our selection would remain the same under each scenario. The following table illustrates the annualized mortality improvement for ages 40 to 94 for PERS, TRS, and all of the retirement systems combined.

Annualized Mortality Improvement			
Data Range	PERS	TRS	All Systems
1984 2017	0.83%	0.80%	0.86%
1990 2017	0.87%	1.02%	0.96%
1996 2017	1.40%	1.16%	1.36%
2002 2017	1.45%	1.38%	1.48%
2008 2017	0.88%	1.35%	1.03%

Furthermore, we tested the sensitivity of the results to the weighting method selected. Under our selected approach, we apply more credibility to age groups that experience more deaths. Specifically, we base our weighting on the number of deaths experienced from 2006-2017. We analyzed the sensitivity of our results using different timeframes to develop our weights. We found the annualized mortality improvements under different weighting techniques did not differ significantly. For example, from 1984 to 2017, the combined annual mortality improvement of all systems fluctuated from 0.87 percent to 0.91 percent using different weighting techniques.

Base Table Type

In determining which base table to select, we performed analysis on PERS to examine the utility of a liability-weighted approach, rather than a headcount-weighted approach for the healthy population. We studied PERS because of the large dispersion in member salaries and benefits in the system. It also has the largest amount of experience data and thus the most credible analysis.

Under the liability-weighted approach our basic methodology remained the same. However, instead of assigning a value of one to each observation, we assigned the corresponding salary for employees or the pension benefit amounts for annuitants. Therefore, this method assigns more weight to members who receive higher salaries or pension benefits. For annuitants, this method assigns weight dependent on the liabilities carried by each member. Another method would be using the final average salary of annuitants. Using a member's final average salary rather than pension benefit could be a better indication of mortality in terms of socioeconomic status. For example, a member could have high pre-retirement income but a low pension benefit if they weren't members of the retirement systems for very many years.

For liability-weighted assumptions, we followed the same process for determining the base mortality tables, and the appropriate age offsets, as outlined in the **General Methodology** section of the **Mortality Rates Summary**. To select a base mortality table, we examined the Pub-2010 group of mortality tables. We determined we would select the PubG-2010 base table with separate employee, retiree, and contingent survivor tables.

MORTALITY RATES *continued*

Similar to the headcount-weighted approach, to determine appropriate age offsets under the liability-weighted approach, we projected the PubG-2010 tables to the midpoint of the 12-year study period (2011) using the long-term MP-2017 rates. We then compared our actual experience to our expected experience using different age offsets. The following table provides a high-level overview of the Actual to Expected (A/E) experience under a variety of age offsets for PERS.

Weighted Average A/E Experience			
PERS Using Liability-Weighted Method			
Offsets	**Male**	**Offsets**	**Female**
(1)	1.19	(1)	1.22
0	1.08	0	1.10
1	0.97	1	0.99

As indicated by this analysis, we would select an age offset under this method of +1 for both males and females for all PERS plans. In other words, we expect both males and females to have higher rates of mortality than those suggested by the PubG-2010 tables. This differs from the headcount mortality tables and analysis which indicated no age offsets provided the best fit.

After determining the corresponding age offsets that we would apply, we ran both best estimate assumptions under the two methodologies in our valuation model to evaluate the relative liability impact to PERS of selecting one approach over another. Using the liability-weighted approach, we observed a roughly 0.2 percent lower present value of future benefits for PERS 2/3 compared to the headcount-weighted approach.

That said, we found the PubG.H-2010 rates approach provided a better fit to our liability-weighted observed mortality experience than the PubG-2010 tables when removing any age offsets. Furthermore, when you consider the large degree of uncertainty in each underlying assumption, we do not believe the difference is large enough to warrant a change in method.

Additionally, we have lower quality data for the liability-weighted analysis than the headcount-weighted analysis. We find the headcount-weighted approach less complex and easier to explain to policymakers and other stakeholders, while still providing a reasonable estimate for future mortality experience. Separately, we considered the use of blended employee and retiree mortality assumptions but found our experience data has a better overall fit with status specific rates. We will continue to revisit this method in future mortality studies.

Beneficiary Mortality Rates

RPEC describes three different approaches for applying the beneficiary mortality rates in the Pub-2010 Public Retirement Mortality Tables Report,

1. Assume the same mortality basis as the retiree except using the rates applicable to the beneficiary's gender.
2. Use the retiree basis while the retiree is alive but use the contingent survivor mortality rates after the death of the retiree.
3. Assume the contingent survivor mortality rates for the beneficiary both before and after the death of the retiree.

MORTALITY RATES *continued*

We believe the second approach to be the most appropriate but, due to current software limitations, we are unable to adopt this method. In order to approximate this method, we developed contingent survivor mortality tables by major occupation category using this approach for non-public safety plans,

- For beneficiaries less than 70 years old, we will use the occupation-specific retiree table using the beneficiary's gender.
- For beneficiaries between 70 and 79 years old, we will use a linearly-interpolated blend of the occupation-specific retiree and contingent survivor tables. In other words, the earlier ages would receive greater weight to the retiree table, and as the age approaches 79, greater weight would be given to the contingent survivor table.
- For beneficiaries greater than or equal to 80 years old, we will use the public plan contingent table.

For beneficiary mortality in public safety plans, we will use the same approach but blend the rates over the ages 60-69 and take into consideration any age offsets we selected. We chose younger ages for this transition period with public safety plans primary due to differences in plan design that may lead to higher levels of widow(er)s receiving benefits at earlier ages.

RP-2014 Base Tables

When selecting our new mortality tables, we primarily focused on SOA tables developed using public plan mortality data. However, we also compared our experience to the RP-2014 tables developed using data from private sector entities.

The RP-2014 tables include projections from 2006 to 2014 using the MP-2014 mortality improvement scale. When analyzing the fit of the various RP-2014 mortality tables, we adjusted the tables back to their base year of 2006 and then projected the tables forward using our new mortality improvement scale assumption. Pub-2010 does not include projections, and therefore a preliminary adjustment to the base year was not necessary in our analysis of Pub-2010.

The RP-2014 mortality tables can vary by a number of factors including:

- Headcount-weighted and liability-weighted,
- The status of the member: annuitant or employee,
- The group characteristics: blue collar, white collar, or the total dataset, and
- Whether the member is disabled.

We reviewed the use of both headcount-weighted and liability-weighted approaches, and the use of either blue collar or white-collar mortality rates. For illustrative purposes, the following table compares the fit of the total dataset RPH-2014 tables (with blended active and annuitant rates based on a cumulative normal approximation) and no age offsets to the new, employment type, Pub.H-2010 tables. In general, a ratio less than 1.00 indicates lower actual rates of death relative to the mortality predicted by the tables. We see a ratio above 1.00 when the number of deaths are higher than predicted by the tables.

Fit of SOA Tables (2006-2017)*				
System/Table	**PERS**	**TRS**	**SERS**	**LEOFF**
Pub.H-2010	1.02	0.99	0.99	0.96
RPH-2014	0.90	0.72	0.68	0.87

The comparative analysis we performed supported our decision to use the Pub.H-2010 tables developed using public plan mortality data.

MORTALITY RATES *continued*

The new base mortality rates are summarized in the following tables. A complete list of our new base mortality tables can be found on our website. Please note these rates do not incorporate any mortality improvement or age offsets.

Selection of New Active and Terminated Vested Mortality Rates

PERS & SERS (PubG.H-2010)			TRS (PubT.H-2010)			LEOFF, PSERS, & WSPRS (PubS.H-2010)		
Age	Male	Female	Age	Male	Female	Age	Male	Female
20	0.00039	0.00014	20	0.00036	0.00013	20	0.00043	0.00016
25	0.00035	0.00013	25	0.00022	0.00010	25	0.00043	0.00020
30	0.00045	0.00019	30	0.00028	0.00015	30	0.00048	0.00028
35	0.00059	0.00028	35	0.00035	0.00022	35	0.00054	0.00039
40	0.00081	0.00043	40	0.00048	0.00034	40	0.00067	0.00054
45	0.00118	0.00065	45	0.00076	0.00053	45	0.00092	0.00075
50	0.00177	0.00097	50	0.00126	0.00080	50	0.00133	0.00103
55	0.00261	0.00142	55	0.00193	0.00117	55	0.00195	0.00143
60	0.00376	0.00210	60	0.00294	0.00178	60	0.00300	0.00198
65	0.00543	0.00327	65	0.00484	0.00294	65	0.00480	0.00273
70	0.00815	0.00528	70	0.00796	0.00505	70	0.00880	0.00533
75	0.01275	0.00861	75	0.01206	0.00921	75	0.01615	0.01040
80	0.02027	0.01405	80	0.02345	0.01826	80	0.02963	0.02030
81+	Retiree Rates		81+	Retiree Rates		81+	Retiree Rates	

Selection of New Retiree Mortality Rates

PERS & SERS (PubG.H-2010)			TRS (PubT.H-2010)			LEOFF, PSERS, & WSPRS (PubS.H-2010)		
Age	Male	Female	Age	Male	Female	Age	Male	Female
<50	Active Rates		<55	Active Rates		<45	Active Rates	
50	0.00503	0.00388	55	0.00295	0.00258	50	0.00275	0.00186
55	0.00634	0.00400	60	0.00419	0.00316	55	0.00375	0.00311
60	0.00808	0.00465	65	0.00649	0.00454	60	0.00625	0.00519
65	0.01125	0.00682	70	0.01156	0.00800	65	0.01031	0.00868
70	0.01822	0.01161	75	0.02181	0.01511	70	0.01736	0.01451
75	0.03102	0.02009	80	0.04086	0.02877	75	0.03149	0.02425
80	0.05391	0.03549	85	0.07551	0.05509	80	0.05703	0.04054
85	0.09385	0.06473	90	0.13749	0.10395	85	0.10313	0.06842
90	0.15781	0.12123	95	0.23152	0.18812	90	0.16904	0.11815
95	0.24131	0.19884	100	0.33591	0.29436	95	0.24754	0.19111
100	0.33591	0.29436	105	0.43069	0.39892	100	0.33591	0.29436
105	0.43069	0.39892	110	0.50000	0.48705	105	0.43069	0.39892
110	0.50000	0.48705	115	0.50000	0.50000	110	0.50000	0.48705
115	0.50000	0.50000	120	1.00000	1.00000	115	0.50000	0.50000
120	1.00000	1.00000				120	1.00000	1.00000

MORTALITY RATES

continued

Selection of New Survivor Mortality Rates											
PERS & SERS			TRS			PSERS			LEOFF & WSPRS		
Age	Male	Female	Age	Male	Female	Age	Male	Female	Age	Male	Female
<60	Retiree Rates		<60	Retiree Rates		<60	Retiree Rates		<60	Retiree Rates	
60	0.00808	0.00465	60	0.00419	0.00316	60	0.00672	0.00540	60	0.00610	0.00540
65	0.01125	0.00682	65	0.00649	0.00454	65	0.01324	0.00992	65	0.01284	0.00992
70	0.01870	0.01200	70	0.01264	0.00872	70	0.02347	0.01587	70	0.02347	0.01587
75	0.03383	0.02249	75	0.02964	0.02023	75	0.03617	0.02449	75	0.03617	0.02449
80	0.05711	0.03958	80	0.05711	0.03958	80	0.05711	0.03958	80	0.05711	0.03958
85	0.09206	0.06761	85	0.09206	0.06761	85	0.09206	0.06761	85	0.09206	0.06761
90	0.14705	0.11912	90	0.14705	0.11912	90	0.14705	0.11912	90	0.14705	0.11912
95	0.23276	0.19502	95	0.23276	0.19502	95	0.23276	0.19502	95	0.23276	0.19502
100	0.33591	0.29436	100	0.33591	0.29436	100	0.33591	0.29436	100	0.33591	0.29436
105	0.43069	0.39892	105	0.43069	0.39892	105	0.43069	0.39892	105	0.43069	0.39892
110	0.50000	0.48705	110	0.50000	0.48705	110	0.50000	0.48705	110	0.50000	0.48705
115	0.50000	0.50000	115	0.50000	0.50000	115	0.50000	0.50000	115	0.50000	0.50000
120	1.00000	1.00000	120	1.00000	1.00000	120	1.00000	1.00000	120	1.00000	1.00000

Selection of New Disabled Retiree Mortality Rates					
PERS, TRS, & SERS (Pub.H-2010)			LEOFF, PSERS, & WSPRS (PubS.H-2010)		
Age	Male	Female	Age	Male	Female
20	0.004120	0.002330	20	0.00146	0.00053
25	0.00318	0.00177	25	0.00146	0.00065
30	0.00405	0.00270	30	0.00163	0.00089
35	0.00522	0.00407	35	0.00185	0.00121
40	0.00723	0.00629	40	0.00229	0.00166
45	0.01094	0.00985	45	0.00314	0.00229
50	0.01700	0.01484	50	0.00455	0.00317
55	0.02228	0.01742	55	0.00644	0.00545
60	0.02722	0.02040	60	0.00938	0.00873
65	0.03390	0.02457	65	0.01415	0.01245
70	0.04338	0.03151	70	0.02220	0.01892
75	0.05721	0.04354	75	0.03634	0.03229
80	0.08069	0.06428	80	0.06044	0.05323
85	0.11775	0.09913	85	0.10313	0.08139
90	0.16957	0.14492	90	0.16904	0.12602
95	0.24514	0.20373	95	0.24754	0.19704
100	0.33591	0.29436	100	0.33591	0.29436
105	0.43069	0.39892	105	0.43069	0.39892
110	0.50000	0.48705	110	0.50000	0.48705
115	0.50000	0.50000	115	0.50000	0.50000
120	1.00000	1.00000	120	1.00000	1.00000