Municipal Employees' Retirement System of Michigan

Experience Study Report for the 5-Year Period From January 1, 2014 through December 31, 2018
For the 745 Defined Benefit Plan and Hybrid Plan Municipalities

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February 14, 2020

The Retirement Board
Municipal Employees' Retirement System of Michigan
Lansing, Michigan

Dear Board Members:

This report presents the results of the 5-year experience study from January 1, 2014 through December 31, 2018 for the Municipal Employees' Retirement System (MERS) 745 Defined Benefit Plan and Hybrid Plan municipalities.

The purpose of this experience study is to review and update the actuarial assumptions used in the annual actuarial valuations of each participating municipality and court. This study was based on the census data furnished for annual actuarial valuations for the period from January 1, 2014 through December 31, 2018.

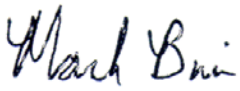
This report should not be relied on for any purpose other than described above. This report was prepared at the request of the Retirement Board and is intended for use by the Retirement System and those designated or approved by the Board. This report may be provided to parties other than the System only in its entirety and only with permission of the Board. GRS is not responsible for unauthorized use of this report.

Michigan Compiled Laws (MCL), Chapter 38, Section 38.1536, Sec. 36. (2)(d) states that, "The retirement board shall arrange for an annual actuarial valuation and report of the actuarial soundness of each participating municipality and court to be prepared by an independent actuary based on data compiled and supplied by employees of the retirement system. The retirement board shall adopt actuarial tables, assumptions, and formulas after consultation with the actuary." We interpret the term "actuarial soundness" from the statute to mean following the guidance of the Actuarial Standards of Practice. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board.

David T. Kausch, Mark Buis, and Rebecca L. Stouffer are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. GRS is independent of the plan and plan sponsors and maintains independent consulting agreements with certain local units of government for services unrelated to the actuarial consulting services provided to MERS in this report.

Respectfully Submitted,

David T. Kausch, FSA, EA, MAAA, FCA, PhD



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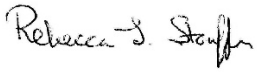

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I. Executive Summary

Overview

This report contains information and analysis for purposes of reviewing and recommending changes to the assumptions used in the annual actuarial valuations of the defined benefit and hybrid plans participating in the Municipal Employee's Retirement System of Michigan (MERS). The demographic experience analyzed in this report is based on the experience from all MERS plan participants from the period from January 1, 2014 through December 31, 2018.

MERS previously studied economic assumptions and the Board adopted changes to those assumptions effective with the December 31, 2019 annual actuarial valuations. The assumed rate of return is getting much more attention in public sector plans than in the past. Many Boards are establishing procedures to review economic assumptions more frequently than the 5-year experience study. This report includes the analysis on the economic assumptions that was provided to the Board for the changes adopted on February 28, 2019. The remainder of this report focuses on the demographic assumptions.

The actuarial principle in force is that over time contributions and investment income must be sufficient to pay benefits throughout retirement for all plan participants. Actuarial valuations make use of a number of assumptions to estimate investment accumulation and benefit payouts in order to determine the required level percent of payroll objective. From year to year, actual experience on any assumption will not coincide exactly with assumed experience. MERS manages these continually changing differences by having annual actuarial valuations and periodic experience studies to review all assumptions. MERS performs experience studies at least every five years.

This report includes many detailed recommendations. The recommendations that we expect to have the greatest impact on plan costs are as follows:

- Updating the mortality and mortality improvement assumptions which includes:
    - Updating to the Pub-2010 mortality tables, the most recent national mortality tables based specifically on public sector pension plan experience (issued January 2019),
    - Changing to sex-distinct mortality assumptions for the valuations,
    - Updating the mortality improvement scale to MP-2019, the most recent national mortality improvement scale available (issued November 2019),
        - Two alternatives are provided for consideration: static and fully generational mortality improvements.
- Separately rating public safety and general plans for certain assumptions.

The actual impact may vary significantly by employer, given the varying demographics and funded status of the plans. At a high level, our recommendations are as listed below. Additional detail may be found in the corresponding report sections.

Assumption	Proposed Change	Common Impact
Mortality Rates	Change to the recently issued Pub-2010 mortality General rates as published by the Society of Actuaries. Scaled to MERS' experience on a liability-weighted basis. Change to sex-distinct assumptions.	Variable. Likely to increase costs for divisions with more females and possibly decrease cost for divisions with more males.
Mortality Improvement	Change to the recently issued MP-2019 mortality improvement scales on a fully generational basis. An alternative static projection is also discussed.	Likely to increase cost for most divisions. Younger active workforces may see the highest increases. A few retiree-only divisions with older populations may see a decrease.
Retirement Rates	Change 100% retirement rates to begin at age 85 vs. current 70. Separate assumptions public safety and general employee divisions. Minor changes to some rates.	Generally, an increase for public safety divisions and possibly a decrease for general employee divisions.
Withdrawal Rates	Remove scaling factors. Separate assumptions public safety and general employee divisions. Minor changes to some rates.	Generally, an increase for public safety divisions and possibly a decrease for general employee divisions.
Disability Rates	No change.	No impact.
Merit and Seniority	Change to a service-based assumption.	Modest increases or decreases depending on division demographics.
Increase in Final Average Compensation	Minimum 1% load introduced for most employers. 0% load for base pay definition of compensation. Fewer individually rated employers.	Modest increase for several employers. Modest decreases for a small number of employers.
Other Assumptions	As described in the report.	Variable.

All recommendations are made based on the guidance of the Actuarial Standards of Practice.

II. Background and Introduction

Background

MERS' Plan, Section 71(1)(d), provides that, at intervals of five years, MERS' actuary shall conduct an actuarial experience study of the Retirement System and report the results to the Retirement Board. "At intervals of five years, the actuary shall conduct an actuarial experience study of the System and report the results to the Retirement Board. The Retirement Board shall adopt actuarial tables, assumptions, and formulas after consultation with the actuary, and incorporate them into its Actuarial Policy, as amended." This is consistent with Michigan Compiled Laws (MCL), Chapter 38, Section 38.1536, Sec. 36. (2)(d).

The purpose of the experience study is to systematically review the actuarial assumptions used in the annual actuarial valuations. Actuarial valuations are mathematical models designed to meet the funding objectives.

The mathematical model is necessary in defined benefit and hybrid plans because there are "knowns" and "unknowns" which must be evaluated before the employer contribution can be determined. The knowns are:

- Who participates in the plan;
- The demographic characteristics of each active and inactive member (i.e., age, sex, salary, service, contribution balance, etc.);
- The demographic characteristics of each retired member and beneficiary (i.e., age, sex, benefit, form of payment, etc.);
- The conditions and characteristics of the plan (i.e., type and amount of benefits payable, eligibility for benefits, length of time benefit is payable, etc.);
- The current purchasing power of a dollar;
- The value of the pool of assets; and
- How the pool of assets is invested.

The unknowns are:

- Who will retire and at what age, service and final average salary;
- Who will quit before becoming vested;
- Who will quit and be entitled to a future vested benefit;
- Who will become disabled;
- How long will members and their beneficiaries live (before and after retirement);
- What is the future purchasing power of a dollar (future inflation); and
- How much income will the pool of assets generate.

The valuation model takes the "knowns," incorporates assumptions about the "unknowns" and develops the estimated cost of the plan for the current members. This cost is then financed using an actuarial cost method to determine the level contribution requirement.

Assumptions should be carefully chosen and continually monitored. A poor choice of assumptions or continued use of outdated assumptions can lead to:

- Understated costs resulting in either an inability to pay benefits when due, or sharp increases in required contributions at some point in the future; and
- Overstated costs resulting in an unnecessarily large burden on the current generation of participants, employers and taxpayers.

A single set of assumptions will not be suitable indefinitely. Conditions change, and our understanding of conditions (whether or not they are changing) also changes.

Prior to selecting new assumptions, we analyze the plans' experience over the last five years. This report provides our analysis of the experience and suggestions on key assumptions.

No single 5-year experience period should be given full credibility in the setting of actuarial valuation assumptions. When we see significant differences between what is expected from our assumptions and actual experience, our strategy in recommending a change in assumptions is usually to select rates that would produce results somewhere between the actual and expected experience. In this way, with each experience study the actuarial assumptions become better and better representations of actual experience. Consequently, temporary conditions that might influence a particular experience study period will not unduly influence the choice of long-term assumptions.

We are recommending certain changes in assumptions for the annual actuarial valuations. The various assumption changes and their impact on the required contribution are described on the following pages. Actuarial assumptions were last revised with the December 31, 2015 annual actuarial valuations.

Introduction

The annual actuarial valuations are based on numerous technical assumptions. An experience study is a mathematical procedure for systematically comparing actual outcomes with expected outcomes of prior years' results based on those assumptions. The resulting analysis may or may not indicate the need for changes to the actuarial assumptions.

For purposes of this analysis, we look to the Actuarial Standards of Practice (ASOPs) for guidance. The pertinent ASOPs for this purpose are:

- ASOP No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, and
- ASOP No. 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations.

Each of these standards require a rationale for selecting assumptions. Selecting assumptions in this context includes when the actuary is advising and the Board is adopting assumptions for the valuation. It does not apply for certain prescribed assumptions such as those required for reporting to the Michigan Department of Treasury under Public Act (PA) 202. Assumptions for PA 202 are not in the scope of this study.

ASOP Nos. 27 and 35 are currently under revision by the Actuarial Standards Board. For purposes of this experience study, we have relied on the guidance from those standards in effect as of the date of this report.

The primary economic assumptions were reviewed and updated by the Retirement Board on February 28, 2019. Changes to certain key economic assumptions, in particular the assumed rate of return and wage inflation, were changed from 7.75% to 7.35% and 3.75% to 3.00% per year, respectively. Those changes will be effective in the December 31, 2019 annual actuarial valuations to be performed in the Spring/Summer of 2020.

Note that wage inflation is the long-term, macroeconomic expectation of total payroll growth for open divisions. It is used in the level percent of payroll amortization calculations and as the first building block for pay increases in divisions for determining actuarial accrued liability for active members.

The primary focus of this study is on the demographic and other noneconomic assumptions used in the valuation. Our understanding is that changes resulting from this experience study, if adopted by the Board, will be reflected in the December 31, 2020 annual actuarial valuations.

Throughout the 5-year experience study period, a participant may decrement (i.e., change status) either by retiring, terminating, becoming disabled, or dying. Our initial analysis of the MERS decrement experience is based on both headcount-weighted and liability-weighted experience. For each decrement, the exposure is the number (or liability) of those who were subject to the specific decrement, the expected is the number (or liability) of those exposed who were assumed to decrement and the actual is the number (or liability) of those exposed who actually did decrement. The ratio of actual to expected decrements (the A/E ratio) provides a quick summary of experience for a particular decrement in total.

While the A/E ratio gives a rough indication of the actual vs. expected experience, it does not necessarily dictate what changes, if any, we may suggest. An A/E ratio of 100% does not preclude a suggested change in the assumption. The following are a few reasons we may suggest a new assumption across various A/E ratios:

(1) experience for an assumption – or a subgroup affected by an assumption – may be too small to assign full credibility,
(2) the direction of the change in this study may be the opposite of the change made in the last study which runs the risk of flip-flopping assumptions,
(3) we may intentionally wish to maintain a ratio other than 100%, such as leaving a margin for static mortality improvement,
(4) it may not be possible to have the A/E ratio on a headcount-weighted and liability-weighted basis both equal 100%, or
(5) there may be other facts and circumstances about the underlying data, the specific experience period, or the interaction with plan provisions or other changes. In addition, even if the A/E ratio is 100% in the aggregate, we may make changes to individual rates within the full assumption set.

A headcount-weighted decrement is designed to mimic the event of a person decrementing. A liability-weighted decrement is designed to mimic the associated liability of a person decrementing, which in turn should reduce the likelihood of a gain or a loss. Actuarial practice on using headcount-weighted vs. liability-weighted is evolving. In general, from the perspective of mitigating gains and losses, we prefer to consider liability-weighted analysis whenever appropriate.

Actuarial assumptions may also be used for purposes other than annual valuations. We understand that the MERS Plan Document and Actuarial Policy refer to administrative practices and procedures that determine actuarial equivalence based on certain actuarial assumptions. This report contains discussion on actuarial principles related to actuarial equivalence for administrative purposes. It is important to note that the ASOPs do not generally apply to plan administration.

The experience study also provides us with an opportunity to review other actuarial methods and procedures including:

- The actuarial cost method, including miscellaneous and technical assumptions;
- The asset valuation method; and
- The amortization method and Actuarial Funding Policy.

The pertinent ASOPs for these purposes are:

- ASOP No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions; and
- ASOP No. 44, Selection and Use of Asset Valuation Methods for Pension Valuations.

ASOP No. 4 is currently under revision by the Actuarial Standards Board. For purposes of this experience study, we have relied on the guidance from that standard in effect as of the date of this report.

The statistical analysis required for studying actuarial assumptions depends on the quantity and quality of the underlying data. The more reliable – or statistically "credible" – data that we have, the more refined we can make our analysis.

The pertinent ASOPs for these purposes are:

- ASOP No. 23, Data Quality; and
- ASOP No. 25, Credibility Procedures.

This report is organized as follows. Each major demographic assumption is reviewed in detail in Section III, including rates of retirement, termination, disability and mortality. Section III also contains summary information and analysis on other non-economic assumptions used in the valuation. Section IV contains analysis on economic assumptions used in the valuations other than the assumed rate of return and wage inflation assumptions which were recently updated by the Board. Section V contains a review of actuarial methods. We are working in conjunction with a MERS project team on a review of the Actuarial Policy. Recommendations for changes to the Actuarial Policy will be forthcoming separately.

III. Demographic Assumptions

Aggregate Results

Retired Participant Experience Summary

Our expectation is that the changes to the mortality assumption will potentially have the biggest impact in this experience study. Recall that the margin for future improvement in the current assumption was estimated to be 10% in the prior experience study. The rule of thumb is that generally a static margin will be "worn away" at roughly 1% per year or roughly 5% over the last 5 years. That said, mortality improvement in the U.S. as a whole slowed down significantly during the study period so a decrease of less than 5% in the margin would not be unexpected.

Based on our analysis of retiree mortality, the ratio of actual to expected deaths under the current assumption is 108% on a headcount-weighted basis as shown in the "A/E" column below. This indicates that there is still an 8% margin for mortality improvement on a headcount-weighted basis, a decrease of 2% from the prior experience study. However, on a liability-weighted basis, the A/E ratio is 98%, indicating there is no margin left in the current assumption. While a headcount-weighted margin provides for the event of future mortality improvement, a liability-weighted margin provides for mitigating future gains and losses from future mortality improvement.

Retired Participant Experience				
Decrement	**Exposures**	**Actual**	**Expected**	**A/E**
Healthy Mortality				
Headcount	144,339.0	3,671.0	3,387.4	108%
Liability (millions)	*35,654.7*	*471.2*	*481.2*	*98%*
Disabled Mortality				
Headcount	8,181.0	256.0	237.5	108%
Liability (millions)	*1,442.5*	*30.8*	*33.5*	*92%*

The A/E ratios for disabled lives are similar; however, the liability-weighted A/E ratio is lower at 92%.

We consider a version of the Pub-2010 Public Sector Mortality tables as published in January 2019 by the Society of Actuaries. There are separate tables for General, Public Safety, and Teachers. For purposes of valuing pension liabilities, it is generally more appropriate to scale these tables to MERS' experience on a liability-weighted basis rather than a headcount-weighted basis. We provide additional detail in the Post-Retirement Mortality section of this report.

The summary of active decrement experience is shown in the following table.

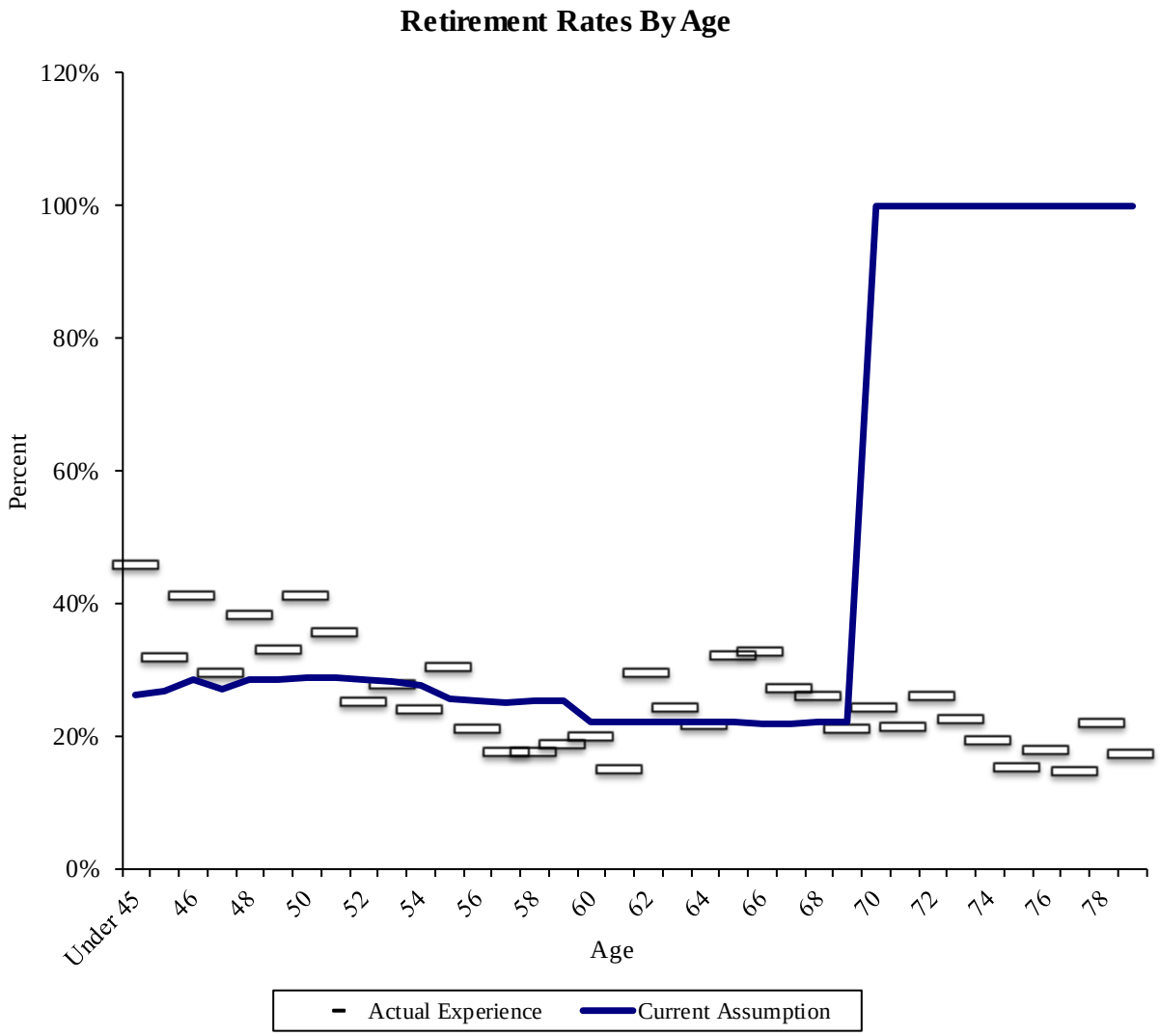
Active Experience				
Decrement	**Exposures**	**Actual**	**Expected**	**A/E**
Unreduced Retirement				
Headcount	26,149.0	6,154.0	6,981.9	88%
Liability (millions)	*6,771.1*	*1,800.8*	*1,914.6*	*94%*
Early reduced Retirement				
Headcount	13,759.0	317.0	603.4	53%
Liability (millions)	*3,384.0*	*82.4*	*145.7*	*57%*
Withdrawal				
Headcount	134,321.0	11,830.0	10,106.1	117%
Liability (millions)	*12,595.3*	*463.7*	*459.3*	*101%*
Disability				
Headcount	134,321.0	201.0	240.2	84%
Liability (millions)	*12,595.3*	*39.9*	*27.2*	*147%*
Pre-retirement Mortality				
Headcount	174,229.0	229.0	419.9	55%
Liability (millions)	*22,750.4*	*35.6*	*69.8*	*51%*

For each decrement, we performed some additional analysis. The following sections summarize our analysis.

Unreduced Retirement

On a headcount weighted basis, there were 6,154 actual unreduced retirements compared with 6,982 expected for an A/E ratio of 88%. At first glance, the headcount-weighted A/E ratio of 88% for unreduced retirement indicates that there were far fewer retirements than expected in the aggregate. This aggregate figure includes all those who were eligible for unreduced retirement at the beginning of the year during the experience study period. It is important to note that there are different assumptions in use for these active participants: (1) retirement rates based on the active participant's replacement index, (2) 100% assumed retirement for those aged 70 and above, and (3) 20% assumed retirement for those with benefits based on frozen plan.

If we examine the experience in detail by age, we see the following picture.



"Current Assumption" in this chart is the average replacement index assumption for those exposed at each age.

The 100% retirement rates at age 70 and above are somewhat arbitrary and were the subject of discussion between GRS and MERS' actuarial staff when we performed the December 31, 2018 annual actuarial valuation. The number of exposures at age 70 and above is 1,109, or about 4% of the total exposures to this decrement.

If we refine the analysis to exclude those with frozen benefits (a very small group) and adjust the "expected" retirement assumption of those age 70 and above to the current applicable replacement index assumption rather than the flat 100%, we end up with quite a different picture:

Active Experience				
Decrement	**Exposures**	**Actual**	**Expected**	**A/E**
Unreduced Retirement				
Headcount	26,032.0	6,135.0	6,105.0	100%
Liability (millions)	*6,751.5*	*1,797.3*	*1,796.0*	*100%*

The revised A/E ratio on this basis is 100% (within rounding) on both a headcount-weighted and liability-weighted basis. This is an indication that the current assumption is still reasonable. Note that a ratio of 100% in the aggregate may indicate that we may only need to make minor adjustments to the rates, if any. Additional analysis may suggest changes are needed.

Replacement Index vs. Age or Service Based Rates

The current assumption is replacement index-based. The prior actuary included the following rationale in the last experience study:

> "The Replacement Index method of measuring rates of retirement was designed specifically for MERS, because of the large variation of benefit formula and member contribution rates within MERS. We do not know of any other retirement plans that use this method. Most plans have uniform benefit and member contribution provisions, or a small number of different sets of these provisions. Such plans will often have a separate retirement rate assumption for each of their benefit provision groups, and members do not move among groups via the adoption of higher or lower benefit provisions for their employee division. The Replacement Index method works very well for a plan like MERS which includes a large number of benefit provision choices and member contribution rate choices, and which does not limit an employer's ability to change benefit provisions and member contribution rates from time to time."

An advantage to retirement rates based on replacement index is that these rates will automatically adjust to changes in benefits and member contribution rates, which is a significant advantage for benefit design changes, as also noted by the prior actuary.

We can analyze the retirement decrement experience by age, service and replacement index by comparing the variance of actual to expected experience in proportion to the exposures at each age, service, or replacement index. The smallest variance is an indication of the best fit.

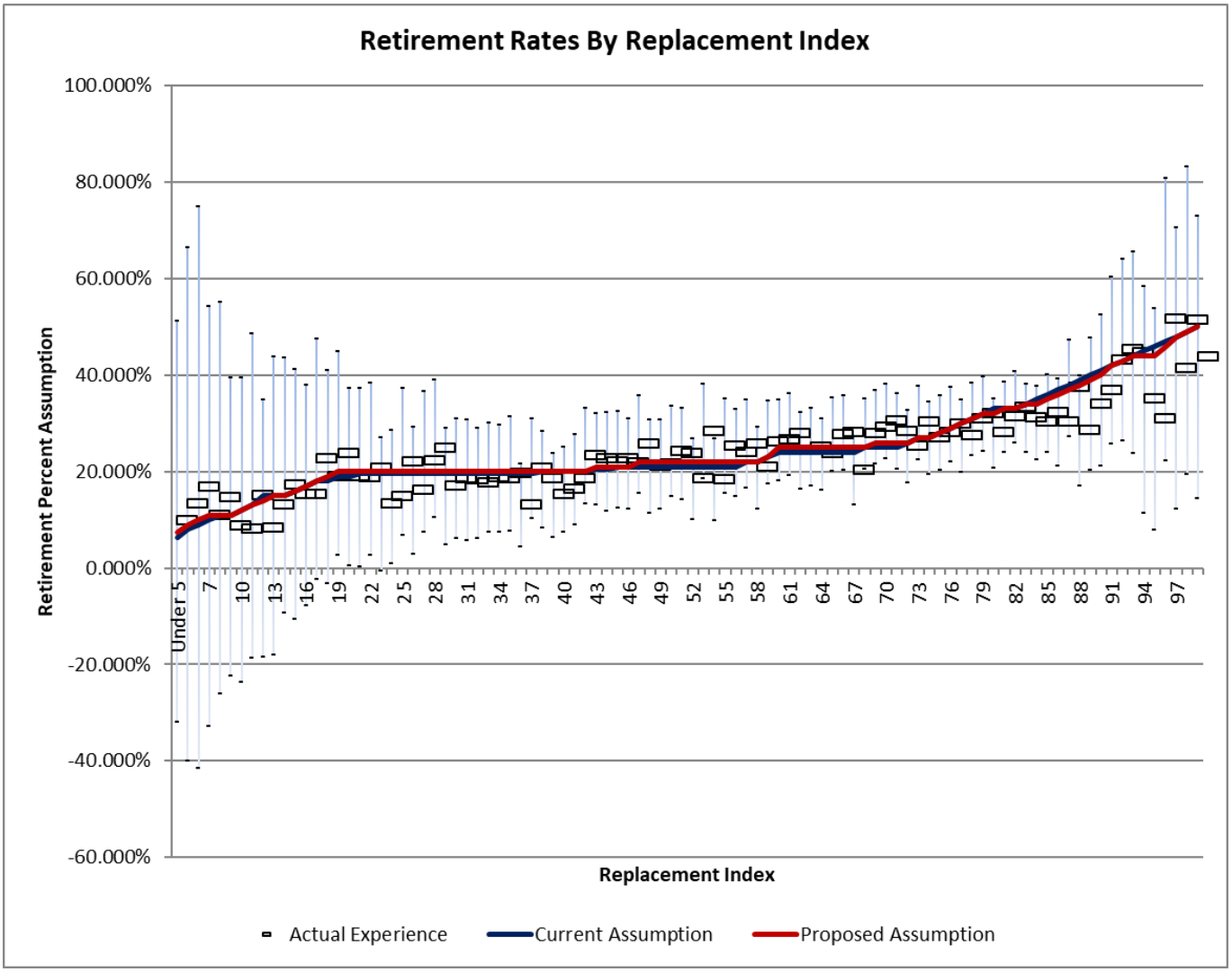
Analysis of Variance of (Actual – Expected)/Exposure – Unreduced Retirement		
	Headcount-Weighted	**Liability-Weighted**
Age-Based	0.5%	0.6%
Service-Based	0.2%	0.3%
Replacement Index-Based	0.2%	0.2%

The replacement index has the lowest variance on both a headcount-weighted and liability-weighted basis, although it is very close to the service-based variance. We agree with the rationale of the prior actuary and the minimal variance provides support for maintaining replacement index as the method for this assumption. We observe that a service-based table could be useful for non-pension (OPEB) valuations.

We continue with the analysis of retirements with respect to replacement index on a liability-weighted basis. Recall that replacement index is defined as the approximate percentage of the member's pay (after reducing for member contributions) that will be replaced by the member's benefit at retirement. The index is calculated as:

Replacement Index = 100 x Accrued Benefit divided by [Pay less Member Contributions]

As mentioned above, this approach is currently applied to active members under age 70 except those in frozen plans. For the following analysis, we continue to exclude those in frozen plans. For those at or over the age of 70, we have ignored the 100% assumption and calculated the "current" assumption for those participants as if it were based on replacement index alone. (For practical valuation purposes, we will continue to apply a 100% retirement rate beginning at age 85.) The experience is summarized in the chart on the following page.



For each possible replacement index up to 100, we compute the liability-weighted expected retirements and compare to the actual retirements. We also determine a 95% confidence interval around each observed retirement rate. The 95% confidence interval is set to be two standard deviations above and below the observed or "crude" rate for each replacement index. In theory, it is 95% likely that the "true" retirement rates fall within these intervals. As a general rule, the narrower the confidence interval for a particular replacement index, the more credible the experience for that rate. Based on these confidence intervals, 99% of the assumed rates fall within the 95% confidence intervals. We make the general observations that observed rates for very low replacement index were somewhat higher than the current assumption and similarly, rates for very high replacement index were somewhat lower than assumed.

We made modest changes to the assumed rates as follows:

(1) Graduate the crude rates to be 50% of the crude rate at the same replacement index plus 25% of the crude rates at replacement index one higher and one lower. The highest and lowest graduated crude rates were set equal to the current assumption;
(2) Apply 20% weight to the graduated crude rate and 80% weight to the current assumption at each replacement index;
(3) Round each assumption to a whole percent; and

(4) Preserve the generally increasing trend of the rates by not allowing any proposed rate to be less than the rate for the next lower replacement index.

As with the current assumption, 99% of the rates in the proposed assumed fall within the 95% confidence interval. The advantages of this procedure are that it results in a slightly tighter fit to the data, is closer to the actual experience below index value of 100, is a smoother set of rates, and is non-decreasing. The disadvantages of this procedure are that some rates did not change even though experience differed from assumed and some rates did not change in the same direction as the experience (e.g., experience was higher than assumed and the proposed rate went down or vice versa in some cases). In our view, cases listed in the disadvantages were isolated exceptions and likely were not indicative of a long-term pattern.

Unreduced Retirement Experience - Liability Weighted									
All Divisions, Males and Females									
Replacement-Index-Based Analysis, Liability Weighted									
Replacement Index	Actual Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements		Ratio of Actuals/Expecteds	
				Current*	Proposed	Current	Proposed	Current	Proposed
Under 5^	0.2	2.1	9.85%	6.35%	7.35%	0.1	0.2	155%	134%
5	0.2	1.6	13.48%	8.00%	9.00%	0.1	0.1	169%	150%
6	0.3	1.7	16.91%	9.00%	10.00%	0.1	0.2	188%	169%
7	0.2	2.1	10.96%	10.00%	11.00%	0.2	0.2	110%	100%
8	0.5	3.1	14.78%	11.00%	11.00%	0.3	0.3	134%	134%
9	0.3	3.3	8.74%	11.00%	11.00%	0.4	0.4	79%	79%
10	0.2	3.0	8.09%	12.00%	12.00%	0.4	0.4	67%	67%
11	0.7	4.6	15.18%	13.00%	13.00%	0.6	0.6	117%	117%
12	0.4	4.4	8.40%	15.00%	14.00%	0.7	0.6	56%	60%
13	0.6	4.8	13.14%	15.00%	15.00%	0.7	0.7	88%	88%
14	1.4	8.2	17.35%	15.00%	15.00%	1.2	1.2	116%	116%
15	1.2	7.9	15.47%	16.00%	16.00%	1.3	1.3	97%	97%
16	1.5	10.0	15.27%	17.00%	17.00%	1.7	1.7	90%	90%
17	2.6	11.4	22.76%	18.00%	18.00%	2.0	2.0	126%	126%
18	2.4	12.7	19.12%	18.00%	19.00%	2.3	2.4	106%	101%
19	3.9	16.3	23.95%	19.00%	20.00%	3.1	3.3	126%	120%
20	3.5	18.3	19.06%	19.00%	20.00%	3.5	3.7	100%	95%
21	3.4	17.9	18.89%	19.50%	20.00%	3.5	3.6	97%	94%
22	4.3	20.7	20.79%	19.50%	20.00%	4.0	4.1	107%	104%
23	3.3	24.2	13.45%	19.50%	20.00%	4.7	4.8	69%	67%
24	4.0	26.6	14.95%	19.50%	20.00%	5.2	5.3	77%	75%
25	6.7	30.0	22.21%	19.50%	20.00%	5.8	6.0	114%	111%
26	5.1	31.3	16.29%	19.50%	20.00%	6.1	6.3	84%	81%
27	7.2	32.5	22.30%	19.50%	20.00%	6.3	6.5	114%	111%
28	9.2	36.7	24.98%	19.50%	20.00%	7.2	7.3	128%	125%
29	6.6	38.8	17.04%	19.50%	20.00%	7.6	7.8	87%	85%
30	7.4	39.8	18.71%	19.50%	20.00%	7.8	8.0	96%	94%
31	7.1	38.6	18.40%	19.50%	20.00%	7.5	7.7	94%	92%
32	8.0	45.2	17.77%	19.50%	20.00%	8.8	9.0	91%	89%
33	9.0	47.4	18.94%	19.50%	20.00%	9.2	9.5	97%	95%
34	9.1	48.6	18.74%	19.50%	20.00%	9.5	9.7	96%	94%
35	9.0	45.5	19.71%	19.50%	20.00%	8.9	9.1	101%	99%
36	8.1	61.1	13.22%	19.50%	20.00%	11.9	12.2	68%	66%
37	12.8	61.7	20.74%	19.50%	20.00%	12.0	12.3	106%	104%
38	11.2	60.1	18.56%	20.00%	20.00%	12.0	12.0	93%	93%
39	10.4	68.3	15.28%	20.00%	20.00%	13.7	13.7	76%	76%
40	11.7	70.9	16.49%	20.00%	20.00%	14.2	14.2	82%	82%
41	12.8	69.0	18.55%	20.00%	20.00%	13.8	13.8	93%	93%
42	16.9	72.1	23.41%	20.00%	20.00%	14.4	14.4	117%	117%
43	17.9	78.3	22.83%	20.50%	21.00%	16.0	16.4	111%	109%
44	14.7	66.5	22.17%	20.50%	21.00%	13.6	14.0	108%	106%
45	16.1	70.8	22.67%	21.00%	21.00%	14.9	14.9	108%	108%
46	17.1	78.2	21.86%	21.00%	21.00%	16.4	16.4	104%	104%
47	19.0	73.7	25.78%	21.00%	22.00%	15.5	16.2	123%	117%
48	15.1	70.9	21.30%	21.00%	22.00%	14.9	15.6	101%	97%
49	17.3	79.9	21.66%	21.00%	22.00%	16.8	17.6	103%	98%
50	20.4	83.7	24.33%	21.00%	22.00%	17.6	18.4	116%	111%

^ Current and proposed rates are weighted averages for replacement indexes below 5.

Unreduced Retirement Experience - Liability Weighted									
All Divisions, Males and Females									
Replacement-Index-Based Analysis, Liability Weighted									
Replacement Index	Actual Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements		Ratio of Actuals/Expecteds	
				Current*	Proposed	Current	Proposed	Current	Proposed
51	19.0	79.9	23.81%	21.00%	22.00%	16.8	17.6	113%	108%
52	16.1	86.1	18.65%	21.00%	22.00%	18.1	18.9	89%	85%
53	24.4	85.7	28.53%	21.00%	22.00%	18.0	18.8	136%	130%
54	15.6	84.4	18.49%	21.00%	22.00%	17.7	18.6	88%	84%
55	20.1	79.1	25.45%	21.00%	22.00%	16.6	17.4	121%	116%
56	22.0	91.4	24.09%	21.00%	22.00%	19.2	20.1	115%	110%
57	24.2	93.5	25.91%	22.00%	22.00%	20.6	20.6	118%	118%
58	19.3	91.9	21.00%	22.00%	22.00%	20.2	20.2	95%	95%
59	27.6	104.8	26.31%	23.00%	23.00%	24.1	24.1	114%	114%
60	29.9	112.0	26.67%	24.00%	25.00%	26.9	28.0	111%	107%
61	30.7	110.0	27.90%	24.00%	25.00%	26.4	27.5	116%	112%
62	28.7	117.5	24.43%	24.00%	25.00%	28.2	29.4	102%	98%
63	29.2	116.0	25.21%	24.00%	25.00%	27.8	29.0	105%	101%
64	31.4	131.8	23.83%	24.00%	25.00%	31.6	32.9	99%	95%
65	38.4	137.9	27.83%	24.00%	25.00%	33.1	34.5	116%	111%
66	38.4	135.8	28.28%	24.00%	25.00%	32.6	34.0	118%	113%
67	26.5	129.9	20.43%	24.00%	25.00%	31.2	32.5	85%	82%
68	41.7	149.1	27.99%	25.00%	25.00%	37.3	37.3	112%	112%
69	42.1	143.2	29.38%	25.00%	26.00%	35.8	37.2	118%	113%
70	43.8	143.4	30.57%	25.00%	26.00%	35.8	37.3	122%	118%
71	38.7	135.8	28.52%	25.00%	26.00%	33.9	35.3	114%	110%
72	34.5	136.0	25.36%	26.00%	26.00%	35.4	35.4	98%	98%
73	44.4	146.2	30.34%	27.00%	27.00%	39.5	39.5	112%	112%
74	37.1	136.7	27.12%	27.00%	27.00%	36.9	36.9	100%	100%
75	38.9	137.7	28.23%	28.00%	28.00%	38.6	38.6	101%	101%
76	42.4	141.3	30.01%	29.00%	29.00%	41.0	41.0	103%	103%
77	38.8	140.7	27.60%	30.00%	30.00%	42.2	42.2	92%	92%
78	48.1	155.0	31.01%	31.00%	31.00%	48.0	48.0	100%	100%
79	46.8	145.6	32.13%	32.00%	32.00%	46.6	46.6	100%	100%
80	43.1	153.2	28.11%	33.00%	32.00%	50.6	49.0	85%	88%
81	51.9	164.7	31.48%	33.00%	33.00%	54.4	54.4	95%	95%
82	53.8	160.6	33.48%	33.00%	33.00%	53.0	53.0	101%	101%
83	53.6	172.0	31.16%	34.00%	34.00%	58.5	58.5	92%	92%
84	44.7	147.4	30.34%	35.00%	34.00%	51.6	50.1	87%	89%
85	43.1	133.7	32.24%	36.00%	35.00%	48.1	46.8	90%	92%
86	31.3	103.0	30.41%	37.00%	36.00%	38.1	37.1	82%	84%
87	34.9	93.1	37.47%	38.00%	37.00%	35.4	34.4	99%	101%
88	17.7	61.8	28.66%	39.00%	38.00%	24.1	23.5	73%	75%
89	16.3	47.6	34.18%	40.00%	39.00%	19.0	18.6	85%	88%
90	13.9	37.7	36.98%	41.00%	40.00%	15.5	15.1	90%	92%
91	14.1	32.5	43.20%	42.00%	42.00%	13.7	13.7	103%	103%
92	12.7	27.9	45.49%	43.00%	43.00%	12.0	12.0	106%	106%
93	10.1	22.6	44.80%	44.00%	44.00%	9.9	9.9	102%	102%
94	5.8	16.5	35.12%	45.00%	44.00%	7.4	7.3	78%	80%
95	5.0	16.2	30.99%	46.00%	44.00%	7.5	7.1	67%	70%
96	6.0	11.7	51.75%	47.00%	46.00%	5.5	5.4	110%	112%
97	4.8	11.4	41.59%	48.00%	48.00%	5.5	5.5	87%	87%
98	5.1	9.8	51.44%	49.00%	49.00%	4.8	4.8	105%	105%
99	5.0	11.5	43.81%	50.00%	50.00%	5.7	5.7	88%	88%
Totals	**1,752.4**	**6,637.1**	**26.40%**	**26.20%**	**26.47%**	**1,738.8**	**1,757.2**	**101%**	**100%**
100 & Over	44.8	114.4	39.19%	50.00%	50.00%	57.2	57.2	78%	78%
Total	**1,797.3**	**6,751.5**	**26.62%**	**26.60%**	**26.87%**	**1,796.0**	**1,814.4**	**100%**	**99%**

**The current retirement assumption is based on replacement index. Values shown are the average in-force in the experience period.*

We have performed some additional analysis on subgroups of the population. Recent trends in public employee retirement system experience studies is to consider reviewing general employees, public safety, and teachers separately. Experience among these subgroups may vary possibly due to different benefit structures, career expectations or workplace risks. Consequently, we have looked at the experience for general and public safety divisions (division codes 02, 05, 20-29, and 50-59) separately. We also split out hybrid plans and those with frozen benefits to see if the difference in plan structure materially affects participant behavior.

Liability-weighted ($millions)

	Exposures	Actual	Expected	A/E
Frozen plan	19.6	3.5	4.2	83%
Hybrid	11.0	1.4	1.5	98%
Public Safety	1,290.2	454.9	383.2	119%
All Others	5,450.3	1,340.9	1,411.3	95%

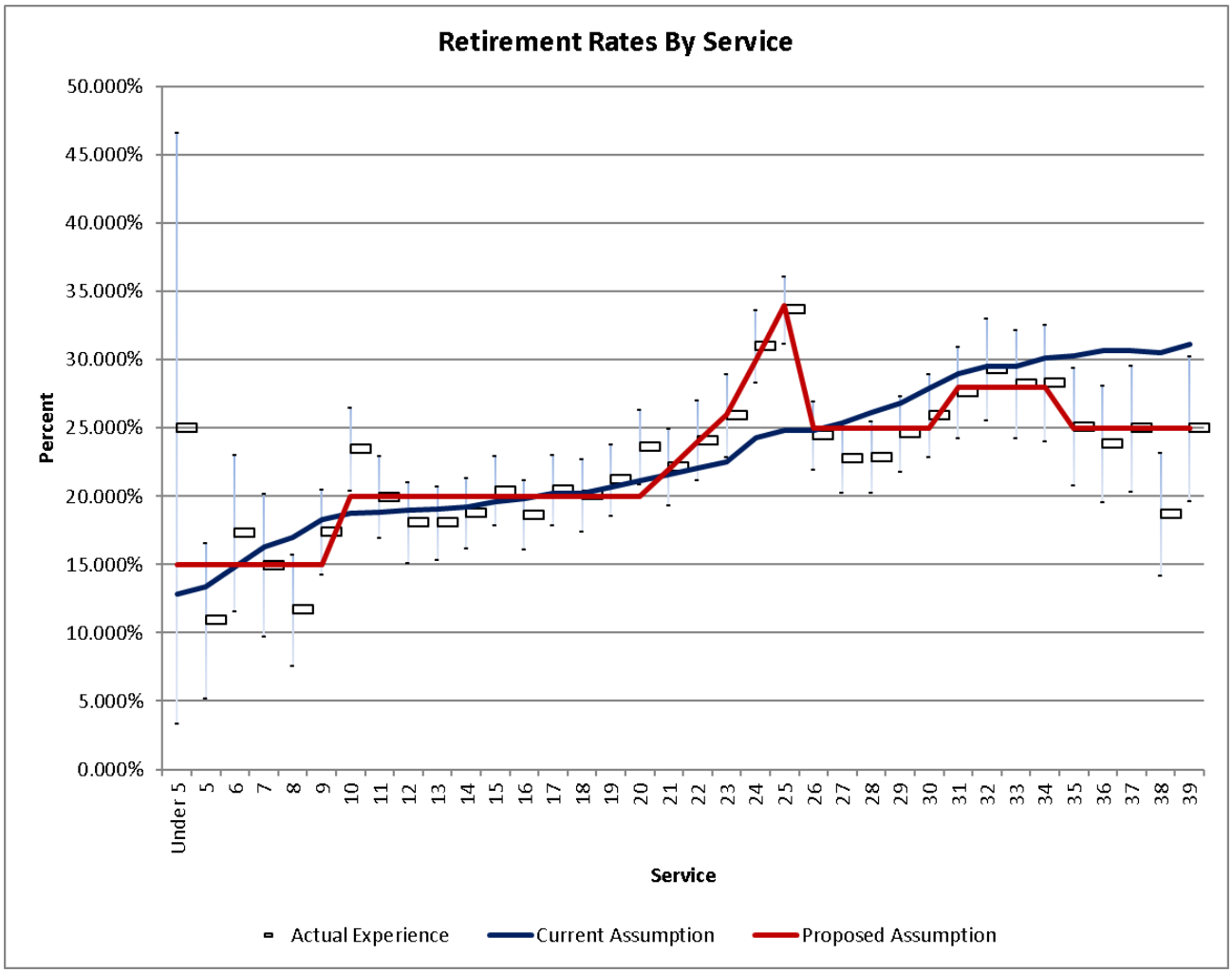
There are many observations that we can make.

The public safety groups have materially higher A/E ratios at 119% indicating more retirements than expected. Frozen plan participants have the lowest A/E ratio at 83% and "All Others" have an A/E ratio of 95%. It is important to note that the frozen plan and Hybrid groups are both extremely small for this decrement so they likely should not be given undue weight. On the other hand, the public safety group is large enough to give their experience more weight.

Based on these ratios, we recommend applying separate retirement rates to public safety and all other non-frozen groups. Scaling the tables by the observed A/E ratio generally brings the A/E ratio closer to 100%, subject to rounding error. We recommend maintaining the 20% assumption for frozen plans. A full set of assumptions is included in the Appendix.

Two final notes on the analysis are that (1) we examined male and female experience separately and did not find that it warranted separate assumptions and (2) the data had 48 retirements (7 of which were Public Safety) during the experience study period flagged as having retired under an early retirement window. An argument can be made for excluding all early retirement windows from the analysis of retirement experience; however, given the small number we opted to not exclude them.

As mentioned, the retirement rates for pension annual actuarial valuations are based on replacement index. There may be circumstances when another actuary may be engaged for other actuarial valuation services for a MERS employer, such as for an OPEB valuation. In that case, the data needed to determine replacement index may not readily be available to the OPEB actuary making it difficult to implement the proposed assumption. We suggest that a service-based retirement table based on this experience study could be selected as follows:


Retirement Rates By Service
50.000%
45.000%
40.000%
35.000%
30.000%
25.000%
20.000%
15.000%
10.000%
5.000%
0.000%
Percent
Under 5
5
6
7
8
9
10
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Service
Actual Experience
Current Assumption
Proposed Assumption

The underlying analysis is as follows:

Unreduced Retirement Experience - Count Weighted									
All Divisions, Males and Females									
Service-Based Analysis, Headcount Weighted									
				Sample Rates		Expected Retirements		Ratio of Actuals/Expecteds	
Service	Actual Retirements	Exposure	Crude Rates	Current*	Proposed	Current	Proposed	Current	Proposed
Under 5	4.0	16.0	25.00%	12.81%	15%	2.1	2.4	195%	167%
5	13.0	119.0	10.92%	13.40%	15%	16.0	17.9	82%	73%
6	30.0	173.0	17.34%	14.81%	15%	25.6	26.0	117%	116%
7	28.0	187.0	14.97%	16.31%	15%	30.5	28.1	92%	100%
8	29.0	248.0	11.69%	17.02%	15%	42.2	37.2	69%	78%
9	101.0	580.0	17.41%	18.29%	15%	106.1	87.0	95%	116%
10	184.0	783.0	23.50%	18.78%	20%	147.0	156.6	125%	117%
11	143.0	716.0	19.97%	18.81%	20%	134.7	143.2	106%	100%
12	123.0	679.0	18.11%	18.95%	20%	128.7	135.8	96%	91%
13	146.0	808.0	18.07%	19.07%	20%	154.1	161.6	95%	90%
14	175.0	931.0	18.80%	19.19%	20%	178.7	186.2	98%	94%
15	202.0	988.0	20.45%	19.58%	20%	193.4	197.6	104%	102%
16	180.0	964.0	18.67%	19.87%	20%	191.6	192.8	94%	93%
17	205.0	1,001.0	20.48%	20.20%	20%	202.2	200.2	101%	102%
18	181.0	901.0	20.09%	20.24%	20%	182.4	180.2	99%	100%
19	208.0	980.0	21.22%	20.65%	20%	202.4	196.0	103%	106%
20	226.0	956.0	23.64%	21.14%	20%	202.1	191.2	112%	118%
21	197.0	888.0	22.18%	21.58%	22%	191.6	195.4	103%	101%
22	203.0	841.0	24.14%	22.08%	24%	185.7	201.8	109%	101%
23	220.0	848.0	25.94%	22.53%	26%	191.0	220.5	115%	100%
24	377.0	1,214.0	31.05%	24.27%	30%	294.6	364.2	128%	104%
25	493.0	1,464.0	33.67%	24.85%	34%	363.8	497.8	136%	99%
26	288.0	1,177.0	24.47%	24.83%	25%	292.2	294.3	99%	98%
27	259.0	1,138.0	22.76%	25.37%	25%	288.7	284.5	90%	91%
28	244.0	1,065.0	22.91%	26.15%	25%	278.5	266.3	88%	92%
29	239.0	971.0	24.61%	26.85%	25%	260.7	242.8	92%	98%
30	220.0	848.0	25.94%	27.90%	25%	236.6	212.0	93%	104%
31	196.0	709.0	27.64%	28.95%	28%	205.3	198.5	95%	99%
32	174.0	593.0	29.34%	29.53%	28%	175.1	166.0	99%	105%
33	146.0	517.0	28.24%	29.50%	28%	152.5	144.8	96%	101%
34	126.0	445.0	28.31%	30.12%	28%	134.0	124.6	94%	101%
35	102.0	406.0	25.12%	30.33%	25%	123.1	101.5	83%	100%
36	95.0	398.0	23.87%	30.68%	25%	122.1	99.5	78%	95%
37	88.0	352.0	25.00%	30.66%	25%	107.9	88.0	82%	100%
38	56.0	299.0	18.73%	30.51%	25%	91.2	74.8	61%	75%
39	67.0	268.0	25.00%	31.14%	25%	83.4	67.0	80%	100%
Totals	**5,968.0**	**25,471.0**	**23.43%**	**23.23%**	**23%**	**5,917.6**	**5,983.9**	**101%**	**100%**
40 & Over	186.0	678.0	27.43%	31.13%	25%	211.0	169.5	88%	110%
Total	**6,154.0**	**26,149.0**	**23.53%**	**23.44%**	**24%**	**6,128.7**	**6,153.4**	**100%**	**100%**

**The current retirement assumption is based on replacement index. Values shown are the average in-force in the experience period.*

Of course, we leave the selection of OPEB-specific assumptions to the OPEB actuary's professional judgment.

Summary of Recommendations:

- Change 100% retirement rates to begin at age 85 vs. current age of 70.
- Separate assumptions public safety and general employee divisions.
- Minor changes to some rates based on credibility procedures as described.

Early Reduced Retirement

On a headcount-weighted basis, the actual number of early reduced retirements was 317 out of an exposure of 13,759 for a crude rate of 2.30% in total. (The corresponding crude rate on a liability-weighted basis was similar at 2.43%.) The number and crude rate of early retirements are nearly half of what was observed in the prior experience study when there were 698 retirements with a crude rate of 5.09%. We also note that the prior actuary increased the early retirement rates part way to the experience last time.

The actual number of early retirements in the aggregate is too small for full credibility. Moreover, establishing separate rates at different ages or service levels would require subdividing the data which would diminish the credibility even further. Give the low incidence of this decrement, we recommend selecting a single rate to apply in all cases of those eligible for early reduced but not yet unreduced retirement.

Under the current assumption, the weighted average expected rate of early retirements under the current assumption is 4.39% on a headcount-weighted basis and 4.31% on a liability-weighted basis. The analysis suggests that a lower rate would be appropriate. Given that the prior actuary increased the rate and the fact that the data is not fully credible, we recommend moving less than half way from the current assumption to the actual experience to avoid over-reacting to the current experience.

Summary of Recommendations:

- Simplify to 4% retirement rates at all eligible ages.

Withdrawal

For purposes of pension actuarial valuations, a withdrawal is a termination from employment prior to retirement which is not the result of a disability. This assumption is also sometimes referred to as the turnover assumption. Active participants may or may not be vested upon termination. Often, turnover is higher at younger ages or low service as individuals change careers and lower at higher ages or service as individuals get close to retirement.

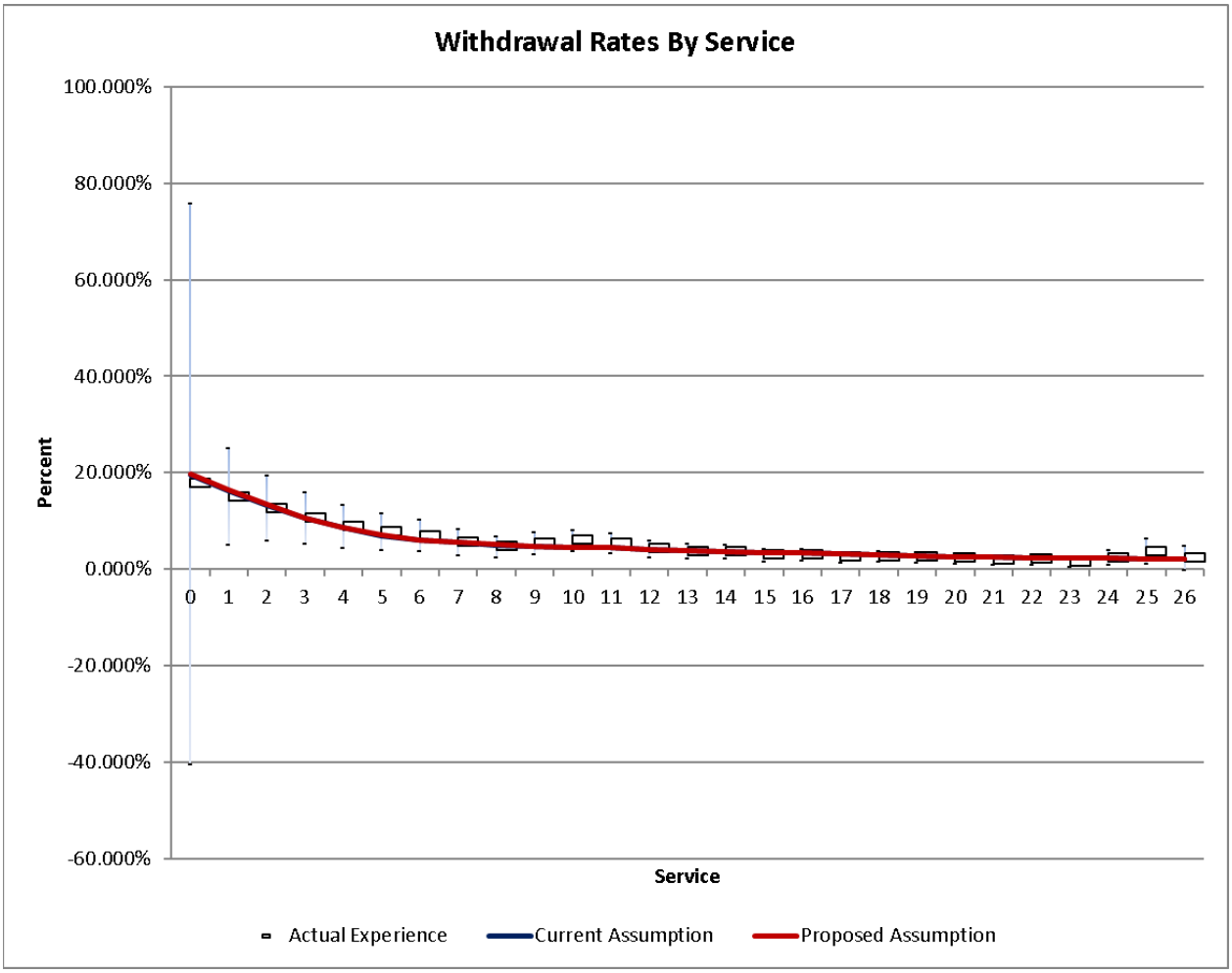
On a headcount-weighted basis, the A/E ratio for withdrawals is 117%, and on a liability-weighted basis it is 101%. Again, from the perspective of aligning the assumptions with gains and losses, we suggest performing the analysis on a liability-weighted basis. The A/E ratio of 101% in this case suggests that very little change in assumptions may be needed.

We can analyze the withdrawal decrement experience by age or service by comparing the variance of actual to expected experience in proportion to the exposures at each age or service level. The smallest variance is an indication of the best fit.

Analysis of Variance of (Actual – Expected)/Exposure – Withdrawal		
	Headcount-Weighted	**Liability-Weighted**
Age-Based	0.3%	0.4%
Service-Based	0.1%	0.0%

The service-based analysis has the lowest variance on both a headcount-weighted and liability-weighted basis. We suggest performing additional analysis on the basis of service.

If we examine the experience in total, in detail by service, we see the following picture.



The graph shows the 95% confidence intervals for each rate which are rather narrow. This indicates a good fit of the data to the average experience.

We suggest selecting the assumed rates as follows:

(1) Compute a service-based rate using the current age-based assumption in force for each service level;
(2) Apply a 101% scaling factor to compensate for the 101% A/E ratio on a liability-weighted basis;
(3) Round each assumption to the nearest tenth of a percent; and
(4) Preserve the generally decreasing trend of the rates by not allowing any proposed rate to be greater than the rate for the next lower service level.

Under this procedure, 97% of the rates in the proposed assumed fall within the 95% confidence interval. The advantages of this procedure are that it results in a tighter fit to the data and is non-increasing. The disadvantages of this procedure are that changing from an age-based to a service-based table may have very different effects on different employers depending on their demographic and some rates did not change in the same direction as the experience (e.g., experience was higher than assumed and the proposed rate went down or vice versa in some cases). In our view, cases listed in the disadvantages were isolated exceptions and likely were not indicative of a long-term pattern.

The detailed analysis for this assumption in the aggregate is shown in the table on the following page.

Withdrawal Experience - Liability Weighted									
All Divisions, Males and Females									
Service-Based Analysis, Liability Weighted									
				Sample Rates		Expected Retirements		Ratio of Actuals/Expecteds	
Service	Actual Withdrawals	Exposure	Crude Rates	Current*	Proposed	Current	Proposed	Current	Proposed
0	0.3	1.7	17.86%	19.60%	19.80%	0.3	0.3	91%	90%
1	7.7	50.7	15.14%	16.30%	16.50%	8.3	8.4	93%	92%
2	12.2	95.4	12.76%	13.30%	13.40%	12.7	12.8	96%	95%
3	14.4	134.5	10.72%	10.50%	10.60%	14.1	14.3	102%	101%
4	14.9	166.5	8.95%	8.60%	8.70%	14.3	14.5	104%	103%
5	15.6	199.7	7.82%	6.90%	7.00%	13.8	14.0	113%	112%
6	17.1	242.0	7.07%	6.00%	6.10%	14.5	14.8	118%	116%
7	16.5	292.5	5.63%	5.50%	5.60%	16.1	16.4	102%	101%
8	16.6	351.0	4.73%	5.00%	5.10%	17.6	17.9	95%	93%
9	22.4	407.0	5.50%	4.80%	4.80%	19.5	19.5	115%	115%
10	26.9	445.9	6.02%	4.60%	4.60%	20.5	20.5	131%	131%
11	26.4	488.7	5.41%	4.40%	4.40%	21.5	21.5	123%	123%
12	24.2	557.3	4.34%	4.00%	4.00%	22.3	22.3	109%	109%
13	24.6	646.2	3.80%	3.80%	3.80%	24.6	24.6	100%	100%
14	25.7	679.8	3.78%	3.60%	3.60%	24.5	24.5	105%	105%
15	21.6	709.9	3.05%	3.40%	3.40%	24.1	24.1	90%	90%
16	23.6	770.2	3.07%	3.30%	3.30%	25.4	25.4	93%	93%
17	20.5	794.5	2.57%	3.10%	3.10%	24.6	24.6	83%	83%
18	22.8	829.3	2.75%	2.90%	2.90%	24.0	24.0	95%	95%
19	20.8	812.9	2.56%	2.70%	2.70%	21.9	21.9	95%	95%
20	18.5	782.1	2.36%	2.60%	2.60%	20.3	20.3	91%	91%
21	15.5	761.9	2.04%	2.50%	2.50%	19.0	19.0	81%	81%
22	15.3	718.1	2.13%	2.40%	2.40%	17.2	17.2	89%	89%
23	10.1	663.1	1.52%	2.35%	2.40%	15.6	15.9	65%	63%
24	11.0	437.3	2.51%	2.30%	2.30%	10.1	10.1	109%	109%
25	7.9	205.3	3.83%	2.20%	2.20%	4.5	4.5	174%	174%
26	3.6	146.8	2.45%	2.20%	2.20%	3.2	3.2	111%	111%
27	3.8	93.7	4.08%	2.20%	2.20%	2.1	2.1	185%	185%
28	1.1	50.7	2.15%	2.20%	2.20%	1.1	1.1	98%	98%
29	0.8	28.1	2.76%	2.20%	2.20%	0.6	0.6	126%	126%
30	0.9	16.6	5.43%	2.20%	2.20%	0.4	0.4	247%	247%
31	-	8.2	0.00%	2.20%	2.20%	0.2	0.2	0%	0%
32	0.0	2.8	0.69%	2.20%	2.20%	0.1	0.1	31%	31%
33	0.1	3.2	4.27%	2.20%	2.20%	0.1	0.1	194%	194%
34	0.0	0.4	2.13%	2.20%	2.20%	0.0	0.0	97%	97%
35	-	0.7	0.00%	2.20%	2.20%	0.0	0.0	0%	0%
Totals	**463.3**	**12,594.9**	**3.68%**	**3.65%**	**3.66%**	**459.2**	**461.2**	**101%**	**100%**
36 & Over	0.4	0.4	94.07%	2.20%	2.20%	0.0	0.0	4276%	4276%
Total	**463.7**	**12,595.3**	**3.68%**	**3.65%**	**3.66%**	**459.3**	**461.2**	**101%**	**101%**

**The current retirement assumption is based on replacement index. Values shown are the average in-force in the experience period.*

All of this analysis is based on the current withdrawal assumption in the aggregate without any scaling factors applied for individual employers. Recall that the prior actuary set scaling factors for employers with more than 500 exposures during the experience study period for approximately 30 employers. New plans entering MERS have a procedure for setting a scaling factor. A more common approach to credibility theory uses the number of actual terminations, not the number of exposures. In order for a data set to be fully credible (defined as the actual rate being within 5% of expected with 95% confidence), the number of actual withdrawals would need to be 1,537. Using this measure, no employers are fully credible. In order to be even 50% credible, an employer would need to have had 384 withdrawals. There were only three such employers during this experience study period. Of those, no single division had sufficient withdrawals or five full years of experience in the study.

Instead of scaling factors under the prior method, we performed some additional analysis by type of employer, similar to the analysis for unreduced retirement. In particular, we examined hybrid plans, public safety (division codes 02, 05, 20-29, and 50-59) and all others separately. The results of the analysis are as follows:

Liability-weighted ($millions)

	Exposure	Actual	Expected	A/E
Hybrid	82.6	7.1	6.0	119%
Public Safety	4,879.1	114.2	162.4	70%
All Others	7,633.7	343.4	290.9	118%

There are many observations that we can make.

The Hybrid and all other groups have high A/E ratios indicating more withdrawals than expected. The public safety group has a materially lower A/E ratio. It is important to note that the Hybrid group is extremely small for this decrement so it likely should not be given undue weight. On the other hand, the public safety group is large enough to give their experience more weight.

Based on the liability-weighted ratios, we recommend applying separate termination rates to public safety and all other groups. Scaling the tables by the observed A/E ratio generally brings the A/E ratio closer to 100%, subject to rounding error. A full set of assumptions is included in the Appendix.

A final note on the analysis is that we examined male and female experience separately and did not find that it warranted separate assumptions.

Summary of Recommendations:

- Remove scaling factors.
- Separate assumptions public safety and general employee divisions.
- Minor changes to some rates.

Disability

The disability assumption only applies prior to retirement eligibility. The number of disabilities who were not retirement eligible (201) is too small to be fully credible. The A/E ratio was under 100% on a headcount-weighted basis and over 100% on a liability-weighted basis.

For members covered by Benefit Program D-2, 54% of disabilities were duty related compared to the current assumption of 60%.

For members not covered by Benefit Program D-2, 21% of disabilities were duty related compared to the current assumption of 20%.

Summary of Recommendations:

- We recommend no change to the disability assumptions.

Pre-Retirement Mortality

Actual pre-retirement mortality experience is significantly lower than assumed. There were only 229 active deaths during the experience study period, too few to be fully credible. This assumption can be difficult to analyze. Therefore, we recommend setting this assumption to be based on the Employee tables corresponding to the Healthy Retiree tables selected from the Pub-2010 assumption set. A full set of assumptions is included in the appendix.

Summary of Recommendations:

- We recommend changing to the Pub-2010 General Employees table without adjustment.
- We recommend no change to the non-duty/duty weighted, currently set at 90%/10% respectively.

Post-Retirement Mortality

Perhaps the most critical demographic assumption used in pension valuations is mortality. Rates of mortality affect our estimate of how long each individual is expected to live and consequently how long each individual is expected to receive a pension. Life expectancy in turn has a direct impact on pension plan liabilities.

Mortality rates have generally decreased over time in the U.S., meaning that life expectancies have generally increased over time. The assumption for future decreases in mortality is referred to as the mortality improvement assumption. In general, the mortality and mortality improvement assumptions are treated separately. The analysis in this section covers the period of 2014 through 2018. During this time, mortality improvement may have occurred. A general procedure is to adjust the actual experience for mortality improvements during the study period to the central year, in this case 2016. For purposes of this study, proposed mortality rates shown in the tables have been adjusted to the central year 2016 using the MP-2019 projection scales.

In January 2019, the Society of Actuaries (SOA) issued the final version of Pub-2010 Public Retirement Plans Mortality Tables. This is the first set of mortality rates published based on U.S. public sector experience. In this study, the SOA examined mortality for Teachers, Public Safety, and General employment categories. The SOA also studied mortality rates by gender, income (in total and separated into above and below median), and status (active employees, retirees, disabled retirees, and contingent survivors). As a consequence, there are over 90 Pub-2010 tables to select from.

In August 2018, the Society of Actuaries (SOA) reviewed the comprehensive annual financial reports of the majority of large public sector employees' retirement systems for a review of their mortality assumptions. The SOA report included analysis of certain annuity values under current assumptions and the new Pub-2010 tables. As can be seen in the charts, the majority of public sector plans would have higher annuity values (i.e., plan costs) under Pub-2010.

Public Plan Mortality Assumption Comparison

Figure 1

2018 AGE 55 ANNUITY FACTORS WITH PUB-2010 AND RP-2006

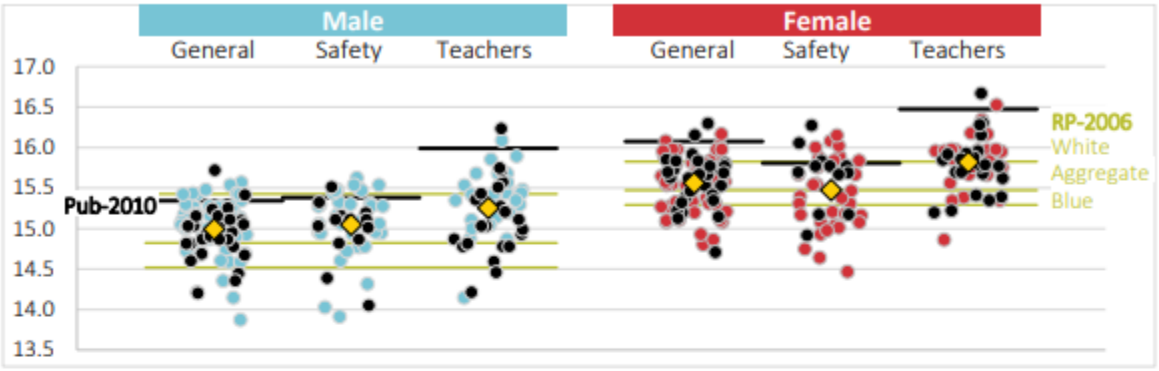


Figure 2

2018 AGE 65 ANNUITY FACTORS WITH PUB-2010 AND RP-2006

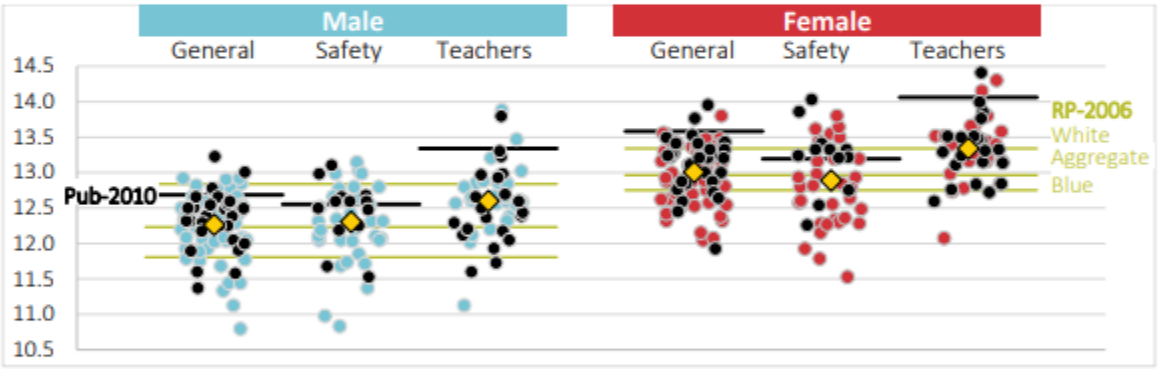
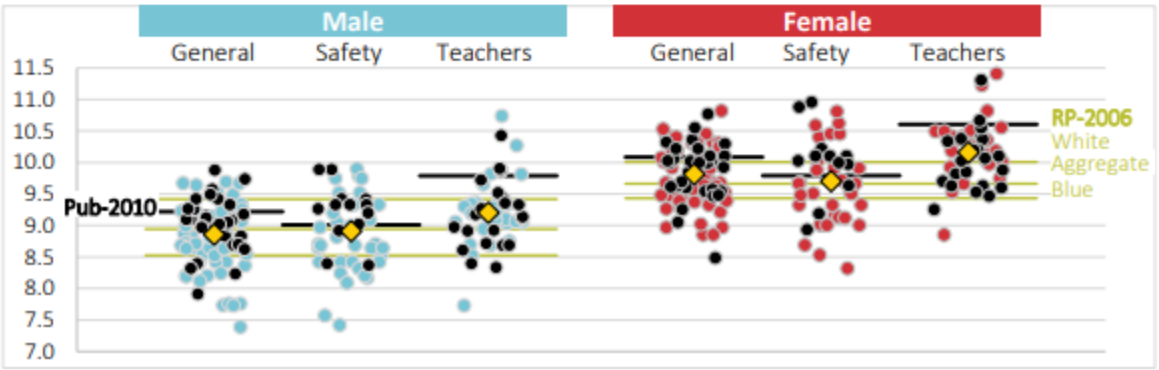


Figure 3

2018 AGE 75 ANNUITY FACTORS WITH PUB-2010 AND RP-2006



Legend

Black dots	Plans that use RP-2006 or RP-2014 mortality rates (possibly adjusted) in the base table
Blue/red dots	Plans that use neither RP-2006 nor RP-2014 mortality rates (adjusted or otherwise) in the base table
Yellow diamonds	Average of all plans in the job category, weighted one per plan
Black lines	Pub-2010 Mortality Tables (amount-weighted) generationally projected with Scale MP-2017
Green lines	RP-2006 Mortality Tables (amount-weighted) generationally projected with Scale MP-2017: white collar (top), aggregate (middle) and blue collar (bottom)
Assumptions	Monthly single life annuities beginning in 2018, computed at 7% interest with 2% annual benefit increases

In this analysis, we look at a subset of the tables illustrated in that study: PubG-2010 for healthy retirees and PubNS-2010 for disabled retirees. In certain cases, the Pub-2010 tables do not have rates below or above certain ages. In cases where rates are absent, we have extended the published tables with cubic splines or exponentials in a manner similar to the way the tables were created.

In terms of the income level, the demographics of MERS participants is more similar to the total SOA study population than to the above or below median subcategories. The current assumption is unisex based and was selected based on headcounts of mortality. We will examine sex-distinct rates and use a liability-weighted analysis. There are two reasons for using a liability-weighted approach. First, mortality experience across the U.S. has been shown to vary depending on income level. Liability-weighting takes into account differing benefit levels. Second, selecting an assumption based on headcount-weighting is consistent with estimating expected deaths, but selecting an assumption based on liability-weighting is consistent with minimizing gains and losses associated with expected deaths.

Based on our analysis of retiree mortality, the ratio of actual to expected deaths under the current assumption is 108% on a headcount-weighted basis as shown in the "A/E" column below. This indicates that there is still an 8% margin for mortality improvement on a headcount-weighted basis, a decrease of 2% from the prior experience study. However, on a liability-weighted basis, the A/E ratio is 98%, indicating there is no margin left in the current assumption. As mentioned earlier, a headcount-weighted margin provides for the *event* of future mortality improvement, a liability-weighted margin provides for *mitigating future gains and losses* from future mortality improvement.

Retired Participant Experience				
Decrement	**Exposures**	**Actual**	**Expected**	**A/E**
Healthy Mortality				
Headcount	144,339.0	3,671.0	3,387.4	108%
Liability (millions)	*35,654.7*	*471.2*	*481.2*	*98%*
Disabled Mortality				
Headcount	8,181.0	256.0	237.5	108%
Liability (millions)	*1,442.5*	*30.8*	*33.5*	*92%*

The A/E ratios for disabled lives of a headcount-weighted basis are similar; however, the liability-weighted A/E ratio is lower at 92%.

We recommend a version of the Pub-2010 Public Sector Mortality tables as published in January 2019 by the Society of Actuaries. There are separate tables for General, Public Safety, and Teachers. For purposes of valuing pension liabilities, it is generally more appropriate to scale these tables to MERS' experience on a liability-weighted basis rather than a headcount-weighted basis.

In the study that we performed last year, we applied the General and Public Safety tables to their respective populations without analysis of MERS' experience. In this analysis, we looked at the experience of General and Public Safety retirees separately and in total. For this purpose, Public Safety retirees are defined as those with division codes 02, 05, 20-29, 50-59. It is possible that some Hybrid divisions also include Public Safety participants, but that information was unavailable. Also, the Hybrid retiree data was too small to be credible (180 exposures, 3 deaths).

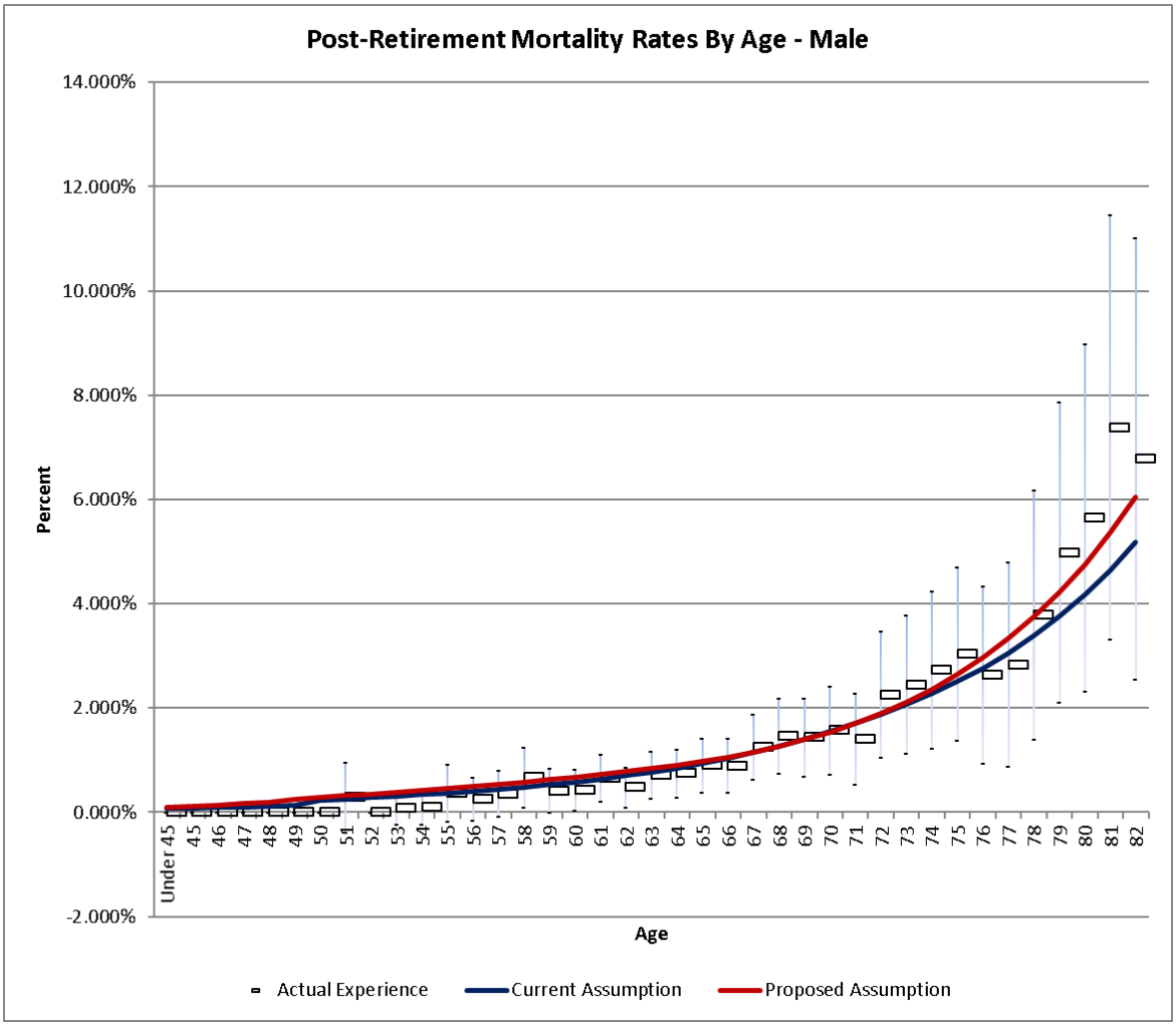
Liability-Weighted ($ millions)					
	Exposures	Expected	Actual	A/E	Adjusted A/E
Public Safety Retirees	9,192.67	97.75	102.19	105%	102%
All other Retirees	26,462.06	383.44	368.99	96%	96%
Total	35,654.73	481.19	471.17	98%	98%

The A/E ratio for Public Safety is slightly higher than all other retirees. We note that the number of actual Public Safety deaths is only 439, making them less than fully credible. If we perform a partial credibility adjustment, the adjusted A/E ratio for Public Safety is 102%, closer to the 96% for all other retirees. Given that the adjusted A/E ratio for Public Safety is not significantly different from the remainder of the population and that administrative complexity increases with multiple assumptions, we suggest using the same mortality assumption for public safety and other retirees.

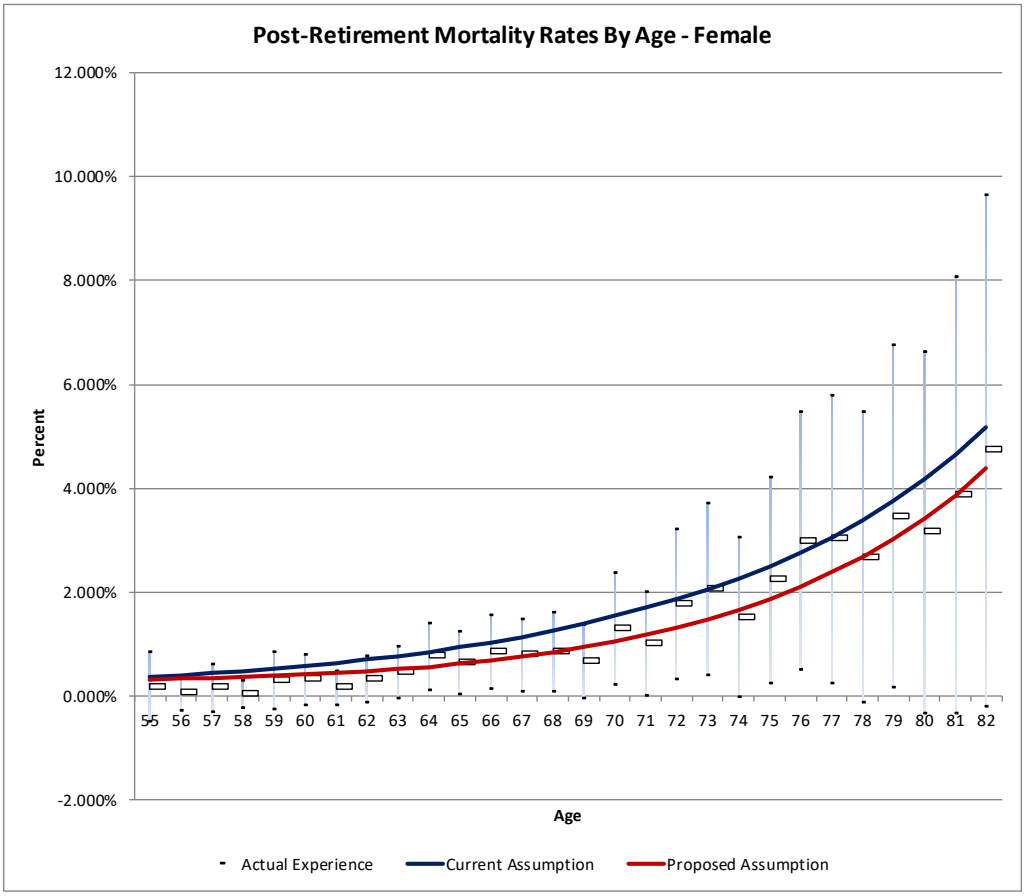
Based on this analysis and adjusting for mortality improvement during the study period, we recommend sex-distinct post-retirement mortality assumptions equal to 106% of the PubG-2010 healthy retiree table for General employees. This adjustment is to scale the base tables only and does not reflect any future mortality improvement. The analysis is shown in the following table for males. Analysis for females was similar, but less credible.

Please note, the proposed assumption columns in the analysis in the following table are the base mortality rates only and do not include mortality improvement. This results in proposed rates appearing higher than the current rates in the analysis since the current rates had a 10% static margin. A full set of assumptions is included in the Appendix.

Note that the Pub-2010 tables do not include rates at all ages. For purposes of selecting mortality rates that are not otherwise published, we use the corresponding Employee or Healthy Retiree rates as applicable.



Post-Retirement Mortality Experience All Divisions, Males Only Age-Based Analysis, Liability Weighted									
				Sample Rates		Expected Deaths		Ratio of Actuals/Expecteds	
Ages	Actual Deaths	Exposure	Crude Rates	Current	Proposed	Current	Proposed	Current	Proposed
Under 55	1.5	1,845.3	0.08%	0.25%	0.33%	4.7	6.0	31%	24%
56 - 60	15.5	3,594.4	0.43%	0.46%	0.55%	16.5	19.8	94%	78%
61 - 65	40.0	6,527.9	0.61%	0.72%	0.79%	46.9	51.4	85%	78%
66 - 70	70.8	6,047.1	1.17%	1.14%	1.15%	69.1	69.5	102%	102%
71 - 75	64.0	3,223.1	1.99%	1.84%	1.87%	59.4	60.1	108%	106%
76 - 80	51.5	1,551.0	3.32%	3.00%	3.27%	46.5	50.7	111%	102%
81 - 85	49.5	711.8	6.96%	5.06%	5.89%	36.0	41.9	138%	118%
86 - 90	31.3	271.9	11.50%	8.76%	10.42%	23.8	28.3	131%	110%
91 - 95	14.2	64.4	21.99%	14.65%	16.81%	9.4	10.8	150%	131%
96 - 100	2.1	7.7	26.98%	23.07%	25.43%	1.8	2.0	117%	106%
Over 100	0.1	0.2	58.44%	33.00%	35.65%	0.1	0.1	177%	164%
Total	**340.4**	**23,844.7**	**1.43%**	**1.32%**	**1.43%**	**314.1**	**340.6**	**108%**	**100%**



Post-Retirement Mortality Experience									
All Divisions, Females Only									
Age-Based Analysis, Liability Weighted									
				Sample Rates		Expected Deaths		Ratio of Actuals/Expecteds	
Ages	Actual Deaths	Exposure	Crude Rates	Current	Proposed	Current	Proposed	Current	Proposed
Under 55	0.2	414.0	0.06%	0.26%	0.25%	1.1	1.0	21%	23%
56 - 60	2.9	1,625.6	0.18%	0.46%	0.36%	7.5	5.9	38%	48%
61 - 65	15.1	3,435.8	0.44%	0.72%	0.49%	24.8	17.0	61%	89%
66 - 70	24.8	3,181.4	0.78%	1.14%	0.76%	36.3	24.1	68%	103%
71 - 75	26.4	1,753.3	1.50%	1.85%	1.30%	32.4	22.7	81%	116%
76 - 80	23.4	826.9	2.83%	3.00%	2.33%	24.8	19.3	94%	121%
81 - 85	17.5	377.9	4.62%	5.08%	4.28%	19.2	16.2	91%	108%
86 - 90	11.3	141.7	8.00%	8.73%	7.85%	12.4	11.1	92%	102%
91 - 95	7.1	45.6	15.48%	15.00%	13.85%	6.8	6.3	103%	112%
96 - 100	1.9	7.2	25.87%	23.07%	21.35%	1.7	1.5	112%	121%
Over 100	0.2	0.5	42.76%	32.46%	30.86%	0.2	0.2	132%	139%
Total	**130.8**	**11,810.0**	**1.11%**	**1.41%**	**1.06%**	**167.0**	**125.4**	**78%**	**104%**

Summary of Recommendations:

- We recommend changing to the recently issued Pub-2010 mortality General rates as published by the Society of Actuaries.
    - Scaled to MERS' experience on a liability-weighted basis. The base table rates are scaled by a factor of 106%.
    - Changed to sex-distinct assumptions.
- We recommend changing the disability mortality assumption to sex-distinct PubNS-2010 disabled tables.
- For vested deferred members, retiree mortality rates apply.

Mortality Improvement

Mortality improvement is a separate component of the mortality assumption. The current assumption assumes a static mortality improvement estimated to be 10% as of the last experience study. The alternatives for a new assumption are to have a new static assumption or apply fully generational mortality improvements. We recommend using the MP-2019 scale, published October 2019, the most current available. We recommend updating this assumption at each experience study.

As an alternative, the Board may wish to maintain the current practice of a 10% static margin.

The difference between a fully generational and static mortality improvement assumption is the approach of anticipating gradual increases in life expectancy over time. The fully generation method explicitly assumes gradual increases each year in the future. The static method assumes a stepped increase in life expectancy immediately. Both approaches are assumptions which predict that future mortality experience can and will differ from current expectations.

In the last few decades, actuaries have observed that static assumptions often have to be "reset" with each experience study, sometimes with significant impact. In theory, a fully generational assumption should need less significant "resetting" with each experience study,

The August 2018 SOA report on public plan mortality referred to above also included a summary of static and fully generational assumptions in use.

Table 2

MORTALITY PROJECTION: NUMBER OF PLANS

Projection Scale[11]	Job Category			Projection Type		
	General	Safety	Teachers	Generational	Static	None
AA	34	19	16	33	36	0
BB[12]	28	11	19	28	30	0
MP[13]	23	12	13	44	4	0
Other	2	2	4	6	2	0
None	3	4	2	0	0	9
Total	90	48	54	111	72	9

In summary, 111 plans use fully generational and 72 use static, roughly a 60%/40% split. It is important to keep in mind that many public plans perform 5-year experience studies over different time periods. The trend to changing to fully generational is somewhat new in the public sector. The SOA report was based on available information mostly through 2017. We expect that the proportion of plans adopting fully generational mortality improvement will continue to increase.

For purposes of the valuation, late retirement factors have been approximated based on the static mortality improvement assumption.

Summary of Recommendations:

- We recommend changing to the recently issued MP-2019 mortality improvement scale on a fully generational basis as published by the Society of Actuaries.
- As an alternative, a 10% static margin could be assumed by changing the scaling factor on the base table from 106% to 96%.

Pay Increases Due to Merit and Seniority

The valuation assumes rates of pay increases for each active participant each year. The current assumption consists of a wage inflation assumption of 3.75% per year and merit and seniority assumptions by age. Beginning with the December 31, 2019 actuarial valuation, the Retirement Board has adopted a wage inflation assumption of 3.00% per year. The purpose of this analysis is to focus on the merit and seniority components of individual pay increases.

Technically, pay increases due to merit and seniority are considered economic assumptions subject to ASOP No. 27. However, because the selection of this assumption is informed by reviewing MERS' demographic experience, we include it in this section of demographic assumptions.

In order to review individual merit and seniority increases, we first must separate the portion of total pay increases attributable to wage inflation. For purposes of this analysis, we estimate the wage inflation experience by all MERS participating employers during the experience study period. There are multiple ways of estimating actual wage inflation over a fixed historical period for a group. The approach that we use is to review the increase in average pay for all active participants from year to year during the experience study period. The aggregate experience is summarized as follows:

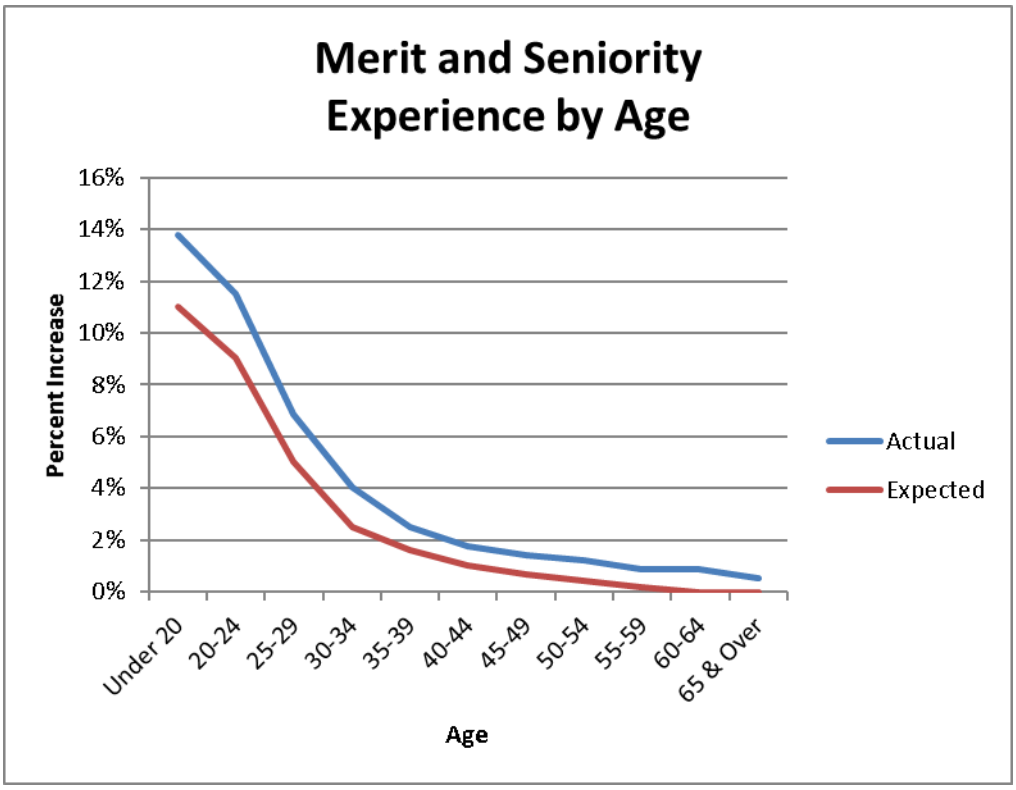
Valuation Date December 31	Number Active	Annual Payroll ($Millions)	Average Pay	Percent Increase
2013	34,809	$ 1,687	$ 48,476	
2014	35,302	1,744	49,397	1.9%
2015	35,274	1,787	50,656	2.5%
2016	34,843	1,780	51,084	0.8%
2017	34,787	1,812	52,102	2.0%
2018	33,891	1,813	53,488	2.7%
		Overall Average:		**2.0%**

The average increase during the experience study period was 2.00%. It is important to keep in mind that the actual wage inflation experience of 2.00% during this 5-year period does not necessarily invalidate the prior or current wage inflation assumptions of 3.75% or 3.00% (just as the actual investment return experience over a 5-year period does not necessarily invalidate an assumed rate of return). This analysis is not intended to be a review of the wage inflation assumption; rather, it is to determine a measure relevant to this experience study period to review the pay increases net of wage inflation.

We generally refer to pay increases net of wage inflation as real pay increases. We have performed analysis of real pay increases for the experience study period in two different ways: age-based rates, and service-based rates. The current assumption is an age-based assumption. Many municipalities in Michigan have pay structures that are service-based rather than age-based.

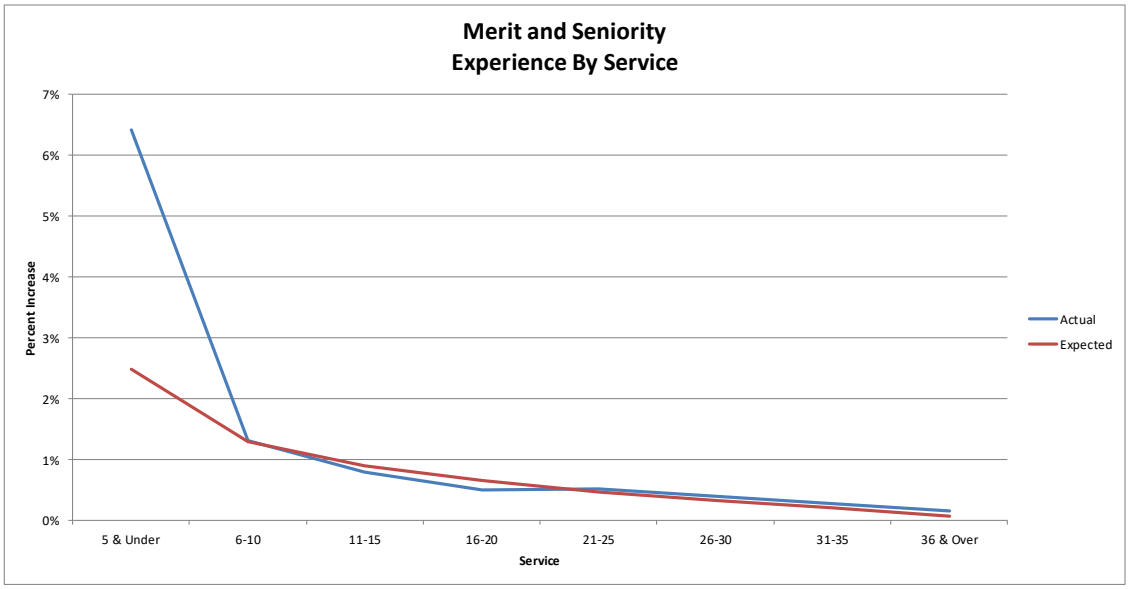
The results of our analysis of age-based real pay increases on are shown in the following table and graph.

Age Group Beginning of Year	Number	Net of Wage 2% Inflation	
		Actual	Expected
Under 20	118	13.81 %	11.00 %
20-24	3,385	11.53 %	9.06 %
25-29	9,939	6.88 %	5.02 %
30-34	13,995	4.05 %	2.52 %
35-39	17,285	2.49 %	1.63 %
40-44	21,272	1.76 %	1.04 %
45-49	25,220	1.40 %	0.68 %
50-54	25,745	1.23 %	0.42 %
55-59	22,412	0.86 %	0.19 %
60-64	11,428	0.89 %	0.00 %
65 & Over	3,702	0.51 %	0.00 %
Total	154,501		



Our general observations are that the actual increases are higher than expected increases at all ages. One possible explanation of this could be that our estimate of the wage inflation assumption is too low. Another explanation is that the differences between actual and expected increases are not uniform across all ages. A different analysis comes in the form of a service-based approach as shown on the next page.

Service Index Beginning of Year	Number	Net of Wage 2% Inflation	
		Actual	Expected
5 & Under	44,985	6.41 %	2.48 %
6-10	26,871	1.32 %	1.29 %
11-15	27,363	0.79 %	0.89 %
16-20	25,802	0.50 %	0.65 %
21-25	15,824	0.52 %	0.47 %
26-30	8,608	0.40 %	0.32 %
31-35	3,225	0.27 %	0.20 %
36 & Over	1,823	0.15 %	0.06 %
Total	154,501		



The "Expected" increase in this case is the average of the current age-based assumptions in effect for the various subgroups of the population by service index as shown. In this case, the graph clearly shows a convergence of the actual and expected increases for 6+ years of service. The actual increases for 5 years of service and under are materially higher than expected. In addition, the subgroup of active participants with 5 or fewer years of service makes up almost 30% of the total exposure. This subgroup is spread out over all the ages and consequently results in the higher actual age-based rates as seen in the age-based analysis.

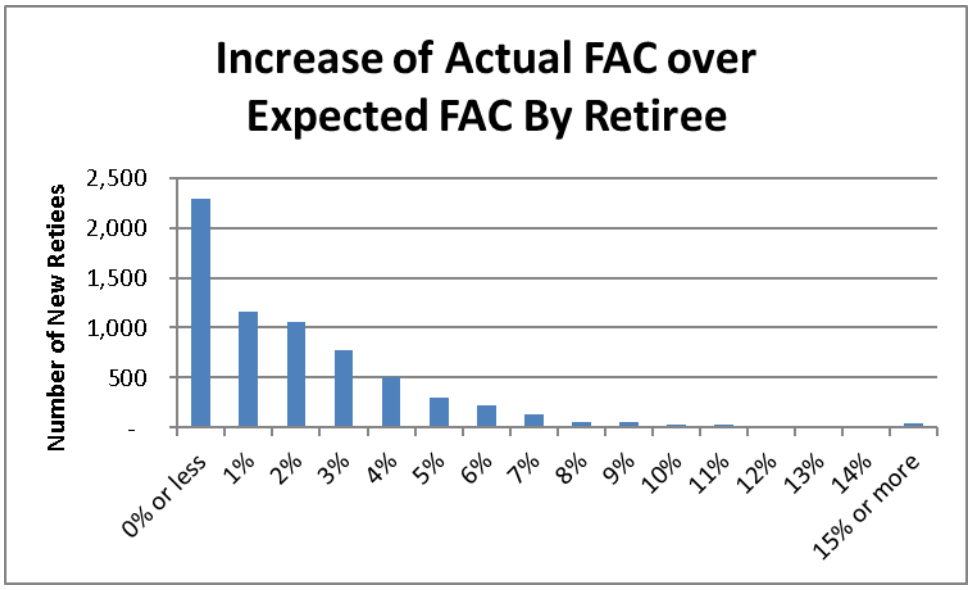
For a service-based approach, the pay changes in the first few years may not be fully reliable. Partial years of service for new hires may introduce distortions even if pays are annualized for new hires. We generally assign less weight to the experience observed in early years of service. For purposes of this analysis, we only consider those participants who were active at the beginning and the end of the year in a specific year of the study. In addition, we excluded a small number of frozen plan active participants and consolidated pay for duplicate records. A full set of assumptions is included in the Appendix.

Summary of Recommendations:

- We recommend changing to the service-based assumption.

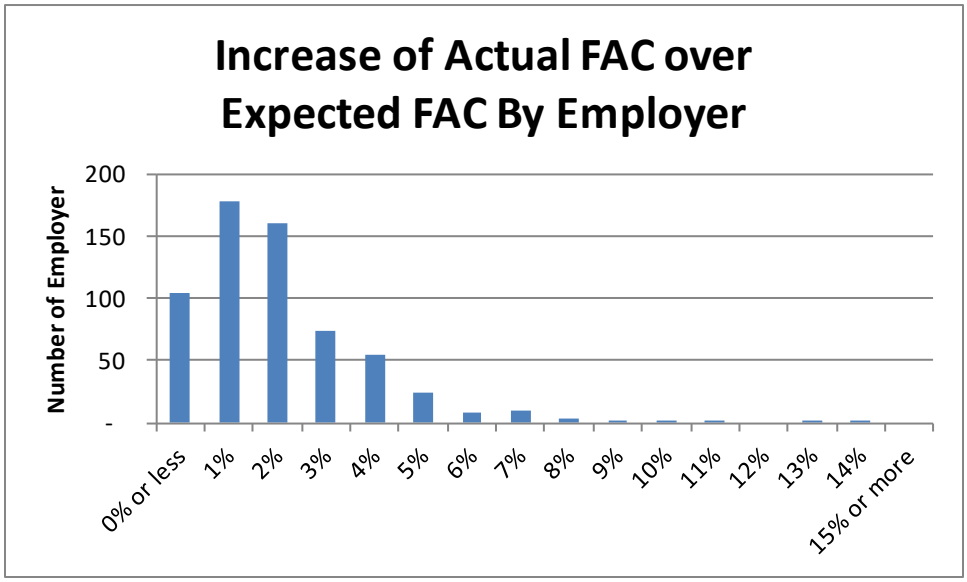
Increases in Final Average Compensation at Retirement

We have analyzed expected Final Average Compensation (FAC) vs. actual FAC for new retirees during the experience study period. Experience is generally similar to the last study in that the actual FAC is often higher than expected. For purposes of this analysis, the expected FAC is based on projected individual pay using valuation assumptions excluding any loads and subject to the minimum FAC as reported for the valuation.



Overall, the average increases were about 2% higher than expected, down somewhat slightly from the prior experience study which stated about a 3% increase. Our analysis includes divisions that have adopted base compensation as the definition of pensionable earnings. It is reasonable to expect that retirees with base compensation only would experience less volatility in their final average compensation and consequently not need a separate load for unexpected increases.

The average increase experienced by all employers was 2.1%.



As with other assumptions, we generally prefer to move part way from the current assumption to the recent experience. In some cases, there were very few retirements, if any, during the study period. In order to proceed, we established the following procedure for the experience study:

- Review each division with sick leave included in FAC separately;
- For divisions with compensation defined as base wages only, set the load to 0%;
- For all other divisions, apply a partial credibility factor to the actual experience based on the count of retirements during the study period as follows:

Count	Partial Credibility
0	0%
10	10%
25	20%
100	30%
160	40%
240	50%

- Round the resulting load to the nearest whole percent; and
- Restrict the load to a minimum of 1% and a maximum of 15%.

Based on this procedure, the change in FAC load for employers with active employees and compensation other than base wages changed as follows:

Change in FAC load	Count of Employers	Percent of Employers
More than 1% decrease	2	0%
-1.00%	15	2%
0.00%	526	73%
1.00%	180	25%
More than 1% increase	0	0%
Total	723	100%

We have reviewed the loads for 10 divisions that have adopted Sick Leave in FAC (SLIF) on a case-by-case analysis. Our review consisted of considering the maximum number of sick leave days allowed in proportion to a full year (260 days = 5 days per week X 52 weeks per year) divided by the number of years of final average earnings.

Summary of Recommendations:

- We recommend a 0% FAC load for base wages definitions of compensation.
- We recommend a minimum 1% FAC load for pay definitions other than base wages.
- We recommend reducing the number of separately rates scaling factors based on the procedure described.

Optional Forms of Payment and Marriage Assumption

The previous experience study observed 68% of males and 32% of females electing a J&S form of payment and indicated that the female percentage had increased from the prior study. We see this trend continuing with 68% of males and 37% of females electing a J&S form of payment.

	Count			Percent		
Electing	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
Percent Certain	133	157	290	4%	5%	4%
Joint & Survivor	2,356	1,264	3,620	68%	37%	53%
Benefit Program RS	79	55	134	2%	2%	2%
Straight Life	910	1,928	2,838	26%	57%	41%
Total	**3,478**	**3,404**	**6,882**	**100%**	**100%**	**100%**

For purposes of the valuation, the marriage assumption is currently 70% for both males and females for death-in-service. Due to the small number, data on actual deaths-in-service during the experience study period is not fully credible. Another approach to estimating marriage percentages is to study those retirees who were eligible for an automatic spousal survivor benefit but elected a life annuity:

	Male	Female	Total
Eligible for automatic J&S	368	144	512
Elected Life	57	36	93
Implied percent married	85%	75%	82%

This suggests the marriage assumption could be increased for the valuation and possibly could be different for males and females.

Summary of Recommendations:

- We recommend increasing the marriage assumption from 70% to 80%.

Future Service Accrual for Active Employees

Most active employees participating in a defined benefit or hybrid plan are full-time employees. In some circumstances, it is possible for an ongoing active member to earn less than a full year of service in a plan. Partial years of service without annualizing pay may result in calculations of final average compensation lower than that of a similarly situated individual earning full years of service.

The current valuation assumes that all active members will work a full year each year until retirement, termination, disability, or death. An assumption that overstates service accruals may – or may not – result in an overstated final average compensation estimate. On the other hand, late career conversions from part-time to full-time and/or service purchases may offset some of the impact of low service accruals in the final average compensation calculation.

In order to study the actual experience, we looked at service accruals for all active members who were active both at the beginning and end of a year during the experience study. During the experience study period, we observed 152,625 instances of members active at the beginning and end of a year in the study period. For those actives, the average benefit service earned was 0.989 years and the average eligibility service earned was 0.988 years. For both types of service, the result is very close to 1 year earned each year.

We did not have sufficient data to study conversions from part-time to full-time and/or actual service purchases during the study period. Each of these may result in actual end of career service accruals (or impact on final average compensation) that is higher than what is observed during employment. In some instances, this may warrant assuming average service accrual slightly higher than what was observed.

Since the current assumption of 1 year of service accrual each year is close to but slightly higher than the average service accrual observed, we recommend no change to this assumption.

Summary of Recommendations:

- No change.

DROP

Certain plans may adopt a Deferred Retirement Option Plan (DROP).

If a participant is covered by the Benefit Program DROP and is eligible for retirement, they have the option to elect a specified DROP period in which they will cease to accrue any additional retirement benefits, but remain employed by the participating municipality or court. The participant must elect a DROP period at least six months after the beginning date, but no more than sixty months after the beginning date, in one-month increments.

Upon the participant's election of DROP and the receipt of an application to enroll in DROP, MERS will calculate the participant's service retirement benefit at the time of entering the DROP. The Retirement System also shall calculate any age differential between the participant and the participant's beneficiary as of the calendar year of the DROP exit date in accordance with Treas. Reg. § 1.401(a)(9)-6. Upon the beginning date of the DROP period, the participant shall be responsible to continue employee contributions, if any.

On the next available benefit payment date after processing is complete, and monthly thereafter, an amount equal to 100% of the monthly service retirement benefit payment the participant would have received if he or she had retired as of the DROP beginning date will be credited to a notional account for the benefit of the participant. Funds in the DROP account are credited with interest in the amount of 3% annually, or prorated in the event of a DROP period that is less than twelve months.

Upon the end date, the participant shall receive a lump-sum distribution of the participant's DROP account and on the first day of the calendar month following end date, the participant will begin receiving monthly service retirement benefit payments.

From an actuarial valuation perspective, a DROP is generally considered a plan provision that is difficult to value under ASOP No. 4. This is because of the additional complexity of the member's choice of variable DROP periods at multiple possible future dates. The funding calculation is also complicated by the fact that member contributions are made to the plan during the DROP period but employer normal cost contributions are not. Additional provisions apply for terminating prior to the DROP end date, death and disability during the DROP period.

Active liability and present value of future benefits are loaded for potential future DROP elections. The DROP load is estimated for an affected division by examining the impact for one or more sample members assumed to stay in the DROP program for 3 years. At the end of the 3-year period, the member was assumed to receive their DROP account balance with interest and the monthly benefit in addition to future annual benefits. The result is then compared to what would have occurred had the member not entered the DROP.

Currently, no load is applied to the normal cost to reflect the fact that employer contributions stop but member contributions continue at DROP entry. Members in the DROP are treated as having retired immediately. No adjustment has been made for interest accruing during the DROP period, continued member contributions, or early termination.

We have reviewed the current DROP load for each division with the provisions. As of December 31, 2018, there is one division with a DROP: Employer 7301, Division 20. This division has 5 active members as of December 31, 2018. By itself, the group is too small to be credible for the purposes of analyzing the actual DROP experience during the 5-year study. Instead, for each active member we study the forward-looking impact of entering or not entering the DROP. For this analysis, we estimated the impact of the increase in present value of future benefits under various potential DROP election scenarios against the cost had the member not entered the DROP. The result of this analysis for the covered active population is as follows:

Estimated Increase in Total Cost			
	Years to DROP Entry after First Eligibility		
Years in DROP	1	3	5
1	1%	2%	3%
3	2%	5%	9%
5	5%	11%	18%

Based on this analysis, a load between 1% and 18% would be reasonable. For such a small group, a single load is sufficient and reasonable. The current load is 6%, which we believe to be appropriate, and recommend no change.

However, we recommend making a change to the application of the load, specifically that the load also apply to total normal cost, in addition to the present value of benefits and actuarial accrued liability. The rationale for this change is that the retirement rates are intended to be the last day of service and no employer contributions will be received during the DROP period. Increasing the normal cost will compensate for the potential lost employer normal cost contributions during the DROP period.

Since there is no explicit DROP entry assumption, there is no explicit adjustment for attribution to DROP under GASB. We recommend no change at this point.

New plans that implement a DROP will require a separate study to determine the appropriate load.

Summary of Recommendations:

- We recommend no change to the magnitude of the load.
- We recommend applying the load to the present value of benefits, actuarial accrued liability, and total normal cost for all active members.

DROP+

Certain plans have adopted a Deferred Retirement Option Plan (DROP) or a Delayed Retirement Option Partial Lump Sum (DROP+). DROP+ may not be adopted after June 30, 2013.

Any member who is eligible to retire with full, immediate retirement benefits has the option to:

(i) Retire immediately and receive a monthly benefit payable immediately; or
(ii) Delay their retirement date and continue to work.

If the member is covered by DROP+ and they retire at least 12 months after first becoming eligible for unreduced benefits, at actual retirement the member has the option to receive a partial lump sum and a reduced monthly benefit:

(i) The member can elect a lump sum equal to 12, 24, 36, 48, or 60 times their monthly accrued benefit (if they have delayed retirement at least that many months).
(ii) For each 12 months included in the lump sum, the member's lifetime benefit is reduced by the DROP+ percentage adopted by the employer. The employer can adopt any of the following DROP+ reduction percentages: 6%, 7%, 8%, 9% or 10%.

From an actuarial valuation perspective, a DROP+ may be considered a plan provision that is difficult to value under ASOP No. 4. The is because of the additional complexity of the member's choice of variable lump sums at multiple possible future dates.

For those covered by Benefit Program DROP+, we performed analysis for each plan to estimate the impact of various lump sum options at various retirement ages to determine an appropriate load. The load is currently applied to each active member present value of future benefits, actuarial accrued liability, and total normal cost.

As of December 31, 2018, there are two divisions with a DROP+: Employer 3501, Division 40 and Employer 6321, Division 02. These divisions have 1 active member and 11 active members respectively as of December 31, 2018. The groups are too small to be fully credible for the purposes of analyzing the actual DROP+ experience during the 5-year study. Instead, we study the forward-looking impact of the DROP+ under various scenarios for each division. The results of the analysis are as follows.

3501-40 – DROP+ (4%) has a current load of 22%. Our understanding is that the prior actuary estimated the impact of the DROP+ for the one individual in this plan by assuming he would retire 4 years after first eligible and take a lump sum of 48 times his monthly pension. We were able to reasonably replicate the 22% load under the current assumptions. Our analysis for the same individual results in a load slightly lower than 21% on consistent method. This is in line with expectations since the longer life expectancy moderately increases the value of the life annuity in proportion to the lump sum. We expanded this analysis to review similar loads for 12-60 month lump sums up to a possible retirement age of 65. The resulting range of loads is 5% to 30%. Given the wide range of loads, we believe the current load of 22% is reasonable and recommend no change.

6321-02 – DROP+ (4%) has a current load 16%. Our analysis for a sample individual (representative of the average characteristics of the group) results in a load slightly lower than 16% on consistent method with the prior actuary (assuming a 4-year deferral and a lump sum of 48 months). We expanded this analysis to review similar loads for 12-60 month lump sums up to a possible retirement age of 65. The resulting range of loads is 4% to 26%. Give the wide range of loads, we believe the current load of 16% is reasonable and recommend no change.

Summary of Recommendations:

- We recommend no change to the loads.

Annuity Withdrawal

An employer may adopt the Annuity Withdrawal Program (AWP). Under the AWP, a retiring member may elect to receive a refund of their accumulated member contributions with interest in a lump sum at retirement. The member's monthly pension would then be reduced by the actuarial equivalent of the lump sum payment. The employer has two options for the interest discount rate used to compute the actuarial equivalent reduction:

(i) The current investment return assumption used in the annual actuarial valuations (currently 7.35%); or
(ii) The most recent December 31 interest rate used for crediting interest on member contributions.

For those with T-Bill interest, the proposed 1-year T-Bill assumption discussed in Section IV of this report is 2.75%, down from 3.00%. The impact of this provision is dependent on the rate of interest and mortality assumption used to convert the annuity. We will not know for certain the administrative assumptions (in particular, mortality) adopted as a result of this experience study until well after this report is published. For purposes of this discussion and analysis, we have assumed a 50/50 unisex weighting of the retiree mortality with static improvement discussed in this report.

In the case when the interest for conversion is the valuation assumption of 7.35%, the conversion is generally considered actuarially equivalent and no adjustment is made in the valuation. Technically, there is a potential for anti-selection which means that an individual may elect this program with additional knowledge that could skew the actual experience. For example, if the administrative assumption uses the valuation mortality (with a unisex blend), that implies that each member electing this program will live an average lifetime. When many individuals elect this program and they have average experience, the cost is equally borne through the actuarial equivalent adjustment. However, an individual may have reason to believe that he or she may not live as long as the average member. In this case, if the member elects this program, he or she would receive a refund up front and a smaller benefit over a shorter lifetime – thus increasing the average cost of this benefit. As we have no reasonable method to analyze actual experience, we have made no adjustment for anti-selection.

In the case when the interest conversion is the T-Bill rate, the annuity withdrawal is effectively a subsidized benefit in the current low-interest environment. This is because the reduction received is based on a present value of the member account balance at the lower T-Bill rate. Therefore, the asset paid out has a higher value than the valuation liability released. The magnitude of this subsidy varies depending on the timing of an individual's retirement and the size of their accumulated member contributions relative to the accrued benefit. The current assumption includes a load on active liabilities for divisions with this provision. We performed analysis on a sample of affected individuals and observed potential increases between 5% and 15% per individual. Our proposed assumption moves inside this range.

Summary of Recommendations:

- We have reviewed this load with revised assumptions and recommend increasing the assumption for divisions with T-Bill interest conversion from 3% to 6%.

Death During Deferral

A retirement allowance shall be paid for life to the surviving spouse of a deceased vested former member if each of the following conditions is met:

(i) The vested former member was married to the surviving spouse at the time of death;
(ii) The vested former member had not named another individual as monthly pension beneficiary in the manner set forth in Section 35 at the time of death; and
(iii) The vested former member was not receiving any form of benefits from the System at the time of death.

Vesting liabilities are currently increased by 2% to reflect the value of the potential survivor benefit payable in case of death during the benefit deferral period. This assumption may be impacted by the change in the assumed rate of return and mortality assumptions. We have reviewed this assumption using the proposed mortality assumption and 7.35% assumed rate of return and recommend no change.

Summary of Recommendations:

- We recommend no change to this assumption.

Promotion Assumptions between Divisions

In some circumstances, active participants may transfer between divisions with different benefit formulas prior to retirement. For example, a promotion from police patrol to police command often results in a change in benefit formula. To the extent that past service benefits increase upon transfer and have not been funded, there will be an actuarial loss in the valuation.

In our review, we noted that the number of transfers between divisions, carve-ins, carve-outs, and other changes throughout the experience study period significantly complicated the analysis. In addition, information potentially connecting divisions which could be affected by promotion between divisions was not easily available.

For these reasons, we recommend not adopting any assumptions for valuation purposes at this time. The issue may be studied more in depth in the next experience study.

Summary of Recommendations:

- We recommend no change to this assumption.

Data Adjustments

There are certain data adjustments in the December 31, 2018 valuations. The adjustments vary from year to year based on the quality of the data received for the valuation. In general, data adjustments do not need to be formally adopted by the Board during the experience study as the actuary will need to make minor modifications in any given year.

Certain adjustments recur every year, some of which are described and reviewed below:

- The gender was not reported for a small number of active members. These active members are currently assumed to be male. We recommend changing this assumption to female which is slightly more conservative.

- Active members with frozen benefits had vesting and eligibility service incremented from the date of termination to the date of the valuation. We recommend no change to this assumption.

- Certain retirees were reported without a beneficiary date of birth. The current assumption is that in the event this data was necessary to value a retired liability, a 3-year age difference was assumed. We recommend no change to this assumption.

- Retired records reported with a recipient type of MEMB, optional form involving a joint and survivor, and beneficiary count of 0, were assumed to have the surviving beneficiary predecease the retiree. These records were valued as straight life. We recommend no change to this assumption.

- Terminated vested members may have defined contribution service which may be used towards eligibility for defined benefit retirement benefits. Currently, the additional defined contribution service is not reported for the annual actuarial valuation. To the extent that the data can be assembled and reported in a timely basis, we will consider adjusting retirement eligibilities for deferred vested participants in the valuation as appropriate.

Additional assumptions for missing or incomplete data may be needed from time to time with each annual actuarial valuation. Therefore, the data adjustments in this section are not intended to be an exhaustive list.

Summary of Recommendations:

- We recommend the changes as described above.

Miscellaneous and Technical Assumptions

Currently, there is a load to estimate the impact of split benefits when the benefit multipliers vary for annual final average compensation (FAC) above and below $4,200. We understand that this $4,200 threshold was established when annual compensation was significantly lower than today. In general, with higher compensation, the multiplier on FAC above the $4,200 threshold determines a majority of the benefit. Often, the difference in multipliers above and below the threshold is small. In the valuation, the benefit is first estimated at the multiplier above the threshold times the full FAC. The load is applied to estimate the impact of the multiplier applying below the threshold. This introduces additional complication to the model for a modest difference in cost estimates.

Summary of Recommendations:

- We recommend eliminating this load.

IV. Economic Assumptions

Overview

In the summer of 2018, we reviewed certain key economic assumptions used in the valuation: the assumed rate of return, the rate of wage inflation, and the rate of price inflation. The Board adopted a change in the assumed rate of return from 7.75% to 7.35% per year, net of expenses, and the wage inflation from 3.75% to 3.00% per year. Price inflation remains at 2.50% per year. The changes will be reflected in the December 31, 2019 annual actuarial valuations.

The following section is a summary of the analysis that was performed in 2018 as the basis for the Board's adopted changes on February 28, 2019. All information in this section is from 2018 and some elements may change over time. In our opinion, these assumptions continue to be reasonable. We may review these assumptions in depth in between the regularly scheduled 5-year experience studies and make recommendations from time to time.

The relevant Actuarial Standard of Practice (ASOP) for economic assumption setting is ASOP No. 27, Selection of Economic Assumptions for Measuring Pension Obligations. Under ASOP No. 27, an assumed rate of return is reasonable if it meets the following criteria:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experiences, observations of estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or other factors are included.

All economic assumptions are in this report are considered expectations of future experience as opposed to market-measures. The rationale for the selection and recommendation of each particular assumption is contained in a separate section.

Price Inflation

Price Inflation is the first building block for other economic assumptions. The assumed rate of inflation, as other economic assumptions, must be a forward-looking expectation of future experience. We survey multiple sources for future price inflation expectations over the next 30 years. A summary of this information is shown in the following table.

Forward-Looking Price Inflation Forecasts[a]	
Congressional Budget Office[b]	
5-Year Annual Average	2.20%
10-Year Annual Average	2.30%
Federal Reserve Bank of Philadelphia[c]	
5-Year Annual Average	2.20%
10-Year Annual Average	2.25%
Federal Reserve Bank of Cleveland[d]	
10-Year Expectation	1.97%
20-Year Expectation	2.14%
30-Year Expectation	2.26%
Federal Reserve Bank of St. Louis[e]	
10-Year Breakeven Inflation	2.10%
20-Year Breakeven Inflation	2.08%
30-Year Breakeven Inflation	2.10%
U.S. Department of the Treasury[f]	
10-Year Breakeven Inflation	2.10%
20-Year Breakeven Inflation	2.12%
30-Year Breakeven Inflation	2.17%
50-Year Breakeven Inflation	2.20%
100-Year Breakeven Inflation	2.23%
Social Security Trustees[g]	
Ultimate Intermediate Assumption	2.60%

[a] Version 2018-05-21 by Gabriel, Roeder, Smith & Company.
[b] *The Budget and Economic Outlook: 2018 to 2028*, Consumer Price Index (CPI-U), Percentage Change from Fourth Quarter to Fourth Quarter, 5-Year Annual Average (2018 - 2022), 10-Year Annual Average (2018 - 2027).
[c] *First Quarter 2018 Survey of Professional Forecasters*, Release Date: February 9, 2018, Headline CPI, 5-Year Annual Average (2018 - 2022), 10-Year Annual Average (2018 - 2027).
[d] Inflation Expectations, Model output date: March 1, 2018.
[e] The breakeven inflation rate represents a measure of expected inflation derived from X-Year Treasury Constant Maturity Securities and X-Year Treasury Inflation-Indexed Constant Maturity Securities. Observation date: March 1, 2018.
[f] *The Treasury Breakeven Inflation (TBI) Curve*, Monthly Average Rates, March, 2018.
[g] *The 2016 and 2017 Annual Reports of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*, Consumer Price Index (CPI-W), for 2019 and later.

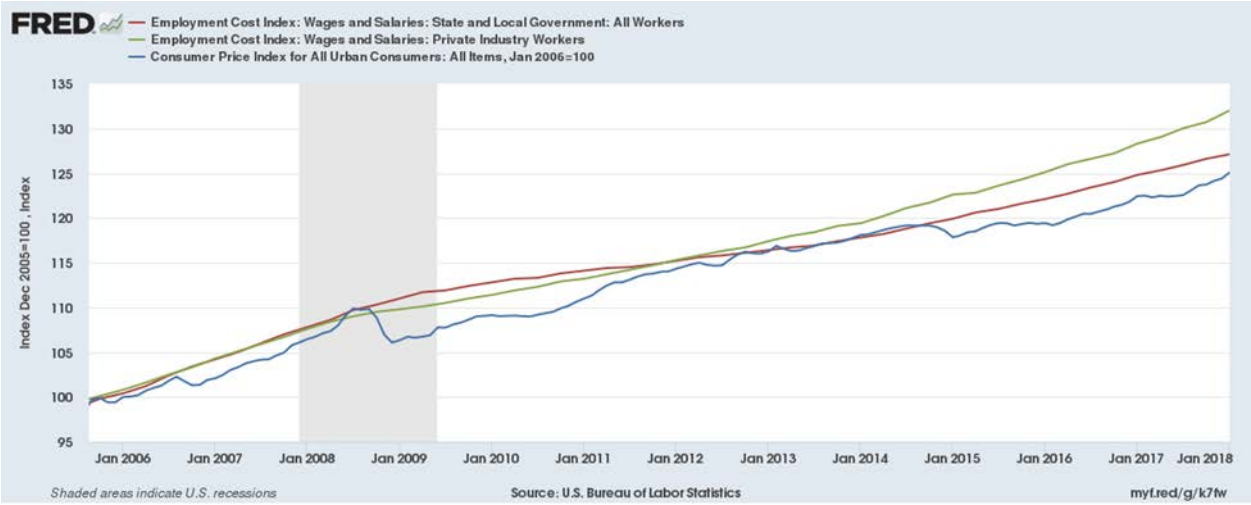
Based on this information, there is a continuing trend of lowering price inflation expectations. The current price inflation assumption is 2.50%. While it would be reasonable to lower the price inflation assumption given this new information, the current assumption of 2.50% is reasonable.

Wage Inflation

Macroeconomic theory suggests that wage inflation will generally exceed price due to productivity increases. Historically wages have traditionally exceeded prices by 50-100 basis point per year, however in recent years that spread has narrowed considerably. In general, it would be reasonable to expect wages to exceed prices by 25-75 basis points per year in the future.

Payroll growth for an active workforce with a constant headcount and stable demographics will generally be equal to wage inflation.

Based on the St. Louis Federal Reserve data from 2006 through 2018, wages for all U.S. employees grew at roughly 2.34% per year, wages for public sector employees grew at 2.02% per year, and price inflation grew at 1.88% per year over the 12 years. This suggests a spread of roughly 0.5% for all workers' wages over prices but only 0.1% for public sector workers wages over prices.



The current wage inflation assumption is 3.75%, corresponding to a spread of 1.25% over price inflation. We recommend lowering the wage inflation assumption to the range of 3.00% to 3.25%.

Assumed Rate of Investment Return

For purposes of budgeting contributions as a level percentage of payroll, the assumed rate of investment return is used as the discount rate to determine the present value of the System's pension obligations. It is important to note that an actuarial investment return assumption based on expected future experience is a single estimate for all years and therefore implicitly assumes that returns above and below expectations will "average out" over time. In other words, the expected risk premium is reflected in the assumed rate of investment return in advance of being earned, while the investment risk is not reflected until actual experience emerges with each valuation.

The assumed rate of investment return generally depends on factors such as plan's investment policy, asset allocation and capital market expectations.

Our analysis is based on the GRS Capital Market Assumption Modeler (CMAM). GRS is a benefits consulting firm and we do not develop or maintain our own capital market expectations. As such, we request and monitor forward-looking expectations developed by several major investment consulting firms. We update our CMAM on an annual basis. The capital market assumptions in the 2018 CMAM are from the following investment consultants (in alphabetical order): Aon Hewitt, BNY Mellon, Callan, JPMorgan, Marquette Associates, Mercer, NEPC, PCA, RVK, Summit Strategies, Voya and Wilshire. We believe the benefit of performing this analysis using multiple investment consulting firms is to recognize the uncertain nature of the items affecting the selection of the investment return assumption.

While there may be differences in asset classes, investment horizons, inflation assumptions, treatment of investment expenses, excess manager performance (i.e., alpha), etc., we have attempted to align the various assumption sets from the different investment consultants to be as consistent as possible.

To the best of our ability, we have adapted the MERS Investment Policy to fit with the twelve consultants' assumptions adjusting for these known differences in assumptions and methodology. In the following charts, all returns are net of investment expenses and administrative expenses and have no assumption for excess manager performance (alpha) in excess of active management fees.

For purposes of this analysis, we have reviewed the following investment allocation based on the Board's Investment Policy adopted in December 2016:

Asset Class	Target Allocation
Global Equity	55.5%
Global Fixed Income	18.5%
Real Assets	13.5%
Diversifying Strategies	12.5%
Total	100.0%

The assumed rate of return is computed net of expenses for funding purposes and net of investment expenses for GASB No. 68 employer reporting purposes. For this reason, before we study the expected return, we review the recent history of plan expenses. We received the following information from MERS on administrative expenses.

Year Ended*	Assets	Admin Expenses	Invest Expenses	Adm & Inv Exp	Admin Basis Points	Invest Basis Points	Total Basis Points
09/30/80	394,885,274	542,361	460,979	1,003,340	13.73	11.67	25.41
09/30/81	473,715,111	513,887	392,345	906,232	10.85	8.28	19.13
09/30/82	548,122,818	561,177	548,275	1,109,452	10.24	10.00	20.24
09/30/83	651,135,080	582,223	728,725	1,310,948	8.94	11.19	20.13
09/30/84	746,453,353	659,608	857,670	1,517,278	8.84	11.49	20.33
09/30/85	837,938,377	778,321	1,529,293	2,307,614	9.29	18.25	27.54
09/30/86	964,090,578	928,801	1,196,274	2,125,075	9.63	12.41	22.04
09/30/87	1,092,671,095	910,040	2,471,908	3,381,948	8.33	22.62	30.95
09/30/88	1,165,122,101	914,648	2,197,064	3,111,712	7.85	18.86	26.71
09/30/89	1,255,230,749	1,189,232	2,291,843	3,481,075	9.47	18.26	27.73
09/30/90	1,346,715,902	1,523,349	2,467,774	3,991,123	11.31	18.32	29.64
09/30/91	1,438,458,004	1,718,039	2,902,810	4,620,849	11.94	20.18	32.12
09/30/92	1,570,034,180	1,750,588	2,899,786	4,650,374	11.15	18.47	29.62
09/30/93	1,707,989,818	1,823,530	3,457,904	5,281,434	10.68	20.25	30.92
09/30/94	1,818,706,923	1,891,936	3,479,578	5,371,514	10.40	19.13	29.53
09/30/95	1,939,872,717	1,980,158	4,153,854	6,134,012	10.21	21.41	31.62
09/30/96	2,216,691,984	2,263,686	6,129,111	8,392,797	10.21	27.65	37.86
12/31/97	3,003,527,525	5,526,846	9,337,147	14,863,993	18.40	31.09	49.49
12/31/98	3,411,188,529	4,871,240	7,303,529	12,174,769	14.28	21.41	35.69
12/31/99	3,941,864,651	5,484,487	7,020,430	12,504,917	13.91	17.81	31.72
12/31/00	3,788,886,471	6,488,045	7,889,922	14,377,967	17.12	20.82	37.95
12/31/01	3,647,820,869	5,756,722	8,288,704	14,045,426	15.78	22.72	38.50
12/31/02	3,285,304,333	7,002,946	8,882,639	15,885,585	21.32	27.04	48.35
12/31/03	4,071,997,180	8,049,500	9,738,809	17,788,309	19.77	23.92	43.68
12/31/04	4,619,495,661	9,957,057	12,061,649	22,018,706	21.55	26.11	47.66
12/31/05	4,907,441,995	11,557,044	16,500,475	28,057,519	23.55	33.62	57.17
12/31/06	5,590,042,692	12,540,010	17,032,361	29,572,371	22.43	30.47	52.90
12/31/07	6,066,336,985	13,903,553	21,268,479	35,172,032	22.92	35.06	57.98
12/31/08	4,512,260,955	16,364,800	17,725,760	34,090,560	36.27	39.28	75.55
12/31/09	5,276,645,338	18,792,644	18,020,598	36,813,242	35.61	34.15	69.77
12/31/10	5,973,038,840	20,951,372	20,093,406	41,044,778	35.08	33.64	68.72
12/31/11	5,937,904,259	22,069,613	19,164,458	41,234,071	37.17	32.27	69.44
12/31/12	6,872,454,000	24,412,000	16,702,000	41,114,000	35.52	24.30	59.82
12/31/13	7,676,016,000	20,271,000	18,930,000	39,201,000	26.41	24.66	51.07
12/31/14	8,066,387,602	17,803,722	16,228,382	34,032,104	22.07	20.12	42.19
12/31/15	7,886,586,000	17,665,000	19,399,000	37,064,000	22.40	24.60	47.00
12/31/16	8,473,498,000	17,446,000	15,253,000	32,699,000	20.59	18.00	38.59
12/31/17	9,476,123,000	17,389,000	12,702,000	30,091,000	18.35	13.40	31.75

The average administrative expense over the last 20 years was 24 basis points. If administrative expenses are not reimbursed by the employers through contributions, they must be netted out of the assumed rate of return. The current assumption is 0.25% for administrative expenses for adjusting the assumption between funding and GASB. We recommend leaving this assumption unchanged. For purposes of the analysis of return expectations, we use 0.24% in the analysis below.

We continue with our analysis of the assumed rate of return.

The arithmetic expected return developed from this asset allocation is shown in the table below. The CMAM begins with the nominal expected return from each consultant (column 2), takes out each consultant's price inflation assumption (column 3) to arrive at the real return (column 4). We then incorporate a proposed price inflation assumption of 2.50% (column 5) to get the adjusted nominal return (column 6). Administrative expenses paid out of trust assets which are not reflected in the employer contributions (column 7) are netted out of the return. The final arithmetic expected return is shown in column 8. Note that the arithmetic return is in general higher than the median return due to compounding effect of random returns. In general, the difference between the arithmetic and median return will be larger for larger standard deviation of returns. We have shown the standard deviation of returns as the investment risk in column 9.

ASOP No. 27 acknowledges that for any given economic assumption, there is a reasonable range of opinions on that assumption. This is evident from the summaries we show from our CMAM.

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Plan Incurred Administrative Expenses	Expected Nominal Return Net of Expenses (6)-(7)		Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		(9)
1	6.42%	2.20%	4.22%	2.50%	6.72%	0.24%	6.48%		13.41%
2	6.93%	2.26%	4.67%	2.50%	7.17%	0.24%	6.93%		12.33%
3	7.32%	2.50%	4.82%	2.50%	7.32%	0.24%	7.08%		15.21%
4	6.91%	2.00%	4.91%	2.50%	7.41%	0.24%	7.17%		12.33%
5	7.05%	2.00%	5.05%	2.50%	7.55%	0.24%	7.31%		13.41%
6	7.64%	2.50%	5.14%	2.50%	7.64%	0.24%	7.40%		14.54%
7	7.41%	2.21%	5.19%	2.50%	7.69%	0.24%	7.45%		14.55%
8	7.62%	2.31%	5.31%	2.50%	7.81%	0.24%	7.57%		13.86%
9	7.65%	2.26%	5.39%	2.50%	7.89%	0.24%	7.65%		16.58%
10	7.75%	2.25%	5.50%	2.50%	8.00%	0.24%	7.76%		16.38%
11	7.53%	1.95%	5.58%	2.50%	8.08%	0.24%	7.84%		14.03%
12	8.55%	2.00%	6.55%	2.50%	9.05%	0.24%	8.81%		11.81%
Average	**7.40%**	**2.20%**	**5.19%**	**2.50%**	**7.69%**	**0.24%**	**7.45%**		**14.04%**

The average expected nominal return from column 8 is 7.45%. This is the average arithmetic rate of return. Note that the arithmetic rate of return represents the average future expected return which is higher than the median future expected. Setting the valuation assumption at the arithmetic expected return means that over time the average accumulated assets are expected to grow at this rate. However, in any given year it is less than 50% likely that this return will be achieved. From the perspective of the Actuarial Standards of Practice, this may be considered a reasonable assumption. Adjusting to the median return (as we do below) is also a reasonable assumption.

Next, we compare the probabilities of achieving returns over a 20-year horizon. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the current assumption of 7.75% and three alternative assumptions of 7.50%, 7.25% and 7.00% over a 20-year horizon. Note that the investment horizon for most of the capital market assumption sets is between 5 and 10 years. For purposes of this analysis, no adjustment has been made to return expectations for 20 years. This implies that the second 10 years are expected to have the same distribution of returns as the first 10 years. A different assumption would result in a different distribution of returns[1].

[1] We requested capital market assumptions over a longer horizon from each of the twelve investment consultants. Three of the investment consultants provided capital market assumptions over a period of 20 or 30 years, the other nine did not provide assumptions over a period longer than 10 years. Each of the three that provided assumptions over a longer horizon had different expectations after the first 10 years. However, two of those three indicated that return expectations after the 10th year were set based on historical return experience, as opposed to a market-based or forward-looking methodology that is predominately used in the development of the 10-year expectations. The third investment consultant did not describe a difference in methodology for the longer horizon.

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of exceeding	Probability of exceeding	Probability of exceeding	Probability of exceeding
	40th	50th	60th	7.75%	7.50%	7.25%	7.00%
(1)	(2)	(3)	(4)	(5)	(6)	(6)	(6)
1	4.90%	5.65%	6.40%	24%	27%	30%	32%
2	5.53%	6.22%	6.92%	29%	32%	35%	39%
3	5.17%	6.01%	6.87%	30%	33%	36%	38%
4	5.78%	6.47%	7.16%	32%	35%	39%	42%
5	5.73%	6.48%	7.23%	33%	37%	40%	43%
6	5.62%	6.43%	7.24%	34%	37%	40%	43%
7	5.67%	6.48%	7.30%	35%	38%	41%	44%
8	5.92%	6.69%	7.47%	37%	40%	43%	46%
9	5.48%	6.40%	7.33%	36%	38%	41%	43%
10	5.63%	6.54%	7.46%	37%	40%	42%	45%
11	6.15%	6.94%	7.72%	40%	43%	46%	49%
12	7.51%	8.17%	8.84%	56%	60%	64%	67%
Average	**5.76%**	**6.54%**	**7.33%**	**35%**	**38%**	**41%**	**44%**

The 50th percentile return is also related to the geometric average return. The geometric average of a sequence of returns over a number of years is the compound average of those returns over the number of years compounded. As the number of years in the geometric average increase and if the distributions of returns each year are independent and identically distributed, then the geometric average will converge to the median return. The median return is a reasonable rate of return for purposes of the valuation. The average of 50th percentile returns is 6.54 % per year.

Summary of Results

Our analysis generally indicates forward-looking expectations lower than currently assumed for price inflation, wage inflation, and the assumed rate of return. The analysis generally provides a range of outcomes for each assumption. The following table summarized our preferred range of assumptions. It is important to note that an assumption outside of the preferred range is not necessarily unreasonable under ASOP No. 27.

Preferred Range of Expectations	Price Inflation	Wage Inflation	Assumed Rate of Return
Low End of Range	2.25%	2.25%	6.50%
Midpoint	2.50%	2.88%	7.00%
High End of Range	2.75%	3.50%	7.50%
Current Assumption	2.50%	3.75%	7.75%

Note that the range for the assumed rate of return is between the median and the arithmetic return (rounded) from the analysis based on a price inflation assumption of 2.50%. A price inflation assumption other than 2.50% would result in a different range.

As mentioned in the overview to this section, in 2018 the Board adopted a change in the assumed rate of return from 7.75% to 7.35% per year, net of expenses, and the wage inflation from 3.75% to 3.00% per year. Price inflation remains at 2.50% per year. The changes will be reflected in the December 31, 2019 annual actuarial valuations.

Additional Analysis

There are certain additional economic assumptions used in the valuation that were not included in the 2018 analysis. Our recommendations for additional economic assumption changes are as follows:

Interest on Member Contributions

Interest on member contributions is based on the T-Bill rate. The current assumption is 3.00% and the rationale given in the last experience study was to consider it with respect to the price inflation assumption. Under the revised wage inflation assumption of 3.00% as adopted by the Board, we recommend lowering the T-Bill interest assumption to 2.75%, which is between the wage and price inflation assumption.

Maximum Deferral and Compensation Limit Increases

The Internal Revenue Code Section 415(b) and 401(a)(17) limits are increased each year under federal statute. The amount of future increase depends on actual price inflation. The current assumption is that limits will increase with wage inflation. We suggest changing from wage inflation to price inflation: 2.50%. This change is consistent with the statutory methodology for updating limits.

CPI-Based COLAs

Certain divisions have benefit COLAs that are indexed to the Consumer Price Index (CPI) limited to 3% or 4%. The proposed CPI assumption is 2.5% per year. It is possible that even if the average CPI is 2.5% over a number of years that the limited CPI may differ. We have estimated the potential difference with a stochastic, lognormal model of projected CPI over 10 years with expected CPI of 2.5% and standard deviation of 1%. Based on this analysis, the limited CPI on average would be 2.30% if capped at 3% and 2.47% if capped at 4%.

The current assumption is to assume the annual COLAs of this type will be 2.5% per year. We believe this assumption is reasonable and recommend making no change.

V. Actuarial Methods

Actuarial Cost Method

The pertinent ASOP for actuarial cost methods and amortization methods is ASOP No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions. The ASOP is currently under revision. The pertinent ASOP for the asset valuation method is ASOP No. 44.

For purposes of this experience study, we review the methods within the context of the current ASOPs. For both the actuarial cost method and the amortization method, we conclude the discussion with a brief summary of the most recent proposed changes to ASOP No. 4. We will not know the final changes to ASOP No. 4 until the Actuarial Standards Board has adopted the final version which is expected to take some time. It is likely that the updated standard will be finalized after this experience study is completed, but before the next five-year experience study is scheduled to start. One the ASOP is finalized, we will notify the Board of any required changes for the annual actuarial valuations.

The preliminary actuarial calculation for each member in the valuation is to compute the present value of future benefits based on the plan provisions and adopted actuarial assumptions. An actuarial cost method is a process for spreading the present value of benefits over time based on the funding objectives of the Board. An actuarial cost method generally determines a normal cost – the portion of the present value of future benefits allocated to the current year – and may also determine an actuarial accrued liability - the portion of the present value of future benefits allocated to past service. All three calculations, the present value of future benefits, the normal cost, and the actuarial accrued liability, are critical components of the funding valuation.

Section II, 1 of the MERS Actuary Policy as of April 25, 2019 identifies MERS' funding policy goals of adequacy, equity, contribution stability, transparency and governance. The actuarial implementation of these goals is to select an actuarial cost method that achieves the following major objectives:

- Develop level required contribution rates as a percentage of payroll (for divisions that are open to
- new hires);
- Finance benefits earned by present employees on a current basis;
- Accumulate assets to enhance members' benefit security;
- Produce investment earnings on accumulated assets to help meet future benefit costs;
- Make it possible to estimate the long-term actuarial cost of proposed amendments to System
- provisions; and
- Assist in maintaining the Retirement System's long-term financial viability.

The basic funding objective is a level pattern of cost as a percentage of pay throughout each member's working lifetime.

The funding method used in this actuarial valuation – the entry age normal cost method – was first used for the December 31, 1993 actuarial valuations and is intended to:

(i) Meet this funding objective; and
(ii) Result in a relatively level long-term contribution requirement as a percentage of pay.

Under the entry age normal cost method, the total actuarially-determined contribution requirement is equal to the sum of the normal cost plus the payment required to fund the unfunded actuarial accrued liability over a period of years. Funding or amortizing the unfunded actuarial accrued liability includes a payment toward the liability (principal) plus a payment to reflect the time value of money (interest).

Normal Cost

In general terms, the normal cost is the cost of benefit rights accruing on the basis of current service. Technically, the normal cost rate is the level percentage-of-pay contribution required each year, with respect to each member, to accumulate over their projected working lifetime the reserves needed to meet the cost of earned benefits. The normal cost represents the ultimate cost of the Retirement System, if the unfunded liability is paid up and the actual experience of the System conforms to the assumptions.

For purposes of Plan funding and State reporting, the normal cost for each member is calculated based on the prospective benefit formula for that member (referred to as the replacement life method). For accounting purposes, the normal cost for each member is calculated as the level contribution over the member's entire career which is anticipated to accumulate to the value of benefits at the end of the career.

Actuarial Accrued Liability

The total actuarial present value of future benefits is computed using the valuation's actuarial assumptions.

Subtracting the present value of future normal costs results in the actuarial accrued liability.
The total actuarial accrued liability essentially represents the amount that would have been accumulated as of a given valuation date, if:

(i) Contributions sufficient to meet the normal costs of the Retirement System had been made each year in the past;
(ii) Benefit provisions had always been the same as current benefit provisions; and
(iii) Actual past experience had always conformed to current actuarial assumptions.

If assets equaled the total accrued liability, there would be no unfunded liability and future contribution requirements would consist solely of the calculated normal cost rates.

In our opinion, the entry age normal actuarial cost method is appropriate for the purpose of the funding valuations.

Treatment of Ad Hoc COLAs

In reviewing the actuarial cost method, we reviewed the treatment of ad hoc COLAs. An ad hoc COLA is one that is not fixed in the plan provisions, but periodically adopted by an employer. Currently, substantively automatic COLAs are valued in the GASB liabilities but not the funding liabilities. Changing this method would potentially have implications on how benefit COLAs are currently funded.

Currently, these types of COLAs are generally funded with an employer contribution equal to the change in actuarial accrued liability determined by a supplemental valuation each year they are adopted. To the extent these ad hoc COLAs recur regularly, an argument can be made that the employer should pre-fund future COLAs as if they will continue to occur with the same regularity. This could be modeled in the valuation by assuming a permanent COLA in proportion to the frequency of the regularly adopted COLAs. As a result, the actuarial accrued liability and normal cost would increase. The change in actuarial accrued liability would be amortized over a number of years as a method change. Consequently, the funded ratio would decrease and employer contributions would increase.

This would be a fundamental change in funding ad hoc COLAs. To a certain extent, it would make permanent a process that is currently ad hoc. We recommend exploring the implications of such a change before considering changing the actuarial method. Currently, we expect this would affect only a handful of divisions.

Plan Administrative Expenses

Another consideration is the treatment of plan expenses. For purposes of funding, all plan expenses are assumed to be paid by the system's investment return. In other words, the assumed rate of return is computed net of all expenses. There is a different treatment for the GASB Statement No. 68 accounting disclosures in that the GASB requires the assumed rate of return to be net of investment expenses only. Administrative expenses must be accounted for separately. In our review of the economic assumptions, we determined that the current estimate of administrative expenses of 0.25% of assets continues to be reasonable. The assumed rate of return for funding purposes effective with the December 31, 2019 annual actuarial valuations is 7.35%, net of all expenses. The assumed rate of return for GASB No. 68 accounting purposes effective with the December 31, 2019 annual actuarial valuations is 7.60%, net of investment expenses.

It is important to note that the actuarial cost method for funding purposes could be adjusted to track administrative assumptions separately. In other words, we could use an assumed rate of return net of investment expenses only, provided that the actuarial cost method properly reflected the administrative expenses in the employer contributions.

The most common approach in this case is to include a provision for administrative expenses in the normal cost. The normal cost is determined as a level percent of payroll. Anticipated administrative expenses could also be estimated as a percent of total payroll and applied to all normal cost calculations. For example, the current administrative expenses are estimated to be 0.25% of assets per year. As of December 31, 2018, the market value of assets was $8.96 billion for implied administrative expenses of $22.4 million (0.25% x $8.96 billion). The total payroll for active participants as of December 31, 2018 was $1.81 billion resulting in an administrative expense load for the normal cost of 1.24% of payroll ($22.4 million / $1.81 billion).

This approach has the advantage of funding administrative expenses directly through employer contributions and is not uncommon for single employer defined benefit pension plan funding. The disadvantage of this approach is that some divisions have no active members and no associated payroll. Under this approach, those divisions would not bear any of the cost of administrative expenses. For this reason, this approach is less common for agent multiple employer plans such as MERS.

A second approach is to reflect administrative expenses as a percentage of pension obligation and determine an associated employer contribution. The total actuarial accrued liability as of December 31, 2018 was $14.42 billion. The associated administrative expenses are 0.16% of actuarial accrued liability. This could be added to the annual employer contribution for all divisions with an adjustment to the appropriate fiscal start by employer. Again, this approach has the advantage of funding administrative expenses directly through employer contributions. However, it is very uncommon in practice.
A disadvantage of this approach for MERS is that some divisions are very well funded and currently have no employer contribution requirement under the MERS Actuarial Policy. This approach would charge those employers a contribution for administrative expenses in this case.

For these reasons, we do not recommend either of these changes at this time.

Pending Changes to ASOP No. 4

As mentioned, there are pending changes to ASOP No. 4. We will not know the full impact of any changes until they are finalized by the Actuarial Standards Board which may take a year or longer. That said, there are some elements that are expected to change that may have an impact on the MERS annual actuarial valuations.

First, there is a version of the entry age normal actuarial cost method referred to as the "ultimate normal cost" method. Under the proposed changes to ASOP No. 4, this method would not be allowed as a reasonable funding method. In this method, if there are multiple benefit tiers with different benefit provisions within a division, the ultimate normal cost method determines the normal cost rate for all members based on the benefits of the newest tier only. It is important to note that the MERS version of entry age normal is not the ultimate normal cost method. Consequently, we do not expect this change to impact the MERS valuation, but we will review the final ASOP carefully to make sure this is the case.

Second, each plan will be required to calculate and disclose the annual gain or loss on actuarial accrued liability and the actuarial value of assets.

The third major change to ASOP No. 4 is the requirement to calculate and disclose a market value of liability. The market value of liability differs from the actuarial accrued liability in two crucial ways: (1) the discount rate used to compute the present value of benefits and actuarial accrued liability is based on low-risk bond yields, rather than the expected return on assets, and (2) the liability is determined as the present value of accrued benefits which is not the same as the level percent method. In the current low interest rate environment, low-risk bond yields are in the range of 1-3%. Using a lower discount rate will result in a higher actuarial accrued liability, possibly significantly. The change in method to the present value of accrued benefits normal reduces the actuarial accrued liability, but it is not expected to reduce the liability nearly as much as the increase due to the lower discount rate.

This additional calculation and disclosure is intended to help decision makers better understand the associated investment risk in the plans and illustrate an estimated cost of defeasing that risk. It is unclear, however, that the requirement to calculate the liability will be included in the final version of the ASOP.

Other changes to ASOP No. 4 include a requirement for the actuary to opine on the reasonableness of the actuarially determined contribution (ADC). One requirement is that the ADC must not allow perpetual negative amortization. Negative amortization can exist under the contribution policy if the unfunded actuarial accrued liability is expected to increase when all contributions are made and all assumptions are met. Perpetual negative amortization results in an ever-increasing unfunded actuarial accrued liability. Under the prior economic assumptions (7.75%/3.75%) and the 20-year amortization period, there was negative amortization in that year's ADC. As the period decreases, the negative amortization was expected to cease once the period was down to 18 years. Now, with the 7.35%/3.00% economic assumptions and a 19-year amortization, there is no expected negative amortization. It is possible that some divisions with a longer amortization period (21 years or longer) will have negative amortization for a few years, but not in perpetuity. Therefore, we do not expect this change in the ASOP to impact MERS.

The MERS Actuarial Policy includes additional information about the amortization periods. Generally, a review of amortization policy may be considered as part of an experience study review under ASOP No. 4 with the actuarial cost method and asset smoothing method. GRS and MERS staff are in the process of performing an in-depth review of the Actuarial Policy and will present any recommendations to the Board in a separate communication.

Asset Valuation Method

The pertinent ASOP for the asset valuation method is ASOP No. 44. The asset valuation method determines the actuarial value of assets on each valuation date.

The actuarial value of assets is determined on the basis of a method that calculates expected investment income at the valuation rate of return and adds a portion of the difference between the expected investment income and actual investment income earned on a market value basis. The difference in investment income between expected return and market return is recognized over a 5-year period at the rate of 20% per year. This asset valuation method was first adopted for the December 31, 2016 valuation, and is applied as follows:

Actuarial Value equals:

(i) Actuarial value of assets from the previous actuarial valuation; plus
(ii) Aggregate employer and member contributions since the last valuation; minus
(iii) Benefit payments and refunds of member contributions since the last valuation; plus
(iv) Estimated investment income at the 7.75% valuation interest rate (7.35% beginning after December 31, 2019); plus
(v) Portion of gain (loss) recognized in the current valuation.

For the above purpose, gain (loss) is defined as the excess during the period of the investment return on the market value of assets over the expected investment income. The portion recognized in the valuation is 20% of the current year's gain (loss) plus 20% of the gain (loss) from each of the 4 preceding years.

This general method has been in place for several years. The change in 2016 was to change from 10-year smoothing to 5-year smoothing. For purposes of transitioning from the 10-year to the 5-year method, the entirety of prior unrecognized gains and losses at December 31, 2016 was combined into a single item and will be recognized over the next four years. The December 31, 2019 valuation will include the final recognition of this item.

ASOP No. 44 requires that the actuarial value bear a reasonable relationship to the market value of assets. Specifically, Section 3.2 of ASOP No. 44 states the following:

a. *Given the inherent volatility of markets, the asset valuation method is likely to produce actuarial values of assets that are sometimes greater than and sometimes less than the corresponding market values.*
b. *The asset valuation method is likely to produce actuarial values of assets that, in the actuary's professional judgment, satisfy both of the following:*
    1. *The asset values fall within a reasonable range around the corresponding market values. For example, there might be a corridor centered at market value, outside of which the actuarial value of assets may not fall, in order to assure that the difference from market value is not greater than the actuary deems reasonable.*
    2. *Any differences between the actuarial value of assets and the market value are recognized within a reasonable period of time. For example, a formula addresses differences between the actuarial value of assets and the market value in a manner that, in the actuary's professional judgment, is rational, systematic, and produces an actuarial value of assets that is expected to converge toward market value at a pace that the actuary deems reasonable, assuming constant asset returns in future periods.*

In lieu of satisfying both (1) and (2) above, an actuarial valuation method could satisfy section 3.3(b) if, in the actuary's professional judgment, the asset valuation method either (i) produces values within a sufficiently narrow range around market value or (ii) recognizes differences from market value in a sufficiently short period.

Prior to 2016, the asset smoothing period was 10 years. The length of time, without any restriction on the difference between the actuarial value or market value of assets, may result in long periods of divergence in asset methods and recognized rates of return. The shortening of the smoothing period in 2016 potentially helps mitigate this effect in the long run. Another approach is to introduce a "corridor" around the market value of assets limiting the actuarial value of assets to a range above or below the market value of assets. In general, a corridor will not take effect unless there are extreme positive or negative returns on the market value of assets.

For example, a 20% corridor would limit the actuarial value of assets to be no less than 80% and no more than 120% of the market value of assets. To illustrate, we develop hypothetical asset values as of December 31, 2019 under two extreme scenarios: +25% return, and -25% return. In this case, assuming the net cash flows in 2019 are the same as in 2018, the resulting actuarial value of assets would be as follows:

Projected 2019 Assets ($Billions)[1]				
Scenario	**Market Value**	**Actuarial Value No Corridor**	**Actuarial Value 20% Corridor**	**Difference**
+25% Return	10.0	10.2	10.2	-
Ratio to Market Value		*102%*	*102%*	*0%*
+-25% Return	7.7	9.7	9.3	(0.4)
Ratio to Market Value		*125%*	*120%*	*-5%*

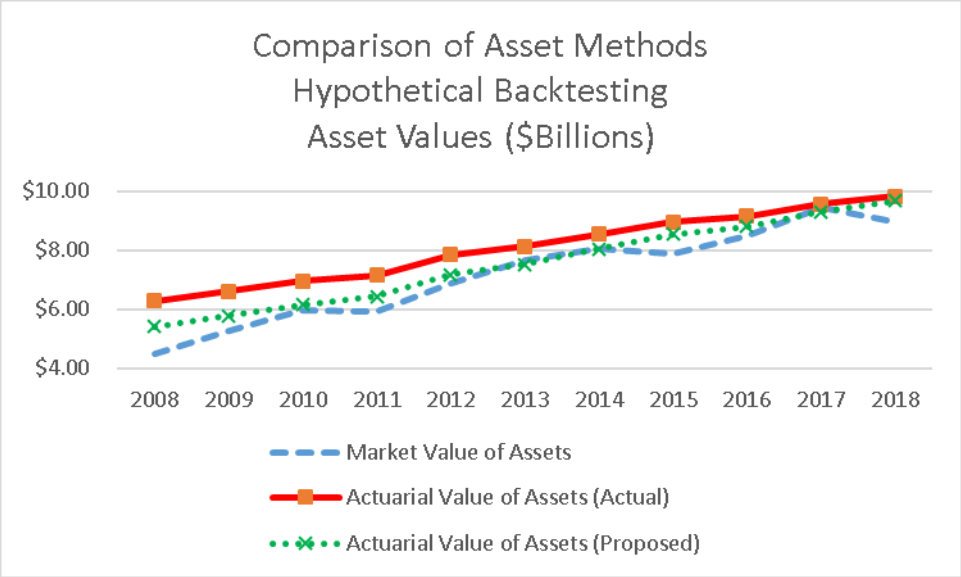
[1] *Based on estimated 2019 cash flows.*

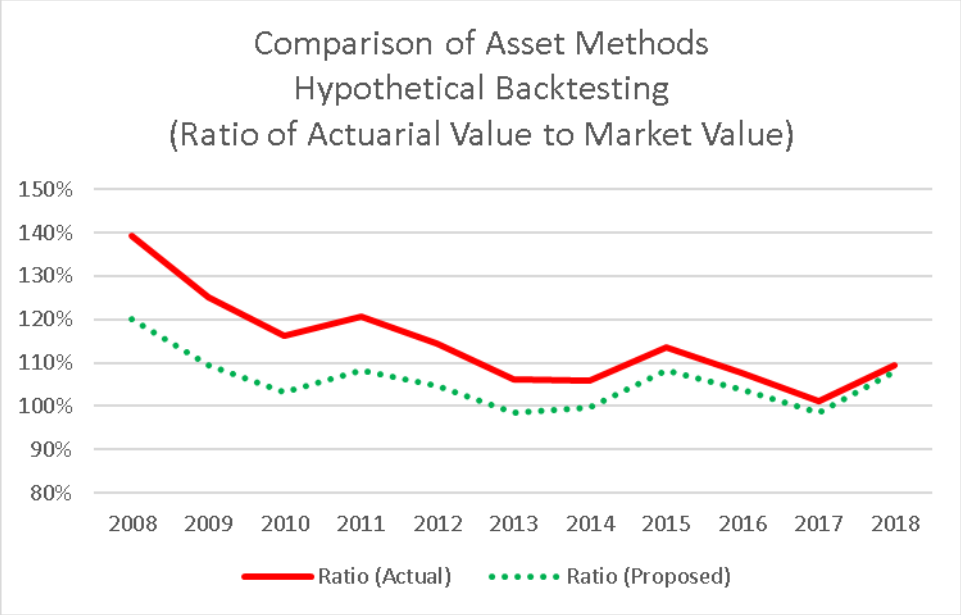
Note that the outcome differs for the high and low market returns because the current ratio of the actuarial value of assets to market value is roughly 110%. The low return of -25% would push this ratio even higher, absent the corridor. Thus, the difference with and without a corridor in this scenario is a 5% difference in the ratio and a dollar difference of $0.4 billion.

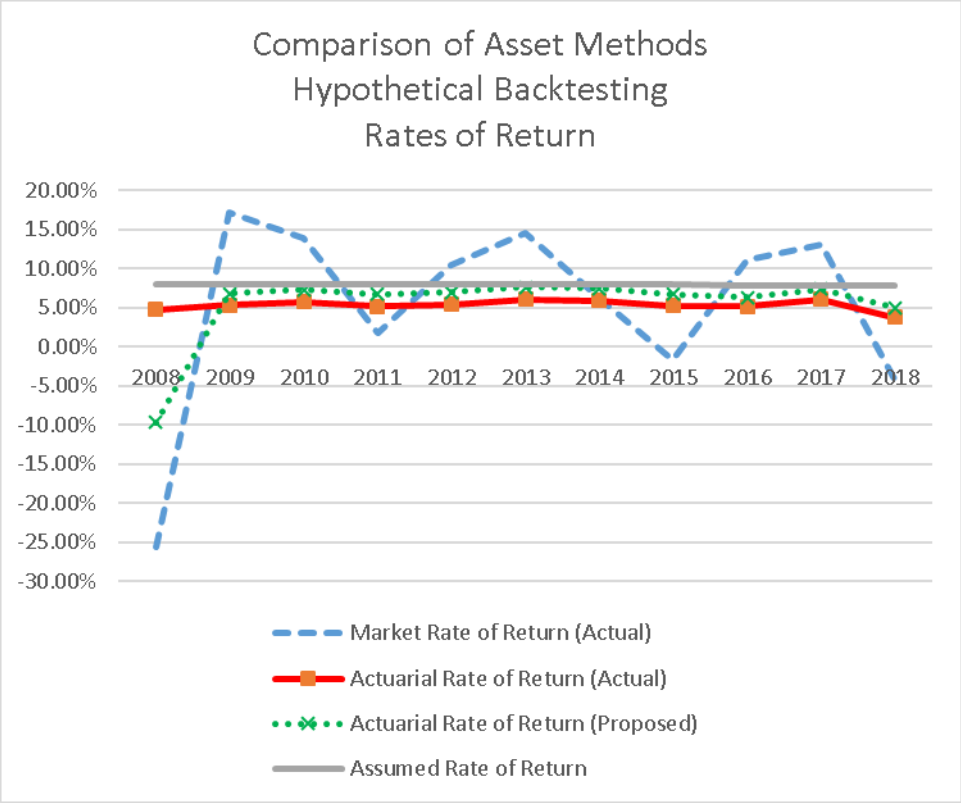
An advantage of a corridor is that it reduces extreme market distortions. If a corridor applies in a given year, the actuarial value will be closer to the market value than it would have without the corridor. The corresponding disadvantage with this approach is that the valuation results will change more significantly in a year when the corridor is exceeded. If a corridor applies in a given year, there may be implications in future years as well. One approach is to assume that the corridor is simply an overlay and the actuarial smoothing method continues in the background with unrecognized gains and losses being recognized as originally scheduled. Another approach is to assume that the corridor forces immediate recognition of any gain or loss outside the corridor in the year that it occurs and thus adjusting the future recognitions accordingly. It is the latter approach that we prefer and illustrate with the following back testing.

Leading up to the Great Recession, the rate of return on the market value of assets for the year ending December 31, 2008 was -25.59%. The resulting actuarial value of assets was 139% of the market value. This difference was expected to decline over the 10-year smoothing period. (As a side note, the change in period from 10 to 5 years in 2016 occurred after 7 years of the 2008 loss had been recognized effectively extended that another 5 years to a 12-year recognition of the 2008 loss. This has resulted in actuarial rates of return below the assumed rate of return every year for the last 11 years with one more year expected in 2019.)

If instead, there had been a 20% corridor and the loss in 2008 outside the corridor had been recognized immediately, two things would have happened. First, the ratio of actuarial value of assets would have been 120% not 139% as of December 31, 2008. This would have decreased the funded ratio of all plans more than they did in the 2008 valuation. Second, the difference between market value of assets over the next few years would have also not been as high as under the current method. In other words, the actuarial value would have tracked the market value more closely over time. Effectively, taking a portion of the hit immediately in 2008 would have avoided spreading it out over 12 years. The recognized rates of return would have been closer to the assumption as well.


Comparison of Asset Methods
Hypothetical Backtesting
Asset Values ($Billions)
$10.00
$8.00
$6.00
$4.00
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Market Value of Assets
Actuarial Value of Assets (Actual)
Actuarial Value of Assets (Proposed)


Comparison of Asset Methods
Hypothetical Backtesting
(Ratio of Actuarial Value to Market Value)
150%
140%
130%
120%
110%
100%
90%
80%
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Ratio (Actual)
Ratio (Proposed)


Comparison of Asset Methods
Hypothetical Backtesting
Rates of Return
20.00%
15.00%
10.00%
5.00%
0.00%
-5.00%
-10.00%
-15.00%
-20.00%
-25.00%
-30.00%
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Market Rate of Return (Actual)
Actuarial Rate of Return (Actual)
Actuarial Rate of Return (Proposed)
Assumed Rate of Return

Additional details are shown in the table below.

Back-testing Proposed Method ($Billions)											
December 31	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Market Value of Assets	$ 4.51	$ 5.28	$ 5.97	$ 5.94	$ 6.86	$ 7.65	$ 8.06	$ 7.89	$ 8.49	$ 9.44	$ 8.96
Market Rate of Return (Actual)	-25.59%	17.10%	13.94%	1.83%	10.41%	14.47%	6.13%	-1.74%	11.17%	13.07%	-4.12%
Actuarial Value of Assets (Actual)	6.28	6.60	6.94	7.16	7.84	8.12	8.55	8.95	9.14	9.55	9.81
Ratio (Actual)	139%	125%	116%	121%	114%	106%	106%	114%	108%	101%	110%
Actuarial Rate of Return (Actual)	4.73%	5.30%	5.74%	5.19%	5.42%	6.04%	5.90%	5.21%	5.14%	6.08%	3.80%
Actuarial Value of Assets (Proposed)	$ 5.41	$ 5.77	$ 6.16	$ 6.42	$ 7.17	$ 7.53	$ 8.03	$ 8.53	$ 8.80	$ 9.30	$ 9.66
Ratio (Proposed)	120%	109%	103%	108%	105%	98%	100%	108%	104%	98%	108%
Actuarial Rate of Return (Proposed)	-9.68%	6.77%	7.32%	6.73%	6.99%	7.65%	7.49%	6.73%	6.33%	7.35%	4.99%
Assumed Rate of Return	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%	7.75%	7.75%	7.75%

We recommend that the Board consider adopting a 20% corridor with immediate recognition of gains and losses outside the corridor. If the Board were to adopt the change, this method would be applied prospectively leaving the December 31, 2018 actuarial value of assets unchanged. This change could be studied further and adopted at a later date so is not considered a recommendation in this report.

Appendix

Proposed Actuarial Assumptions

Unreduced Retirement Rates:

Sample Replacement Index	Percent of Eligible Active Members Retiring Within the Next Year	
	Public Safety	General
0	6.0%	5.0%
1	7.0	6.0
2	7.0	6.0
3	8.0	7.0
4	10.0	8.0
5	11.0	9.0
6	12.0	10.0
7	13.0	10.0
8	13.0	10.0
9	13.0	10.0
10	14.0	11.0
11	15.0	12.0
12	17.0	13.0
13	18.0	14.0
14	18.0	14.0
15	19.0	15.0
16	20.0	16.0
17	21.0	17.0
18	23.0	18.0
19	24.0	19.0
20	24.0	19.0
21	24.0	19.0
22	24.0	19.0
23	24.0	19.0
24	24.0	19.0
25	24.0	19.0
26	24.0	19.0
27	24.0	19.0
28	24.0	19.0
29	24.0	19.0
30	24.0	19.0
31	24.0	19.0
32	24.0	19.0
33	24.0	19.0
34	24.0	19.0

Sample Replacement Index	Percent of Eligible Active Members Retiring Within the Next Year	
	Public Safety	General
35	24.0%	19.0%
36	24.0	19.0
37	24.0	19.0
38	24.0	19.0
39	24.0	19.0
40	24.0	19.0
41	24.0	19.0
42	24.0	19.0
43	25.0	20.0
44	25.0	20.0
45	25.0	20.0
46	25.0	20.0
47	26.0	21.0
48	26.0	21.0
49	26.0	21.0
50	26.0	21.0
51	26.0	21.0
52	26.0	21.0
53	26.0	21.0
54	26.0	21.0
55	26.0	21.0
56	26.0	21.0
57	26.0	21.0
58	26.0	21.0
59	27.0	22.0
60	30.0	24.0
61	30.0	24.0
62	30.0	24.0
63	30.0	24.0
64	30.0	24.0
65	30.0	24.0
66	30.0	24.0
67	30.0	24.0
68	30.0	24.0
69	31.0	25.0

Unreduced Retirement Rates (Concluded):

Sample Replacement Index	Percent of Eligible Active Members Retiring Within the Next Year	
	Public Safety	General
70	31.0%	25.0%
71	31.0	25.0
72	31.0	25.0
73	32.0	26.0
74	32.0	26.0
75	33.0	27.0
76	35.0	28.0
77	36.0	29.0
78	37.0	29.0
79	38.0	30.0
80	38.0	30.0
81	39.0	31.0
82	39.0	31.0
83	40.0	32.0
84	40.0	32.0
85	42.0	33.0
86	43.0	34.0
87	44.0	35.0
88	45.0	36.0
89	46.0	37.0
90	48.0	38.0
91	50.0	40.0
92	51.0	41.0
93	52.0	42.0
94	52.0	42.0
95	52.0	42.0
96	55.0	44.0
97	57.0	46.0
98	58.0	47.0
99	58.0	47.0
100	60.0	48.0

Early Reduced Retirement Rates:

Age	Percent of Eligible Active Members
All Applicable ages	4.0%

Withdrawal Rates:

Sample Years of Service	% of Active Members Withdrawing Within the Next Year	
	Public Safety	General
0	13.90%	23.40%
1	11.60	19.50
2	9.40	15.80
3	7.40	12.50
4	6.10	10.30
5	4.90	8.30
6	4.30	7.20
7	3.90	6.60
8	3.60	6.00
9	3.40	5.70
10	3.20	5.40
11	3.10	5.20
12	2.80	4.70
13	2.70	4.50
14	2.50	4.20
15	2.40	4.00
16	2.30	3.90
17	2.20	3.70
18	2.00	3.40
19	1.90	3.20
20	1.80	3.10
21	1.80	3.00
22	1.70	2.80
23	1.70	2.80
24	1.60	2.70
25 and Over	1.50	2.60

Disability Rates:

No change to current assumption.

Merit and Seniority Increases:

Sample Years of Service	Base (Wage Inflation)	Merit and Longevity	Total Percentage Increase in Pay
0	3.00%	6.70%	9.70%
1	3.00	4.60	7.60
2	3.00	3.20	6.20
3	3.00	2.70	5.70
4	3.00	2.30	5.30
5	3.00	1.90	4.90
6	3.00	1.70	4.70
7	3.00	1.30	4.30
8	3.00	1.20	4.20
9	3.00	1.20	4.20
10	3.00	1.10	4.10
11	3.00	1.10	4.10
12	3.00	0.90	3.90
13	3.00	0.90	3.90
14	3.00	0.80	3.80
15	3.00	0.70	3.70
16	3.00	0.70	3.70
17	3.00	0.60	3.60
18	3.00	0.60	3.60
19	3.00	0.60	3.60
20	3.00	0.60	3.60
21	3.00	0.60	3.60
22	3.00	0.50	3.50
23	3.00	0.40	3.40
24	3.00	0.40	3.40
25	3.00	0.40	3.40
26	3.00	0.30	3.30
27	3.00	0.30	3.30
28	3.00	0.30	3.30
29	3.00	0.30	3.30
30	3.00	0.20	3.20
31	3.00	0.20	3.20
32	3.00	0.20	3.20
33	3.00	0.20	3.20
34	3.00	0.20	3.20
35	3.00	0.10	3.10
36	3.00	0.10	3.10
37	3.00	0.10	3.10
38	3.00	0.10	3.10
39	3.00	0.10	3.10
40 and Over	3.00	0.00	3.00

Pre-retirement Mortality Rates (Base Year 2010):

Age in 2018	Static Mortality Rates		Generational Mortality Rates	
	Male	Female	Male	Female
1	0.015%	0.009%	0.015%	0.016%
2	0.013%	0.009%	0.013%	0.010%
3	0.011%	0.007%	0.011%	0.008%
4	0.010%	0.007%	0.010%	0.008%
5	0.010%	0.007%	0.010%	0.008%
6	0.009%	0.008%	0.009%	0.009%
7	0.009%	0.008%	0.009%	0.009%
8	0.009%	0.007%	0.009%	0.008%
9	0.008%	0.007%	0.008%	0.008%
10	0.009%	0.008%	0.009%	0.009%
11	0.009%	0.008%	0.009%	0.009%
12	0.011%	0.007%	0.011%	0.008%
13	0.012%	0.007%	0.012%	0.008%
14	0.014%	0.008%	0.014%	0.009%
15	0.017%	0.009%	0.017%	0.010%
16	0.023%	0.011%	0.024%	0.012%
17	0.031%	0.012%	0.032%	0.013%
18	0.036%	0.013%	0.037%	0.014%
19	0.038%	0.013%	0.039%	0.014%
20	0.037%	0.013%	0.038%	0.014%
21	0.036%	0.012%	0.038%	0.013%
22	0.033%	0.011%	0.035%	0.012%
23	0.031%	0.010%	0.034%	0.011%
24	0.029%	0.009%	0.032%	0.010%
25	0.028%	0.009%	0.032%	0.011%
26	0.030%	0.010%	0.036%	0.012%
27	0.031%	0.011%	0.038%	0.014%
28	0.033%	0.012%	0.041%	0.015%
29	0.034%	0.013%	0.043%	0.016%
30	0.036%	0.015%	0.047%	0.019%
31	0.038%	0.016%	0.050%	0.021%
32	0.040%	0.018%	0.053%	0.023%
33	0.042%	0.019%	0.056%	0.024%
34	0.044%	0.021%	0.059%	0.027%
35	0.047%	0.023%	0.062%	0.029%
36	0.050%	0.025%	0.065%	0.031%
37	0.053%	0.028%	0.068%	0.034%
38	0.057%	0.030%	0.071%	0.035%
39	0.061%	0.033%	0.074%	0.038%
40	0.066%	0.036%	0.077%	0.040%

Pre-retirement Mortality Rates (Base Year 2010) (Continued):

Age in 2018	Static Mortality Rates		Generational Mortality Rates	
	Male	Female	Male	Female
41	0.071%	0.040%	0.080%	0.043%
42	0.077%	0.043%	0.084%	0.045%
43	0.083%	0.047%	0.087%	0.048%
44	0.090%	0.051%	0.092%	0.051%
45	0.098%	0.056%	0.097%	0.055%
46	0.107%	0.061%	0.104%	0.059%
47	0.116%	0.066%	0.110%	0.063%
48	0.127%	0.071%	0.120%	0.068%
49	0.138%	0.077%	0.129%	0.074%
50	0.149%	0.083%	0.140%	0.080%
51	0.162%	0.090%	0.153%	0.089%
52	0.175%	0.097%	0.166%	0.097%
53	0.189%	0.105%	0.182%	0.107%
54	0.203%	0.113%	0.198%	0.117%
55	0.219%	0.123%	0.216%	0.129%
56	0.236%	0.133%	0.236%	0.142%
57	0.255%	0.144%	0.259%	0.154%
58	0.275%	0.156%	0.283%	0.167%
59	0.296%	0.170%	0.307%	0.181%
60	0.319%	0.186%	0.333%	0.196%
61	0.344%	0.203%	0.359%	0.211%
62	0.371%	0.222%	0.386%	0.227%
63	0.401%	0.244%	0.414%	0.245%
64	0.433%	0.269%	0.442%	0.264%
65	0.468%	0.296%	0.471%	0.285%
66	0.506%	0.327%	0.501%	0.310%
67	0.548%	0.362%	0.535%	0.339%
68	0.594%	0.400%	0.571%	0.370%
69	0.646%	0.442%	0.614%	0.407%
70	0.703%	0.489%	0.661%	0.448%
71	0.767%	0.541%	0.716%	0.496%
72	0.837%	0.598%	0.778%	0.549%
73	0.915%	0.661%	0.847%	0.609%
74	1.001%	0.731%	0.925%	0.676%
75	1.096%	0.808%	1.013%	0.751%
76	1.200%	0.893%	1.110%	0.835%
77	1.315%	0.986%	1.219%	0.927%
78	1.440%	1.090%	1.337%	1.030%
79	1.578%	1.204%	1.469%	1.144%
80	1.730%	1.330%	1.614%	1.270%

Pre-retirement Mortality Rates (Base Year 2010) (Concluded):

Age in 2018	Static Mortality Rates		Generational Mortality Rates	
	Male	Female	Male	Female
81	5.374%	3.787%	5.028%	3.629%
82	6.052%	4.276%	5.677%	4.111%
83	6.811%	4.834%	6.406%	4.660%
84	7.656%	5.474%	7.219%	5.286%
85	8.591%	6.205%	8.121%	5.999%
86	9.615%	7.041%	9.112%	6.810%
87	10.733%	7.987%	10.192%	7.728%
88	11.947%	9.046%	11.368%	8.752%
89	13.260%	10.216%	12.634%	9.883%
90	14.672%	11.487%	13.995%	11.109%
91	16.170%	12.833%	15.428%	12.408%
92	17.745%	14.239%	16.931%	13.759%
93	19.392%	15.702%	18.484%	15.164%
94	21.107%	17.228%	20.087%	16.624%
95	22.888%	18.825%	21.733%	18.149%
96	24.731%	20.505%	23.547%	19.800%
97	26.634%	22.278%	25.418%	21.555%
98	28.589%	24.147%	27.358%	23.408%
99	30.586%	26.113%	29.345%	25.358%
100	32.609%	28.160%	31.365%	27.395%
101	34.636%	30.265%	33.402%	29.499%
102	36.640%	32.382%	35.430%	31.619%
103	38.604%	34.494%	37.423%	33.746%
104	40.512%	36.581%	39.372%	35.849%
105	42.352%	38.625%	41.267%	37.920%
106	44.113%	40.609%	43.100%	39.952%
107	45.786%	42.519%	44.847%	41.902%
108	47.364%	44.341%	46.518%	43.777%
109	48.843%	46.067%	48.086%	45.567%
110	50.000%	47.690%	49.359%	47.253%
111	50.000%	49.205%	49.487%	48.847%
112	50.000%	50.000%	49.616%	49.731%
113	50.000%	50.000%	49.741%	49.820%
114	50.000%	50.000%	49.870%	49.905%
115	50.000%	50.000%	50.000%	50.000%
116	50.000%	50.000%	50.000%	50.000%
117	50.000%	50.000%	50.000%	50.000%
118	50.000%	50.000%	50.000%	50.000%
119	50.000%	50.000%	50.000%	50.000%
120	100.000%	100.000%	100.000%	100.000%

Post-retirement Mortality Rates (Base Year 2010):

Age in 2018	Static				Generational			
	Expected Years of Life Remaining		Mortality Rates		Expected Years of Life Remaining		Mortality Rates	
	Male	Female	Male	Female	Male	Female	Male	Female
1	81.34	84.73	0.014%	0.014%	87.18	90.39	0.016%	0.017%
2	80.35	83.74	0.012%	0.009%	86.10	89.32	0.014%	0.010%
3	79.36	82.75	0.011%	0.007%	85.01	88.24	0.012%	0.008%
4	78.37	81.75	0.010%	0.007%	83.92	87.16	0.011%	0.008%
5	77.38	80.76	0.010%	0.007%	82.83	86.08	0.011%	0.008%
6	76.38	79.76	0.009%	0.008%	81.74	85.00	0.010%	0.009%
7	75.39	78.77	0.009%	0.008%	80.65	83.92	0.010%	0.009%
8	74.40	77.77	0.009%	0.007%	79.56	82.84	0.010%	0.008%
9	73.40	76.78	0.008%	0.007%	78.47	81.76	0.009%	0.008%
10	72.41	75.78	0.009%	0.008%	77.38	80.68	0.010%	0.009%
11	71.42	74.79	0.009%	0.008%	76.28	79.60	0.010%	0.009%
12	70.42	73.80	0.011%	0.007%	75.19	78.52	0.012%	0.008%
13	69.43	72.80	0.012%	0.007%	74.10	77.44	0.013%	0.008%
14	68.44	71.81	0.013%	0.008%	73.01	76.36	0.015%	0.009%
15	67.45	70.81	0.016%	0.009%	71.93	75.28	0.018%	0.010%
16	66.46	69.82	0.022%	0.011%	70.84	74.19	0.025%	0.012%
17	65.47	68.83	0.030%	0.012%	69.76	73.12	0.034%	0.014%
18	64.49	67.83	0.035%	0.012%	68.68	72.04	0.039%	0.015%
19	63.51	66.84	0.036%	0.012%	67.61	70.96	0.041%	0.015%
20	62.54	65.85	0.036%	0.012%	66.54	69.88	0.040%	0.015%
21	61.56	64.86	0.035%	0.012%	65.47	68.80	0.040%	0.014%
22	60.58	63.87	0.032%	0.011%	64.40	67.73	0.037%	0.013%
23	59.60	62.87	0.030%	0.010%	63.33	66.65	0.036%	0.012%
24	58.62	61.88	0.028%	0.009%	62.25	65.56	0.034%	0.011%
25	57.63	60.88	0.027%	0.009%	61.18	64.48	0.034%	0.011%
26	56.65	59.89	0.029%	0.010%	60.10	63.40	0.038%	0.013%
27	55.66	58.89	0.030%	0.011%	59.03	62.32	0.040%	0.014%
28	54.68	57.90	0.032%	0.012%	57.96	61.24	0.044%	0.016%
29	53.70	56.91	0.033%	0.012%	56.89	60.17	0.046%	0.017%
30	52.71	55.91	0.035%	0.014%	55.82	59.09	0.050%	0.020%
31	51.73	54.92	0.036%	0.015%	54.76	58.01	0.053%	0.022%
32	50.75	53.93	0.038%	0.017%	53.70	56.94	0.057%	0.025%
33	49.77	52.94	0.040%	0.018%	52.64	55.87	0.060%	0.026%
34	48.79	51.95	0.042%	0.020%	51.58	54.80	0.062%	0.028%
35	47.81	50.96	0.045%	0.022%	50.52	53.73	0.066%	0.031%
36	46.83	49.97	0.048%	0.024%	49.46	52.66	0.069%	0.033%
37	45.85	48.98	0.051%	0.027%	48.41	51.59	0.072%	0.036%
38	44.88	48.00	0.055%	0.029%	47.36	50.52	0.075%	0.038%
39	43.90	47.01	0.059%	0.032%	46.31	49.45	0.078%	0.040%
40	42.93	46.02	0.063%	0.035%	45.25	48.39	0.082%	0.042%

Post-retirement Mortality Rates (Base Year 2010) (Continued):

Age in 2018	Static			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
41	41.95	45.04	0.068%	0.038%
42	40.98	44.06	0.074%	0.041%
43	40.01	43.07	0.080%	0.045%
44	39.04	42.09	0.086%	0.049%
45	38.08	41.11	0.094%	0.054%
46	37.11	40.14	0.103%	0.059%
47	36.15	39.16	0.111%	0.063%
48	35.19	38.18	0.122%	0.068%
49	34.23	37.21	0.132%	0.074%
50	33.28	36.24	0.286%	0.213%
51	32.37	35.31	0.308%	0.224%
52	31.47	34.39	0.332%	0.236%
53	30.57	33.47	0.357%	0.249%
54	29.68	32.55	0.385%	0.261%
55	28.79	31.64	0.414%	0.275%
56	27.91	30.72	0.444%	0.289%
57	27.03	29.81	0.477%	0.305%
58	26.16	28.90	0.512%	0.323%
59	25.29	27.99	0.550%	0.344%
60	24.43	27.09	0.590%	0.369%
61	23.57	26.19	0.635%	0.399%
62	22.72	25.29	0.684%	0.436%
63	21.87	24.40	0.739%	0.480%
64	21.03	23.51	0.803%	0.530%
65	20.20	22.64	0.876%	0.588%
66	19.37	21.77	0.963%	0.655%
67	18.56	20.91	1.064%	0.730%
68	17.75	20.06	1.180%	0.815%
69	16.96	19.22	1.313%	0.912%
70	16.17	18.39	1.465%	1.020%
71	15.41	17.57	1.635%	1.143%
72	14.66	16.77	1.828%	1.282%
73	13.92	15.98	2.044%	1.437%
74	13.20	15.21	2.289%	1.612%
75	12.50	14.45	2.564%	1.808%
76	11.81	13.71	2.875%	2.027%
77	11.15	12.98	3.227%	2.273%
78	10.50	12.27	3.624%	2.552%
79	9.88	11.58	4.073%	2.867%
80	9.28	10.90	4.583%	3.226%

Age in 2018	Generational			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
41	44.20	47.32	0.085%	0.046%
42	43.15	46.26	0.089%	0.048%
43	42.11	45.20	0.092%	0.051%
44	41.06	44.14	0.097%	0.054%
45	40.01	43.07	0.103%	0.058%
46	38.96	42.01	0.110%	0.062%
47	37.92	40.95	0.117%	0.067%
48	36.87	39.90	0.127%	0.072%
49	35.83	38.84	0.137%	0.078%
50	34.79	37.78	0.296%	0.228%
51	33.80	36.78	0.321%	0.243%
52	32.82	35.79	0.349%	0.261%
53	31.85	34.79	0.379%	0.280%
54	30.88	33.81	0.414%	0.299%
55	29.92	32.83	0.451%	0.319%
56	28.96	31.85	0.492%	0.339%
57	28.02	30.88	0.535%	0.361%
58	27.09	29.92	0.580%	0.382%
59	26.17	28.96	0.630%	0.405%
60	25.25	28.00	0.680%	0.430%
61	24.35	27.05	0.732%	0.459%
62	23.45	26.11	0.786%	0.492%
63	22.57	25.17	0.843%	0.531%
64	21.69	24.24	0.905%	0.575%
65	20.82	23.31	0.974%	0.626%
66	19.96	22.39	1.053%	0.685%
67	19.11	21.48	1.146%	0.753%
68	18.26	20.57	1.253%	0.833%
69	17.43	19.67	1.378%	0.926%
70	16.61	18.78	1.522%	1.033%
71	15.80	17.91	1.685%	1.157%
72	15.00	17.05	1.875%	1.300%
73	14.22	16.20	2.090%	1.462%
74	13.45	15.37	2.336%	1.646%
75	12.71	14.56	2.617%	1.856%
76	11.98	13.76	2.937%	2.092%
77	11.27	12.99	3.302%	2.359%
78	10.59	12.24	3.716%	2.663%
79	9.93	11.51	4.187%	3.007%
80	9.29	10.80	4.722%	3.400%

Post-retirement Mortality Rates (Base Year 2010) (Concluded):

Age in 2018	Static			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
81	8.70	10.25	5.159%	3.636%
82	8.14	9.62	5.810%	4.105%
83	7.62	9.01	6.539%	4.641%
84	7.11	8.42	7.350%	5.255%
85	6.64	7.86	8.247%	5.957%
86	6.19	7.33	9.230%	6.759%
87	5.77	6.82	10.304%	7.668%
88	5.37	6.35	11.469%	8.684%
89	5.00	5.91	12.730%	9.807%
90	4.66	5.49	14.085%	11.028%
91	4.34	5.11	15.523%	12.320%
92	4.05	4.76	17.035%	13.669%
93	3.78	4.44	18.616%	15.074%
94	3.53	4.13	20.263%	16.539%
95	3.30	3.85	21.972%	18.072%
96	3.09	3.59	23.742%	19.685%
97	2.89	3.35	25.569%	21.387%
98	2.71	3.13	27.445%	23.181%
99	2.55	2.92	29.363%	25.068%
100	2.40	2.73	31.305%	27.034%
101	2.26	2.56	33.251%	29.054%
102	2.14	2.41	35.174%	31.087%
103	2.03	2.27	37.060%	33.114%
104	1.93	2.14	38.892%	35.118%
105	1.85	2.03	40.658%	37.080%
106	1.77	1.93	42.348%	38.985%
107	1.70	1.84	43.955%	40.818%
108	1.65	1.76	45.469%	42.567%
109	1.61	1.69	46.889%	44.224%
110	1.58	1.64	48.000%	45.782%
111	1.58	1.60	48.000%	47.237%
112	1.58	1.58	48.000%	48.000%
113	1.57	1.57	48.000%	48.000%
114	1.56	1.56	48.000%	48.000%
115	1.54	1.54	48.000%	48.000%
116	1.50	1.50	48.000%	48.000%
117	1.43	1.43	48.000%	48.000%
118	1.29	1.29	48.000%	48.000%
119	1.02	1.02	48.000%	48.000%
120	0.50	0.50	96.000%	96.000%

Age in 2018	Generational			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
81	8.68	10.12	5.329%	3.847%
82	8.10	9.47	6.018%	4.358%
83	7.55	8.84	6.790%	4.939%
84	7.03	8.24	7.652%	5.604%
85	6.54	7.67	8.609%	6.359%
86	6.08	7.13	9.659%	7.219%
87	5.65	6.62	10.804%	8.192%
88	5.25	6.14	12.050%	9.278%
89	4.87	5.70	13.392%	10.475%
90	4.53	5.29	14.835%	11.775%
91	4.21	4.91	16.354%	13.152%
92	3.92	4.56	17.947%	14.585%
93	3.65	4.23	19.593%	16.073%
94	3.40	3.94	21.292%	17.621%
95	3.16	3.66	23.037%	19.238%
96	2.95	3.40	24.960%	20.988%
97	2.75	3.16	26.943%	22.849%
98	2.57	2.94	28.999%	24.813%
99	2.40	2.73	31.106%	26.879%
100	2.25	2.54	33.247%	29.039%
101	2.11	2.37	35.406%	31.269%
102	1.99	2.22	37.556%	33.516%
103	1.88	2.08	39.669%	35.770%
104	1.78	1.96	41.734%	37.999%
105	1.69	1.84	43.743%	40.195%
106	1.61	1.75	45.686%	42.349%
107	1.54	1.66	47.538%	44.416%
108	1.48	1.58	49.309%	46.403%
109	1.44	1.51	50.971%	48.301%
110	1.41	1.46	52.320%	50.088%
111	1.40	1.41	52.457%	51.778%
112	1.40	1.39	52.593%	52.714%
113	1.39	1.39	52.725%	52.810%
114	1.38	1.38	52.862%	52.899%
115	1.37	1.37	53.000%	53.000%
116	1.34	1.34	53.000%	53.000%
117	1.29	1.29	53.000%	53.000%
118	1.19	1.19	53.000%	53.000%
119	0.97	0.97	53.000%	53.000%
120	0.50	0.50	100.000%	100.000%

Post-disabled Mortality Rates (Base Year 2010):

Age in 2018	Static			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
1	66.46	69.78	0.015%	0.015%
2	65.47	68.79	0.013%	0.009%
3	64.48	67.79	0.011%	0.007%
4	63.48	66.80	0.010%	0.007%
5	62.49	65.80	0.010%	0.007%
6	61.50	64.81	0.009%	0.008%
7	60.50	63.81	0.009%	0.008%
8	59.51	62.82	0.009%	0.007%
9	58.51	61.82	0.008%	0.007%
10	57.52	60.83	0.009%	0.008%
11	56.52	59.83	0.009%	0.008%
12	55.53	58.84	0.011%	0.007%
13	54.53	57.84	0.012%	0.007%
14	53.54	56.85	0.014%	0.008%
15	52.55	55.85	0.017%	0.009%
16	51.55	54.85	0.023%	0.011%
17	50.57	53.86	0.031%	0.012%
18	49.58	52.87	0.403%	0.246%
19	48.78	52.00	0.421%	0.245%
20	47.98	51.12	0.412%	0.233%
21	47.18	50.24	0.386%	0.215%
22	46.36	49.35	0.352%	0.194%
23	45.52	48.44	0.316%	0.176%
24	44.67	47.53	0.289%	0.164%
25	43.79	46.60	0.278%	0.164%
26	42.92	45.68	0.292%	0.179%
27	42.04	44.76	0.306%	0.196%
28	41.17	43.85	0.321%	0.215%
29	40.30	42.94	0.337%	0.235%
30	39.43	42.04	0.354%	0.257%
31	38.57	41.15	0.372%	0.281%
32	37.71	40.26	0.391%	0.307%
33	36.86	39.39	0.411%	0.336%
34	36.01	38.52	0.434%	0.367%
35	35.16	37.66	0.458%	0.401%
36	34.32	36.81	0.486%	0.438%
37	33.49	35.97	0.518%	0.479%
38	32.66	35.14	0.555%	0.524%
39	31.84	34.32	0.597%	0.574%
40	31.03	33.51	0.645%	0.629%

Age in 2018	Generational			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
1	73.52	77.35	0.015%	0.016%
2	72.36	76.19	0.013%	0.010%
3	71.19	75.03	0.011%	0.008%
4	70.02	73.87	0.010%	0.008%
5	68.85	72.71	0.010%	0.008%
6	67.68	71.55	0.009%	0.009%
7	66.51	70.39	0.009%	0.009%
8	65.34	69.23	0.009%	0.008%
9	64.17	68.06	0.008%	0.008%
10	63.00	66.90	0.009%	0.009%
11	61.84	65.74	0.009%	0.009%
12	60.67	64.58	0.011%	0.008%
13	59.51	63.42	0.012%	0.008%
14	58.35	62.27	0.014%	0.009%
15	57.19	61.11	0.017%	0.010%
16	56.04	59.96	0.024%	0.012%
17	54.90	58.81	0.032%	0.013%
18	53.77	57.67	0.412%	0.263%
19	52.84	56.67	0.431%	0.262%
20	51.91	55.66	0.422%	0.249%
21	50.98	54.65	0.402%	0.234%
22	50.04	53.63	0.374%	0.215%
23	49.08	52.60	0.344%	0.199%
24	48.10	51.55	0.323%	0.190%
25	47.12	50.51	0.320%	0.193%
26	46.13	49.46	0.346%	0.215%
27	45.16	48.44	0.372%	0.240%
28	44.20	47.42	0.401%	0.267%
29	43.26	46.42	0.430%	0.296%
30	42.34	45.44	0.461%	0.328%
31	41.43	44.47	0.491%	0.361%
32	40.53	43.52	0.521%	0.395%
33	39.65	42.58	0.550%	0.432%
34	38.77	41.66	0.580%	0.468%
35	37.91	40.75	0.607%	0.505%
36	37.06	39.86	0.635%	0.542%
37	36.21	38.98	0.663%	0.580%
38	35.38	38.11	0.693%	0.618%
39	34.54	37.25	0.723%	0.657%
40	33.72	36.40	0.755%	0.698%

Post-disabled Mortality Rates (Base Year 2010) (Continued):

Age in 2018	Static			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
41	30.23	32.72	0.700%	0.689%
42	29.44	31.95	0.763%	0.754%
43	28.66	31.19	0.834%	0.825%
44	27.90	30.44	0.916%	0.902%
45	27.15	29.71	1.007%	0.985%
46	26.42	29.00	1.109%	1.073%
47	25.71	28.31	1.221%	1.167%
48	25.02	27.64	1.342%	1.267%
49	24.36	26.99	1.470%	1.373%
50	23.71	26.36	1.605%	1.483%
51	23.09	25.75	1.712%	1.535%
52	22.48	25.14	1.818%	1.587%
53	21.89	24.54	1.921%	1.640%
54	21.31	23.94	2.020%	1.692%
55	20.74	23.34	2.114%	1.742%
56	20.18	22.75	2.201%	1.789%
57	19.62	22.15	2.280%	1.833%
58	19.06	21.56	2.355%	1.874%
59	18.51	20.96	2.428%	1.914%
60	17.96	20.36	2.503%	1.956%
61	17.41	19.76	2.584%	2.000%
62	16.86	19.15	2.677%	2.051%
63	16.31	18.54	2.785%	2.110%
64	15.76	17.93	2.908%	2.178%
65	15.22	17.32	3.044%	2.256%
66	14.68	16.70	3.193%	2.346%
67	14.15	16.09	3.353%	2.450%
68	13.62	15.49	3.524%	2.569%
69	13.10	14.88	3.706%	2.706%
70	12.58	14.28	3.901%	2.862%
71	12.08	13.69	4.113%	3.039%
72	11.57	13.10	4.344%	3.239%
73	11.07	12.52	4.599%	3.464%
74	10.58	11.95	4.880%	3.718%
75	10.10	11.39	5.192%	4.003%
76	9.63	10.85	5.537%	4.322%
77	9.16	10.32	5.921%	4.678%
78	8.71	9.80	6.347%	5.075%
79	8.26	9.30	6.822%	5.517%
80	7.83	8.81	7.348%	6.007%

Age in 2018	Generational			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
41	32.89	35.56	0.790%	0.741%
42	32.07	34.73	0.830%	0.787%
43	31.25	33.90	0.876%	0.838%
44	30.44	33.08	0.932%	0.895%
45	29.63	32.27	0.996%	0.959%
46	28.83	31.47	1.073%	1.031%
47	28.04	30.68	1.162%	1.113%
48	27.26	29.90	1.264%	1.208%
49	26.50	29.15	1.378%	1.316%
50	25.75	28.41	1.505%	1.437%
51	25.03	27.71	1.614%	1.509%
52	24.32	27.01	1.729%	1.587%
53	23.63	26.33	1.847%	1.670%
54	22.95	25.66	1.967%	1.753%
55	22.30	25.02	2.088%	1.833%
56	21.66	24.38	2.204%	1.903%
57	21.04	23.76	2.315%	1.962%
58	20.44	23.14	2.419%	2.008%
59	19.85	22.53	2.517%	2.041%
60	19.27	21.92	2.610%	2.065%
61	18.70	21.31	2.698%	2.081%
62	18.13	20.68	2.786%	2.097%
63	17.57	20.05	2.876%	2.115%
64	17.02	19.41	2.969%	2.140%
65	16.46	18.76	3.063%	2.175%
66	15.91	18.10	3.163%	2.224%
67	15.35	17.43	3.271%	2.291%
68	14.80	16.76	3.389%	2.379%
69	14.24	16.08	3.521%	2.489%
70	13.68	15.41	3.669%	2.624%
71	13.12	14.73	3.840%	2.786%
72	12.57	14.07	4.035%	2.974%
73	12.02	13.42	4.259%	3.191%
74	11.47	12.77	4.511%	3.439%
75	10.93	12.14	4.799%	3.722%
76	10.39	11.53	5.123%	4.040%
77	9.87	10.94	5.487%	4.397%
78	9.36	10.36	5.894%	4.796%
79	8.87	9.80	6.350%	5.241%
80	8.39	9.27	6.856%	5.734%

Post-disabled Mortality Rates (Base Year 2010) (Concluded):

Age in 2018	Static			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
81	7.41	8.34	7.929%	6.550%
82	7.01	7.89	8.565%	7.150%
83	6.62	7.46	9.259%	7.811%
84	6.24	7.05	10.010%	8.536%
85	5.88	6.66	10.815%	9.331%
86	5.54	6.29	11.678%	10.163%
87	5.20	5.95	12.605%	11.014%
88	4.88	5.62	13.603%	11.878%
89	4.57	5.31	14.861%	12.757%
90	4.28	5.02	16.253%	13.665%
91	4.01	4.73	17.681%	14.617%
92	3.77	4.46	19.126%	15.635%
93	3.54	4.19	20.588%	16.740%
94	3.33	3.93	22.078%	17.955%
95	3.13	3.68	23.617%	19.298%
96	2.94	3.45	25.226%	20.784%
97	2.76	3.22	26.924%	22.444%
98	2.59	3.01	28.723%	24.226%
99	2.44	2.81	30.624%	26.135%
100	2.30	2.62	32.609%	28.160%
101	2.16	2.45	34.636%	30.265%
102	2.05	2.30	36.640%	32.382%
103	1.94	2.17	38.604%	34.494%
104	1.84	2.04	40.512%	36.581%
105	1.76	1.93	42.352%	38.625%
106	1.68	1.84	44.113%	40.609%
107	1.62	1.75	45.786%	42.519%
108	1.56	1.67	47.364%	44.341%
109	1.52	1.61	48.843%	46.067%
110	1.50	1.55	50.000%	47.690%
111	1.50	1.51	50.000%	49.205%
112	1.50	1.50	50.000%	50.000%
113	1.49	1.49	50.000%	50.000%
114	1.48	1.48	50.000%	50.000%
115	1.47	1.47	50.000%	50.000%
116	1.44	1.44	50.000%	50.000%
117	1.38	1.38	50.000%	50.000%
118	1.25	1.25	50.000%	50.000%
119	1.00	1.00	50.000%	50.000%
120	0.50	0.50	100.000%	100.000%

Age in 2018	Generational			
	Expected Years of Life		Mortality Rates	
	Male	Female	Male	Female
81	7.92	8.76	7.418%	6.277%
82	7.48	8.27	8.034%	6.874%
83	7.05	7.81	8.708%	7.530%
84	6.64	7.37	9.438%	8.243%
85	6.24	6.95	10.224%	9.021%
86	5.87	6.57	11.067%	9.830%
87	5.51	6.20	11.970%	10.657%
88	5.16	5.86	12.944%	11.493%
89	4.83	5.53	14.159%	12.341%
90	4.52	5.22	15.503%	13.215%
91	4.24	4.92	16.870%	14.133%
92	3.98	4.63	18.249%	15.108%
93	3.74	4.35	19.624%	16.166%
94	3.51	4.08	21.011%	17.326%
95	3.30	3.82	22.426%	18.605%
96	3.09	3.57	24.019%	20.070%
97	2.90	3.33	25.695%	21.716%
98	2.72	3.10	27.486%	23.485%
99	2.55	2.89	29.382%	25.379%
100	2.40	2.70	31.365%	27.395%
101	2.25	2.52	33.402%	29.499%
102	2.12	2.36	35.430%	31.619%
103	2.01	2.22	37.423%	33.746%
104	1.91	2.09	39.372%	35.849%
105	1.81	1.97	41.267%	37.920%
106	1.73	1.87	43.100%	39.952%
107	1.66	1.78	44.847%	41.902%
108	1.60	1.70	46.518%	43.777%
109	1.55	1.63	48.086%	45.567%
110	1.52	1.57	49.359%	47.253%
111	1.51	1.53	49.487%	48.847%
112	1.51	1.50	49.616%	49.731%
113	1.50	1.50	49.741%	49.820%
114	1.49	1.49	49.870%	49.905%
115	1.47	1.47	50.000%	50.000%
116	1.44	1.44	50.000%	50.000%
117	1.38	1.38	50.000%	50.000%
118	1.25	1.25	50.000%	50.000%
119	1.00	1.00	50.000%	50.000%
120	0.50	0.50	100.000%	100.000%

Employer	Current FAC Load	Proposed FAC Load
101	2.0%	2.0%
201	2.0%	2.0%
202	3.0%	3.0%
203	2.0%	2.0%
301	5.0%	5.0%
302	3.0%	3.0%
303	2.0%	2.0%
304	2.0%	2.0%
305	1.0%	1.0%
306	0.0%	1.0%
307	0.0%	1.0%
308	0.0%	1.0%
309	2.0%	2.0%
310	0.0%	1.0%
311	0.0%	1.0%
313	0.0%	1.0%
401	2.0%	2.0%
402	2.0%	2.0%
403	1.0%	1.0%
405	0.0%	1.0%
406	0.0%	1.0%
501	4.0%	4.0%
502	2.0%	2.0%
504	0.0%	1.0%
506	1.0%	1.0%
601	0.0%	1.0%
602	2.0%	2.0%
603	1.0%	1.0%
604	4.0%	4.0%
605	1.0%	1.0%
606	0.0%	1.0%
701	4.0%	4.0%
702	2.0%	2.0%
703	2.0%	2.0%
704	2.0%	2.0%
705	0.0%	1.0%
801	1.0%	1.0%
802	2.0%	2.0%
803	0.0%	1.0%
804	0.0%	1.0%
807	4.0%	4.0%
901	3.0%	3.0%
902	3.0%	3.0%
903	3.0%	3.0%
904	0.0%	1.0%
905	2.0%	2.0%
906	1.0%	1.0%
907	4.0%	4.0%
1001	2.0%	2.0%
1002	1.0%	1.0%

Employer	Current FAC Load	Proposed FAC Load
1003	2.0%	2.0%
1004	5.0%	5.0%
1005	0.0%	1.0%
1006	0.0%	1.0%
1007	1.0%	1.0%
1101	2.0%	2.0%
1102	1.0%	1.0%
1103	1.0%	1.0%
1104	0.0%	1.0%
1105	2.0%	2.0%
1106	0.0%	1.0%
1107	0.0%	1.0%
1108	0.0%	1.0%
1109	0.0%	1.0%
1110	0.0%	1.0%
1112	1.0%	1.0%
1113	0.0%	1.0%
1114	2.0%	2.0%
1115	7.0%	7.0%
1117	0.0%	1.0%
1118	0.0%	1.0%
1119	0.0%	1.0%
1120	0.0%	1.0%
1121	0.0%	1.0%
1201	3.0%	3.0%
1202	2.0%	2.0%
1203	5.0%	5.0%
1204	3.0%	3.0%
1205	3.0%	3.0%
1301	1.0%	1.0%
1302	3.2%	3.0%
1303	2.0%	2.0%
1304	0.0%	1.0%
1306	3.0%	3.0%
1308	0.0%	1.0%
1310	2.0%	2.0%
1311	2.0%	2.0%
1312	0.0%	1.0%
1313	0.0%	1.0%
1316	1.0%	1.0%
1401	1.0%	1.0%
1402	4.0%	3.0%
1403	2.0%	2.0%
1404	0.0%	1.0%
1405	0.0%	1.0%
1406	0.0%	1.0%
1501	1.0%	1.0%
1502	3.0%	3.0%
1503	2.0%	2.0%
1504	1.0%	1.0%

Employer	Current FAC Load	Proposed FAC Load
1505	3.0%	3.0%
1506	1.0%	1.0%
1507	0.0%	1.0%
1508	1.0%	1.0%
1509	1.0%	1.0%
1601	3.0%	3.0%
1602	2.2%	2.0%
1603	3.0%	3.0%
1604	1.0%	1.0%
1606	2.0%	2.0%
1701	4.0%	4.0%
1702	0.0%	1.0%
1703	2.0%	2.0%
1704	2.0%	2.0%
1705	1.0%	1.0%
1706	1.0%	1.0%
1707	2.0%	2.0%
1708	0.0%	1.0%
1709	0.0%	1.0%
1801	2.0%	2.0%
1802	2.0%	2.0%
1803	1.0%	1.0%
1804	1.0%	1.0%
1805	2.0%	2.0%
1806	0.0%	1.0%
1807	1.0%	1.0%
1901	4.0%	4.0%
1902	3.0%	3.0%
1903	3.0%	3.0%
1904	0.0%	1.0%
1905	2.0%	2.0%
1907	0.0%	1.0%
1908	2.0%	2.0%
1909	3.0%	3.0%
1910	2.0%	2.0%
2001	4.0%	4.0%
2002	2.0%	2.0%
2003	2.0%	2.0%
2004	3.0%	3.0%
2101	5.0%	5.0%
2102	3.0%	3.0%
2103	2.0%	2.0%
2105	2.0%	2.0%
2106	6.0%	6.0%
2107	0.0%	1.0%
2201	4.0%	4.0%
2202	3.5%	4.0%
2203	2.0%	2.0%
2204	7.3%	7.0%
2205	1.0%	1.0%

Employer	Current FAC Load	Proposed FAC Load
2206	5.0%	5.0%
2207	3.0%	3.0%
2301	2.0%	2.0%
2302	2.0%	2.0%
2303	2.0%	2.0%
2304	1.0%	1.0%
2305	2.0%	2.0%
2306	8.0%	8.0%
2307	1.0%	1.0%
2308	5.0%	5.0%
2309	2.0%	2.0%
2310	0.0%	1.0%
2312	1.0%	1.0%
2313	0.0%	1.0%
2316	0.0%	1.0%
2401	6.0%	6.0%
2402	3.0%	3.0%
2404	0.0%	1.0%
2405	3.0%	3.0%
2406	0.0%	1.0%
2407	0.0%	1.0%
2501	1.0%	1.0%
2502	4.0%	4.0%
2503	2.0%	2.0%
2504	2.0%	2.0%
2505	2.0%	2.0%
2506	1.0%	1.0%
2507	3.0%	3.0%
2508	1.0%	1.0%
2509	0.0%	1.0%
2510	3.0%	3.0%
2511	1.0%	1.0%
2512	2.0%	2.0%
2513	2.0%	2.0%
2514	3.0%	3.0%
2515	1.0%	1.0%
2516	3.0%	3.0%
2517	1.0%	1.0%
2518	2.0%	2.0%
2519	1.0%	1.0%
2521	2.3%	1.0%
2522	2.0%	2.0%
2523	1.0%	1.0%
2525	0.0%	1.0%
2530	6.1%	5.0%
2532	1.0%	1.0%
2601	7.0%	7.0%
2602	2.0%	2.0%
2605	1.0%	1.0%
2607	2.0%	2.0%
2608	0.0%	1.0%
2701	4.0%	4.0%
2702	2.0%	2.0%
2703	1.0%	1.0%
2704	1.0%	1.0%
2706	2.5%	2.5%
2801	2.0%	2.0%
2802	2.0%	2.0%
2803	2.0%	2.0%
2805	5.0%	5.0%
2807	1.0%	1.0%
2808	3.0%	3.0%
2809	1.0%	1.0%
2810	1.0%	1.0%
2811	0.0%	1.0%
2901	3.0%	3.0%
2902	2.0%	2.0%
2903	3.0%	3.0%
2904	2.0%	2.0%
2905	2.0%	2.0%
2906	1.0%	1.0%
2908	0.0%	1.0%
2909	0.0%	1.0%
3001	3.0%	3.0%
3002	2.0%	2.0%
3003	0.0%	1.0%
3004	4.0%	4.0%
3005	1.0%	1.0%
3006	1.0%	1.0%
3007	2.0%	2.0%
3101	2.0%	2.0%
3102	1.0%	1.0%
3103	3.0%	3.0%
3104	2.0%	2.0%
3105	0.0%	1.0%
3106	0.0%	1.0%
3107	2.0%	2.0%
3108	0.0%	1.0%
3109	1.0%	1.0%
3201	3.0%	3.0%
3202	4.0%	4.0%
3203	2.0%	2.0%
3204	3.0%	3.0%
3205	1.0%	1.0%
3206	0.0%	1.0%
3207	0.0%	1.0%
3208	0.0%	1.0%
3209	0.0%	1.0%
3211	2.0%	2.0%
3212	2.0%	2.0%
3214	0.0%	1.0%
3215	2.0%	2.0%
3301	5.0%	5.0%
3303	3.2%	3.0%
3304	4.9%	5.0%
3305	3.0%	3.0%
3307	2.0%	2.0%
3308	3.0%	2.0%
3310	3.6%	4.0%
3311	2.0%	2.0%
3313	1.0%	1.0%
3314	0.0%	1.0%
3315	1.0%	1.0%
3316	2.0%	2.0%
3317	1.0%	1.0%
3318	1.0%	1.0%
3319	0.0%	1.0%
3320	2.0%	2.0%
3401	3.0%	3.0%
3402	0.0%	1.0%
3403	3.0%	3.0%
3404	4.0%	4.0%
3405	1.0%	1.0%
3406	2.0%	2.0%
3407	0.0%	1.0%
3408	4.0%	4.0%
3410	2.0%	2.0%
3411	0.0%	1.0%
3412	1.0%	1.0%
3413	0.0%	1.0%
3501	2.0%	2.0%
3502	3.0%	3.0%
3503	1.0%	1.0%
3504	3.0%	3.0%
3601	6.0%	6.0%
3602	1.0%	1.0%
3603	5.0%	5.0%
3605	1.0%	1.0%
3606	3.0%	3.0%
3608	2.0%	2.0%
3611	0.0%	1.0%
3612	2.0%	2.0%
3614	0.0%	1.0%
3615	0.0%	1.0%
3617	0.0%	1.0%
3701	4.0%	4.0%
3702	2.2%	2.2%
3703	2.0%	2.0%
3704	0.0%	1.0%
3705	2.0%	2.0%

Employer	Current FAC Load	Proposed FAC Load
3707	2.0%	2.0%
3708	2.0%	2.0%
3709	0.0%	1.0%
3801	1.0%	1.0%
3802	3.0%	3.0%
3803	1.0%	1.0%
3804	1.0%	1.0%
3805	1.0%	1.0%
3806	3.0%	3.0%
3901	1.0%	1.0%
3902	0.0%	1.0%
3903	0.0%	1.0%
3904	1.0%	1.0%
3907	0.0%	1.0%
4001	2.0%	2.0%
4002	1.0%	1.0%
4003	1.0%	1.0%
4004	4.0%	4.0%
4005	0.0%	1.0%
4101	0.0%	1.0%
4102	3.0%	3.0%
4103	2.0%	2.0%
4104	2.0%	2.0%
4105	2.0%	2.0%
4106	1.0%	1.0%
4107	1.0%	1.0%
4108	3.0%	3.0%
4109	2.0%	2.0%
4110	1.0%	1.0%
4112	2.0%	2.0%
4116	0.0%	1.0%
4201	3.0%	3.0%
4202	1.0%	1.0%
4301	2.0%	2.0%
4302	1.0%	1.0%
4401	2.0%	2.0%
4402	2.0%	2.0%
4403	2.0%	2.0%
4404	2.0%	2.0%
4405	2.0%	2.0%
4406	0.0%	1.0%
4407	2.0%	2.0%
4408	0.0%	1.0%
4409	1.0%	1.0%
4410	1.0%	1.0%
4501	1.0%	1.0%
4503	2.0%	2.0%
4504	1.0%	1.0%
4506	0.0%	1.0%
4601	3.0%	3.0%
4602	2.0%	2.0%
4603	1.0%	1.0%
4604	0.0%	1.0%
4605	0.0%	1.0%
4606	2.0%	2.0%
4607	0.0%	1.0%
4701	1.0%	1.0%
4702	2.0%	2.0%
4703	1.0%	1.0%
4704	2.0%	2.0%
4705	0.0%	1.0%
4706	1.0%	1.0%
4707	1.0%	1.0%
4708	1.0%	1.0%
4709	2.0%	2.0%
4710	0.0%	1.0%
4711	0.0%	1.0%
4712	2.0%	2.0%
4713	0.0%	1.0%
4714	2.0%	2.0%
4715	0.0%	1.0%
4716	0.0%	1.0%
4717	0.0%	1.0%
4801	3.0%	3.0%
4802	1.0%	1.0%
4803	2.0%	2.0%
4804	1.0%	1.0%
4805	3.0%	3.0%
4806	1.0%	1.0%
4901	1.0%	1.0%
4902	3.0%	2.0%
4903	3.0%	3.0%
4904	3.0%	3.0%
4905	4.0%	4.0%
4906	5.0%	5.0%
5001	2.0%	2.0%
5002	4.0%	4.0%
5003	6.6%	7.0%
5005	0.0%	1.0%
5006	1.0%	1.0%
5007	2.0%	2.0%
5008	4.0%	4.0%
5009	2.0%	2.0%
5010	2.0%	2.0%
5011	0.0%	1.0%
5012	0.0%	1.0%
5014	2.0%	2.0%
5016	3.0%	3.0%
5019	7.7%	7.0%
5022	0.0%	1.0%
5101	1.0%	1.0%
5103	2.0%	2.0%
5104	2.0%	2.0%
5105	2.0%	2.0%
5107	1.0%	1.0%
5201	7.6%	7.0%
5202	3.0%	3.0%
5203	4.0%	4.0%
5204	4.0%	4.0%
5206	3.0%	3.0%
5207	1.0%	1.0%
5208	0.0%	1.0%
5209	3.0%	3.0%
5211	4.0%	4.0%
5212	8.0%	8.0%
5213	0.0%	1.0%
5214	3.0%	3.0%
5215	1.0%	1.0%
5216	2.0%	2.0%
5217	0.0%	1.0%
5218	0.0%	1.0%
5301	2.0%	2.0%
5302	2.0%	2.0%
5303	1.0%	1.0%
5304	3.0%	3.0%
5305	1.0%	1.0%
5308	2.0%	2.0%
5401	3.0%	3.0%
5402	4.0%	4.0%
5403	2.0%	2.0%
5405	2.0%	2.0%
5406	2.0%	2.0%
5501	1.0%	1.0%
5502	3.0%	3.0%
5503	4.0%	4.0%
5504	0.0%	1.0%
5601	5.0%	5.0%
5602	4.0%	4.0%
5603	0.0%	1.0%
5604	2.0%	2.0%
5702	1.0%	1.0%
5801	3.0%	3.0%
5802	3.0%	3.0%
5803	0.0%	1.0%
5804	1.0%	1.0%
5805	4.0%	4.0%
5806	0.0%	1.0%
5807	0.0%	1.0%
5808	2.0%	2.0%
5810	2.0%	2.0%

Employer	Current FAC Load	Proposed FAC Load
5812	0.0%	1.0%
5901	2.0%	2.0%
5902	0.0%	1.0%
5904	1.0%	1.0%
5905	2.0%	2.0%
5906	1.0%	1.0%
5907	6.4%	6.0%
6001	3.0%	3.0%
6002	0.0%	1.0%
6101	3.0%	3.0%
6102	2.0%	2.0%
6103	3.0%	2.0%
6104	2.0%	2.0%
6105	0.0%	1.0%
6106	3.0%	3.0%
6107	1.0%	1.0%
6108	1.0%	1.0%
6109	1.0%	1.0%
6110	2.0%	2.0%
6111	0.0%	1.0%
6112	3.0%	3.0%
6113	0.0%	1.0%
6114	0.0%	1.0%
6115	2.0%	2.0%
6116	2.0%	2.0%
6117	1.0%	1.0%
6201	2.0%	2.0%
6203	2.0%	2.0%
6204	1.0%	1.0%
6205	0.0%	1.0%
6206	2.0%	2.0%
6207	2.0%	2.0%
6208	1.0%	1.0%
6209	1.0%	1.0%
6211	0.0%	1.0%
6212	1.0%	1.0%
6214	0.0%	1.0%
6301	2.0%	2.0%
6302	3.0%	3.0%
6303	3.0%	3.0%
6304	3.0%	3.0%
6305	1.0%	1.0%
6306	2.0%	2.0%
6307	1.0%	1.0%
6308	4.0%	4.0%
6309	2.0%	2.0%
6310	1.0%	1.0%
6311	2.0%	2.0%
6312	1.0%	1.0%
6313	1.0%	1.0%
6314	1.0%	1.0%
6315	4.0%	4.0%
6316	6.0%	6.0%
6317	2.0%	2.0%
6318	3.0%	3.0%
6319	2.0%	2.0%
6320	2.0%	2.0%
6321	1.0%	1.0%
6322	2.0%	2.0%
6323	1.0%	1.0%
6324	4.0%	4.0%
6325	1.0%	1.0%
6326	2.0%	2.0%
6327	0.0%	1.0%
6328	2.0%	2.0%
6329	2.0%	2.0%
6332	0.0%	1.0%
6333	0.0%	1.0%
6335	0.0%	1.0%
6336	0.0%	1.0%
6343	5.0%	5.0%
6345	0.0%	1.0%
6401	2.0%	2.0%
6402	2.0%	2.0%
6403	0.0%	1.0%
6501	1.0%	1.0%
6502	1.0%	1.0%
6503	2.0%	2.0%
6504	0.0%	1.0%
6505	2.0%	2.0%
6506	1.0%	1.0%
6508	0.0%	1.0%
6509	0.0%	1.0%
6602	2.0%	2.0%
6603	2.0%	2.0%
6604	2.0%	2.0%
6701	2.0%	2.0%
6702	2.0%	2.0%
6703	1.0%	1.0%
6704	1.0%	1.0%
6705	1.0%	1.0%
6706	0.0%	1.0%
6801	2.0%	2.0%
6802	2.0%	2.0%
6803	2.0%	2.0%
6901	3.0%	3.0%
6902	2.0%	2.0%
6903	2.0%	2.0%
6904	0.0%	1.0%
7001	4.0%	4.0%
7002	3.0%	3.0%
7003	2.0%	2.0%
7004	0.0%	1.0%
7005	2.0%	2.0%
7007	0.0%	1.0%
7008	1.0%	1.0%
7009	0.0%	1.0%
7010	2.0%	2.0%
7011	1.0%	1.0%
7012	3.0%	3.0%
7013	1.0%	1.0%
7014	0.0%	1.0%
7015	1.0%	1.0%
7016	2.0%	2.0%
7018	0.0%	1.0%
7101	3.0%	3.0%
7102	3.0%	3.0%
7103	2.0%	2.0%
7104	2.0%	2.0%
7105	0.0%	1.0%
7106	0.0%	1.0%
7201	1.0%	1.0%
7202	0.0%	1.0%
7203	0.0%	1.0%
7205	3.0%	3.0%
7301	12.0%	12.0%
7303	1.0%	1.0%
7304	3.0%	3.0%
7305	2.0%	2.0%
7306	2.0%	2.0%
7307	2.0%	2.0%
7308	3.0%	3.0%
7309	1.0%	1.0%
7310	2.0%	2.0%
7311	2.0%	2.0%
7312	8.0%	8.0%
7313	5.0%	5.0%
7314	5.0%	5.0%
7315	0.0%	1.0%
7316	3.0%	3.0%
7317	0.0%	1.0%
7318	2.0%	2.0%
7319	1.0%	1.0%
7320	1.0%	1.0%
7321	7.0%	7.0%
7322	1.0%	1.0%
7323	0.0%	1.0%
7401	2.0%	2.0%
7402	0.0%	1.0%
7403	1.0%	1.0%

Employer	Current FAC Load	Proposed FAC Load
7404	0.0%	1.0%
7405	0.0%	1.0%
7407	0.0%	1.0%
7410	0.0%	1.0%
7501	4.0%	4.0%
7503	1.0%	1.0%
7504	4.0%	4.0%
7505	2.0%	2.0%
7506	1.0%	1.0%
7601	5.0%	5.0%
7602	2.0%	2.0%
7603	1.0%	1.0%
7604	2.3%	2.0%
7605	0.0%	1.0%
7606	0.0%	1.0%
7607	4.0%	4.0%
7608	0.0%	1.0%
7609	1.0%	1.0%
7610	0.0%	1.0%
7611	0.0%	1.0%
7701	1.0%	1.0%
7702	4.0%	4.0%
7703	1.0%	1.0%
7705	1.0%	1.0%
7706	1.0%	1.0%
7707	2.0%	2.0%
7708	2.0%	2.0%
7709	3.0%	3.0%
7711	2.0%	2.0%
7712	5.0%	5.0%
7715	0.0%	1.0%
7801	2.9%	3.0%
7803	2.0%	2.0%
7804	0.0%	1.0%
7805	0.0%	1.0%
7806	0.0%	1.0%
7901	1.0%	1.0%
7902	3.0%	3.0%
7903	2.0%	2.0%
7904	0.0%	1.0%
7905	0.0%	1.0%
7906	2.0%	2.0%
7907	2.0%	2.0%
7908	1.0%	1.0%
8001	2.0%	2.0%
8002	4.0%	4.0%
8003	0.0%	1.0%
8005	7.0%	7.0%
8006	3.0%	3.0%
8007	3.0%	3.0%

Employer	Current FAC Load	Proposed FAC Load
8010	0.0%	1.0%
8101	3.0%	3.0%
8102	6.0%	6.0%
8103	2.0%	2.0%
8104	8.0%	8.0%
8105	5.0%	5.0%
8106	8.4%	8.0%
8107	0.0%	1.0%
8109	1.0%	1.0%
8110	1.0%	1.0%
8111	1.0%	1.0%
8112	1.0%	1.0%
8113	5.0%	5.0%
8115	2.0%	2.0%
8116	1.0%	1.0%
8117	0.0%	1.0%
8118	0.0%	1.0%
8201	4.0%	4.0%
8202	0.0%	1.0%
8203	2.0%	2.0%
8205	3.0%	3.0%
8206	5.6%	6.0%
8207	7.0%	7.0%
8208	4.0%	4.0%
8209	10.0%	10.0%
8210	4.0%	4.0%
8211	3.0%	3.0%
8212	2.0%	2.0%
8213	3.8%	4.0%
8215	3.0%	3.0%
8216	3.0%	2.0%
8217	1.0%	1.0%
8218	3.0%	3.0%
8219	0.0%	1.0%
8220	0.0%	1.0%
8221	1.0%	1.0%
8222	1.0%	1.0%
8223	1.0%	1.0%
8224	4.0%	4.0%
8225	3.0%	3.0%
8226	0.0%	1.0%
8228	1.0%	1.0%
8229	2.0%	2.0%
8230	4.0%	4.0%
8231	0.0%	1.0%
8232	1.0%	1.0%
8233	3.0%	3.0%
8234	3.0%	3.0%
8235	3.0%	3.0%
8236	0.0%	1.0%

Employer	Current FAC Load	Proposed FAC Load
8237	0.0%	1.0%
8238	2.0%	2.0%
8241	2.0%	2.0%
8242	0.0%	1.0%
8243	3.0%	3.0%
8244	4.0%	4.0%
8247	1.0%	1.0%
8250	0.0%	1.0%
8251	0.0%	1.0%
8252	0.0%	1.0%
8255	3.0%	3.0%
8260	4.4%	4.0%
8262	0.0%	1.0%
8301	1.0%	1.0%
8302	3.0%	3.0%
8303	2.0%	2.0%
8304	1.0%	1.0%
8305	2.0%	2.0%
8306	0.0%	1.0%
8401	1.0%	1.0%
8402	0.0%	1.0%
8403	0.0%	1.0%
8404	0.0%	1.0%

Glossary

The following glossary is intended to provide definitions of a number of terms which are used throughout this report and which are somewhat unique to the discussion of an Experience Study.

Actuarial Decrement. The actual number of decrements which occurred during the study. This number is a straight tabulation of the actual number of occurrences of the particular decrement in question. Normally, the actual number of decrements will be subdivided by age and possibly sex.

Aggregate Assumptions. Assumptions which vary only by sex and/or age. The impact of year of service on the decrement is ignored. All experience is combined by age and/or sex without regard to service. Rates of death and disablement are more appropriate to aggregate measurement in a retirement system.

Crude Rate of Decrement. The rate of decrement determined by dividing the actual number of the respective decrement for that age and sex by the corresponding exposure for that age and sex. The rate is described as a crude rate because no smoothing or elimination of statistical fluctuations has been made. It is indicative of the underlying true rate of the decrement and is the basis used in graduation to obtain the graduated or tabular rate.

Decrements. The decrements are the means by which a member ceases to be a member. For active members, the decrements are death, withdrawal, service retirement, and disability retirement. For retired members, the only decrement is death. The purpose of the Experience Study is to determine the underlying rates of each decrement.

Expected Decrement. This is the number of occurrences of a given decrement expected to occur for a given age and sex based on the number of lives exposed to the risk of the particular decrement and the current assumed rate for that decrement. It may also be referred to as the tabular number of decrements. It is the number of deaths, withdrawals, retirements, or disabilities (whichever is applicable) that would have actually occurred had the actuarial assumptions been exactly realized.

Exposure. The number of lives exposed to a given risk of decrement for a particular age and sex. It represents the number of members who could have potentially died, retired, become disabled, or withdrawn at that particular age and for that particular sex. This term will also be described as "the number exposed to a given risk."

Graduated Rates. Graduation is the mathematical process by which a set of crude rates of a particular type is translated into graduated or tabular rates. The graduation process attempts to smooth out statistical fluctuations and to arrive at a set of rates that adequately fit the underlying actual experience of the crude rates that are being graduated. The graduation process involves smoothing the results, but at the same time trying to fit the results to be consistent with the original data. It requires that the actuary exercise his or her judgment in what the underlying shape of the risk curve should look like.

Interpolated Rates. For the active rates of decrement (death, disability, retirement, and withdrawal), the actuary will develop graduated rates based on quinquennial age groupings (see definition). To arrive at the rates of decrement for ages between two quinquennial ages, the graduated quinquennial rates must be interpolated for these intermediate ages. The interpolated results are arrived at by applying a mathematical interpolation formula to the quinquennial graduated rates.

Merit and Seniority Pay Increase Rate. The portion of the total salary scale which varies by service. It reflects the impact of moving up the salary grid in a given year, rather than the increase in the overall grid. It includes the salary increase associated with promotions during the year.

Quinquennial Age Groupings. For the active decrements, it is preferable to group the experience in five-year age groups for graduation and analysis purposes so as to minimize statistical fluctuations resulting from a lack of exposure which may occur for individual ages. Quinquennial age grouping is the five-year age grouping which is used to develop the graduated rates of decrement for active membership. The quinquennial age is the central age of the five-year grouping.

Tabular Rates. The tabular rate of decrement or salary increase is the rate determined by the graduation and interpolation process. It is the expected rate of change as opposed to the crude rate of change. It is deemed to be the underlying rate applicable to the decrement or to the rate of salary increase. In the first phase of the study, the actual results are compared to the expected results based on the tabular rates developed by the previous study. The second phase of the study determines the new tabular rates based on the crude rates. The final phase of the study compares the actual decrement to the expected decrement based on the new tabular rates.

Wage Inflation. The general rate of increase in salaries during a year. It is the component of the total salary scale which is independent of age or service. It consists of two components: inflation and productivity increases. It may be viewed as the ultimate rate of increase if there are no more step-rate/promotional increases applicable.