OHIO STATE HIGHWAY PATROL RETIREMENT SYSTEM

ACTUARIAL EXPERIENCE STUDY
May 18, 2020

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Retirement Board
Ohio State Highway Patrol Retirement System
1900 Polaris Parkway, Suite 201
Columbus, OH 43240-4037

Re: Draft Actuarial Experience Study

Dear Board:

The following report presents the results of an experience study on the actuarial assumptions of the Ohio State Highway Patrol Retirement System (OHPRS or the System) during the five-year period from December 31, 2013 to December 31, 2018. The report includes a review of demographic and economic experience, a comparison of this experience to current actuarial assumptions, and our suggestions for consideration regarding changes in assumptions or methods to be effective for the December 31, 2019 actuarial valuation. In addition, the report details the estimated actuarial impact of these potential changes, determined as if the changes would have had been made on the December 31, 2018 valuation.

This report has been prepared for OHPRS and its stakeholders by Foster & Foster, Inc. to document the results of the experience study and is intended to be used by the System as it reviews the potential changes to assumptions and methods. Additionally, the findings, conclusions, and recommendations for consideration presented in this report are specific to OHPRS, and the plans sponsored by OHPRS. Foster & Foster may produce different findings or arrive at different conclusions in other situations or even in cases involving similar plans. As such, it is important to keep in mind that the use of this information for purposes other than those expressed here may not be appropriate.

In preparing this report, we compiled experience for the Plans using data furnished by the System. While we have not audited the information provided, the supplied information was reviewed for consistency and reasonableness. We have no reason to doubt the substantial accuracy of the information and believe it has produced appropriate results.

The study was prepared in accordance with the applicable Actuarial Standards of Practice issued by the Actuarial Standards Board.

Future actuarial measurements may differ significantly from current measurements due to such factors as: plan experience differing from that anticipated by the assumptions; changes in assumptions; increases or decreases expected as part of the natural operation of the methodology used; changes in plan provisions or applicable law.

The funded status measurements included in this report are based on the assumptions and methods used to determine the Plans' obligations and asset values as of December 31, 2018. Funded status measurements for financial accounting purposes may not be appropriate for assessing the sufficiency of System assets to cover the estimated cost of settling its benefit obligations. Likewise, funded status measurements for financial accounting purposes may not be appropriate for assessing the need for or the amount of future actuarially determined contributions. Funded status measurements for funding purposes would also be different if market values of assets were used instead of actuarial asset values.

Foster & Foster does not provide legal, investment or accounting advice. Thus, the information in this report is not intended to supersede or supplant the advice or the interpretations of the System or its affiliated legal, investing or accounting partners.

The undersigned are familiar with the relevant aspects of retirement and other postemployment benefit valuations and collectively meet the Qualification Standards of the American Academy of Actuaries necessary to render the actuarial opinions contained herein. All the sections of this report, including any appendices and attachments, are considered an integral part of the actuarial opinions.

We look forward to presenting the conclusions and discussing the suggested changes for consideration contained in this report to the Board and are available to answer any questions concerning its contents.

Respectfully submitted,

FOSTER & FOSTER INC.

By: _____
Bradley R. Heinrichs, FSA, EA, MAAA

By: _____
Drew D. Ballard, EA, MAAA

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SECTION I. INTRODUCTION

The purpose of this study is to review the current economic and demographic assumptions used in the actuarial valuations of the Plan to determine which changes, if any, should be considered to achieve the objective of developing costs that are stable, predictable, and represent our best estimate of anticipated future experience.

The ultimate cost of any defined benefit pension plan is the sum of the benefits paid from the plan and the administrative expenses incurred, less any net investment gains received. Therefore, the actual cost of the plan will only be known after all benefits accrued by the members are paid to the members or their beneficiaries. Since members who retire, become disabled, terminate or die are continuously replaced by new employees, the exact cost to the System cannot be determined at any one point in time. To determine if the scheduled contribution rates can meet the actual costs over a reasonable period of time, the actuary must make certain demographic and economic assumptions about future contingent events. Economic assumptions include salary growth and investment growth, both of which include inflation as a component. The demographic assumptions include rates of retirement, withdrawal, disability, and mortality.

Although the ultimate cost is independent of the actuarial assumptions used to determine the amortization period over which contributions will pay for these benefits, the assumptions should reflect the actuary's best estimate of future plan experience. If the assumptions are inappropriate or do not reflect the long-term plan experience, the plan will incur experience gains (decreases in the amortization period) or experience losses (increases in the amortization period).

The specific assumptions investigated throughout the remainder of this study are as follows:

- Retirement Rates
- Withdrawal Rates
- Disability Rates
- Mortality Rates
- Investment Return
- Salary Increases
- Inflation
- Payroll Growth Rate
- DROP Experience
- Marriage Percentage
- Administrative expense
- Medical/Rx and Dental/Vision Election, and Spouse Coverage Assumptions used in measurements of the Post-Retirement Healthcare Program's obligations.

Actuarial Standards of Practice

Background

The Actuarial Standards Board (ASB) is responsible for determining which actuarial activities are the best representations of generally accepted actuarial principles, and issuing guidance in the form of Actuarial Standards of Practice (ASOPs) to help actuaries in various practice areas deliver results and recommendations that are consistent with those representations. Generally speaking, ASOPs identify what the actuary should consider, document, and disclose when performing actuarial assignments.

The experience study and related measurements of benefit obligations for the System's plans are subject to the "coordinated guidance" provided in various ASOPs[1], including but not limited to:

- ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, which ties together the standards shown below, provides guidance on actuarial cost methods, and addresses overall considerations for measuring pension obligations and determining plan costs or contributions

- ASOP No. 6, *Measuring Retiree Group Benefits Obligations and Determining Retiree Group Benefits Program Periodic Costs or Actuarially Determined Contributions*

- ASOP No. 23, *Data Quality*

- ASOP No. 25, *Credibility Procedures*

- ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*

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

- ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*

- ASOP No. 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*

This report refers to ASOPs by number (e.g. ASOP 4) throughout. It is important to keep in mind that this experience study report only reflects the guidance provided in the final releases of the aforementioned ASOPs issued by the ASB on or before the date of this report. The results provided in this report reflect the requirements of, and are consistent with the applicable aforementioned Actuarial Standards of Practice. When applicable, details from the relevant ASOP will be provided in the report section associated with a particular analysis or topic.

[1] Please note that ASOP Nos. 27, 35, and 44 may also apply to measurements of obligations and determinations of costs and/or actuarially determined contributions for retiree group benefit programs even though their titles only refer to "pensions".

Experience Review Summary

Foster & Foster performed an experience study on valuation data for the years December 31, 2013 through December 31, 2018. The purpose of this study is to review and provide suggested updates to the assumptions used by the System for the Pension Fund. Below is a summary of our key findings and suggested changes for your consideration. The remainder of the document provides details of our analysis and documents our suggestions. The impact on the accrued liabilities, and amortization period, for each assumption change is summarized on Section VI. of this document.

- **Retirement Rates**: We recommend the Board consider amending the retirement rates at many ages to better reflect experience.

- **Withdrawal Rates**: We recommend the Board consider slight increases to the withdrawal rates.

- **Disability Rates**: We recommend the Board consider slight decreases to the disability rates and increase the percentage of disabilities assumed to be service-incurred from 50% to 55%.

- **Mortality Rates**: We recommend the Board consider updating the RP-2014 Combined mortality rates to the following and the mortality improvement projection scale to MP-2019:
    - Active members – PubS-2010 (amount-weighted) employee tables
    - Retirees/VTs – PubS-2010 (amount-weighted) healthy retiree tables adjusted by 94%
    - Survivors – PubS-2010 (amount-weighted, above-median) contingent survivor tables adjusted by 105%
    - Disabled – PubS-2010 (amount-weighted) disabled retiree tables

- **Investment Return**: Since investment consultant's projections suggest future returns for this portfolio will range from 6.7% to 7.8%, we feel the 7.25% assumption is supported and do not recommend any change to the assumed rate of return.

- **Salary Increases:** We recommend the Board consider updating the salary increase rates to reflect higher increases at many service points.

- **Payroll Growth Rate**: We recommend the Board consider lowering the payroll growth assumption used for purposes of amortizing the Unfunded Actuarial Accrued Liability (UAAL).

- **Inflation Rate:** We recommend no change to current 2.50% inflation rate assumption.

- **Marriage Assumptions**: We recommend the Board consider an increase from 75% to 80% for active members that are assumed to be married for purposes of the automatic survivor coverage.

- **DROP Experience:** We recommend the Board consider decreasing the number of years members are assumed to participate in DROP from 8 years to 5 years, and also consider an assumption that 15% of active members eligible for unreduced retirement/DROP do not enter the DROP or retire in any given year prior to age 60.

- **Administrative Expense Assumption**: We recommend the Board consider amending the administrative expense load (applied to the normal cost rate) to be based on the average of the actual expenses incurred in the prior two years instead of being a fixed rate.

SECTION II. EXPERIENCE ANALYSIS – DEMOGRAPHIC ASSUMPTIONS

ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*, provides guidance to actuaries in selecting (including giving advice on selecting) demographic and other noneconomic assumptions for measuring obligations under defined benefit pension plans.

In this section, the following demographic assumptions will be reviewed:

- Retirement Rates
- Withdrawal Rates
- Disability Rates
- Mortality Rates
- DROP Experience

Generally, demographic assumptions are based on actual plan experience with additional considerations for current trends. ASOP No. 35 states "the actuary should use professional judgment to estimate possible future outcomes based on past experience and future expectations, and select assumptions based upon application of that professional judgment." ASOP No. 35 also states that "a reasonable assumption is one that is expected to appropriately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses, the actuary should not give undue weight to past experience when selecting demographic assumptions."

Demographic assumptions generally remain consistent over time, absent significant changes in plan provisions. Therefore, the best true indicator of future experience is often past experience. For each assumption, the study compares actual experience for that time period to assumptions used in the valuations.

Note that actuarial assumptions reflect average experience over long periods of time. A change in actuarial assumptions generally results when experience over a period of years indicates a consistent pattern. Suggested changes for consideration to the demographic assumptions better reflect actual Plan experience over the studied time period. The suggested changes also meet the objective of developing costs that are stable, predictable, and represent our best estimate of anticipated future experience.

Retirement Rates

Overview

A retirement rate is the associated probability at a specific point in time that a member will retire, given that they have attained the eligibility requirements for retirement. The associated cost due to retirement experience is determined by the age at which members actually retire.

The current requirements for unreduced normal retirement eligibility are as follows:

1. Age 48 and 25 years of service, for members hired prior to January 1, 2020, or
2. Age 52 and 20 years of service

The current requirement for reduced early retirement eligibility is as follow:

1. Age 48 and 20 years of service

Current Assumption

The current retirement rate assumption for the plan reflects one age-based table for members. All members are assumed to retire by age 60. In addition, it is currently assumed that 100% of eligible members age 55 and older would retire upon attaining 34 or more years of service.

Experience

The charts and graphs on the following pages illustrate the relationship between actual retirement experience over the last five years and expected experience based on the current assumption. The "Eligible Members" column sums the total number of members eligible to retire at each age for all years of experience studied.

In total, when comparing these assumptions to the actual experience shown on the following charts, the actual experience incurred during the study was slightly lower than the current unreduced normal retirement assumptions and greater than the current reduced early retirement assumptions. The total expected number of unreduced normal retirements was 218.7 and the actual number of unreduced normal retirements was 211. The actual unreduced normal retirement experience at ages 55+ was generally lower than expected. The total expected number of reduced early retirements was 5.5 and the actual number of reduced early retirements was 17.

- Table 1: Unreduced Benefit Normal Retirement Experience
- Table 2: Reduced Benefit Early Retirement Experience
- Graph 1: Unreduced Benefit Normal Retirement Experience
- Graph 2: Reduced Benefit Early Retirement Experience

Recommended Assumption for Consideration

In general, we recommend slight adjustments to the assumed rates of unreduced normal and reduced early retirement. Due to the mandatory retirement age based on Ohio Revised Code 5505.16 (C), we recommend keeping the 100% retirement age as age 60. Based on actual experience, we recommend removing the assumption that 100% of eligible members age 55 and older will retire upon attaining 34 or more years of service.

An illustration of the expected retirements using the suggested rates is included in the charts that follow.

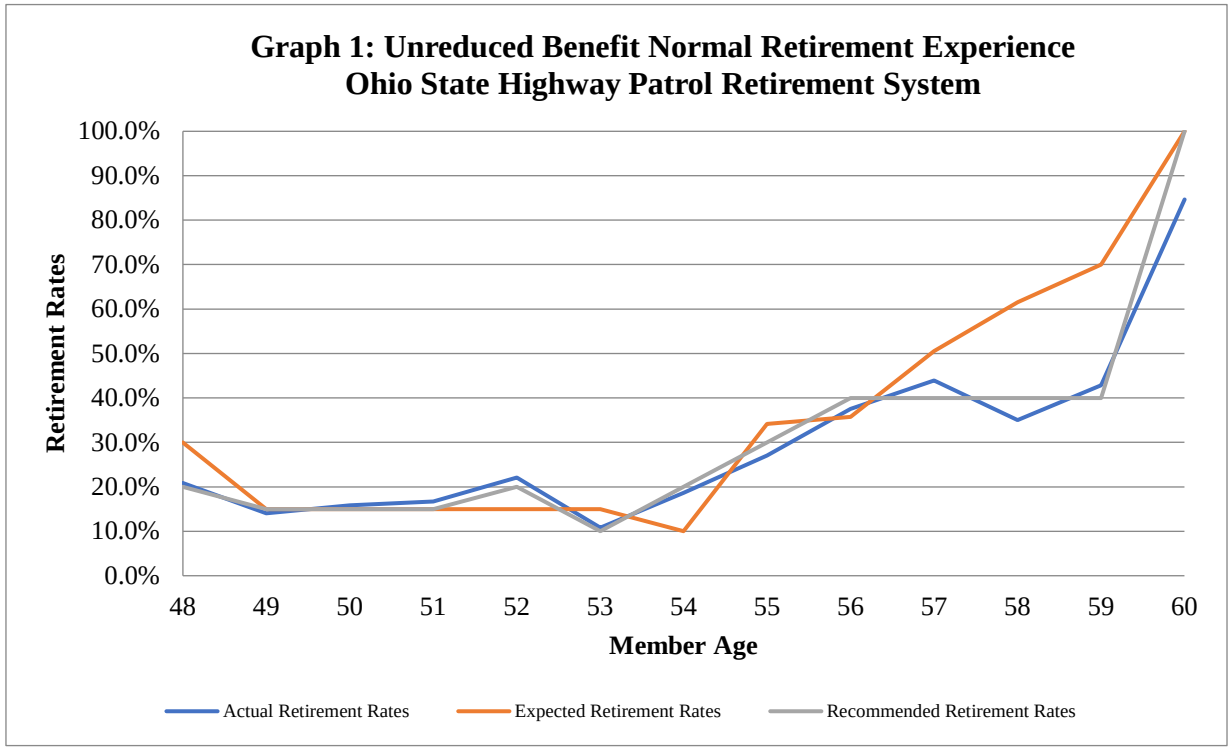
Ohio State Highway Patrol Retirement System

Table 1 - Unreduced Benefit Normal Retirement Experience*

Age	Eligible Members	Actual Retirements	Expected Retirements	Recommended Retirements	Actual Retirement Rates	Expected Retirement Rates	Recommended Retirement Rates
48	48	10	14.4	9.6	20.8%	30.0%	20.0%
49	114	16	17.1	17.1	14.0%	15.0%	15.0%
50	120	19	18.0	18.0	15.8%	15.0%	15.0%
51	114	19	17.1	17.1	16.7%	15.0%	15.0%
52	136	30	20.4	27.2	22.1%	15.0%	20.0%
53	111	12	16.7	11.1	10.8%	15.0%	10.0%
54	102	19	10.2	20.4	18.6%	10.0%	20.0%
55	85	23	29.0	25.5	27.1%	34.1%	30.0%
56	56	21	20.0	22.4	37.5%	35.7%	40.0%
57	41	18	20.7	16.4	43.9%	50.5%	40.0%
58	20	7	12.3	8.0	35.0%	61.5%	40.0%
59	14	6	9.8	5.6	42.9%	70.0%	40.0%
60	13	11	13.0	13.0	84.6%	100.0%	100.0%
Total**	**974**	**211**	**218.7**	**211**	**21.7%**	**22.4%**	**21.7%**
			Prior Experience				
2010-2014	**894**	**195**	**177.0**		**21.8%**	**19.8%**	

*Data from December 31, 2013 through December 31, 2018.

**Total rates are based on the number of incidences divided by the number of exposures and do not represent an average of the numbers above.


Graph 1: Unreduced Benefit Normal Retirement Experience
Ohio State Highway Patrol Retirement System
Retirement Rates
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
48
49
50
51
52
53
54
55
56
57
58
59
60
Member Age
Actual Retirement Rates
Expected Retirement Rates
Recommended Retirement Rates

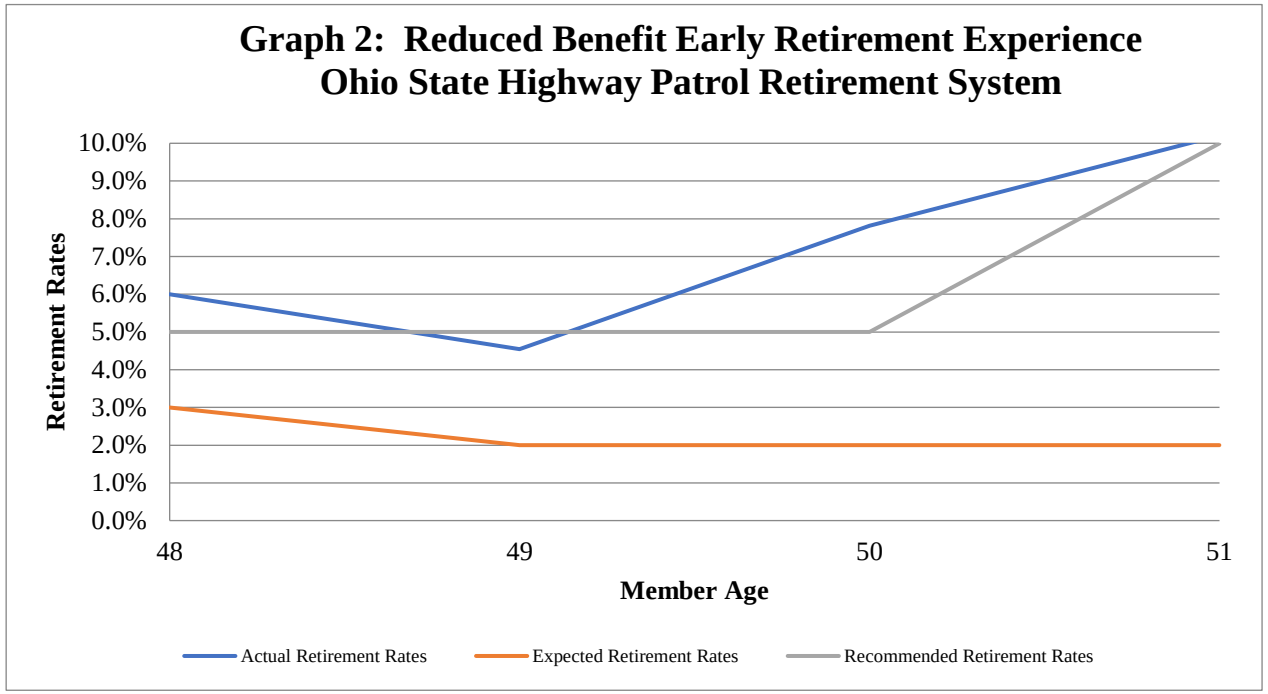
Ohio State Highway Patrol Retirement System

Table 2 - Reduced Benefit Early Retirement Experience*

Age	Eligible Members	Actual Retirements	Expected Retirements	Recommended Retirements	Actual Retirement Rates	Expected Retirement Rates	Recommended Retirement Rates
48	50	3	1.5	2.5	6.0%	3.0%	5.0%
49	88	4	1.8	4.4	4.5%	2.0%	5.0%
50	64	5	1.3	3.2	7.8%	2.0%	5.0%
51	49	5	1.0	4.9	10.2%	2.0%	10.0%
Total**	**251**	**17**	**5.5**	**15**	**6.8%**	**2.2%**	**6.0%**
			Prior Experience				
2010-2014	**260**	**5**	**9.0**		**1.9%**	**3.5%**	

*Data from December 31, 2013 through December 31, 2018.

**Total rates are based on the number of incidences divided by the number of exposures and do not represent an average of the numbers above.


Graph 2: Reduced Benefit Early Retirement Experience
Ohio State Highway Patrol Retirement System
Retirement Rates
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
48
49
50
51
Member Age
Actual Retirement Rates
Expected Retirement Rates
Recommended Retirement Rates

Withdrawal Rates

Overview
The withdrawal rate, or termination rate, is the probability that a member will separate employment from a cause other than disability, death, or retirement. This includes members who terminate and receive a refund of contributions.

Current Assumption
The current withdrawal assumption reflects one service-based table for members, with rates decreasing from 10% at employment to 0.5% near retirement.

Experience
The following charts compare actual termination experience to the current assumption. In total, actual termination experience was slightly heavier than expected.

- Table 3: Withdrawal Experience
- Graph 3: Withdrawal Experience

Recommended Assumption for Consideration
We are proposing slight increases to the withdrawal rates. The recommended rates are detailed in the experience charts.

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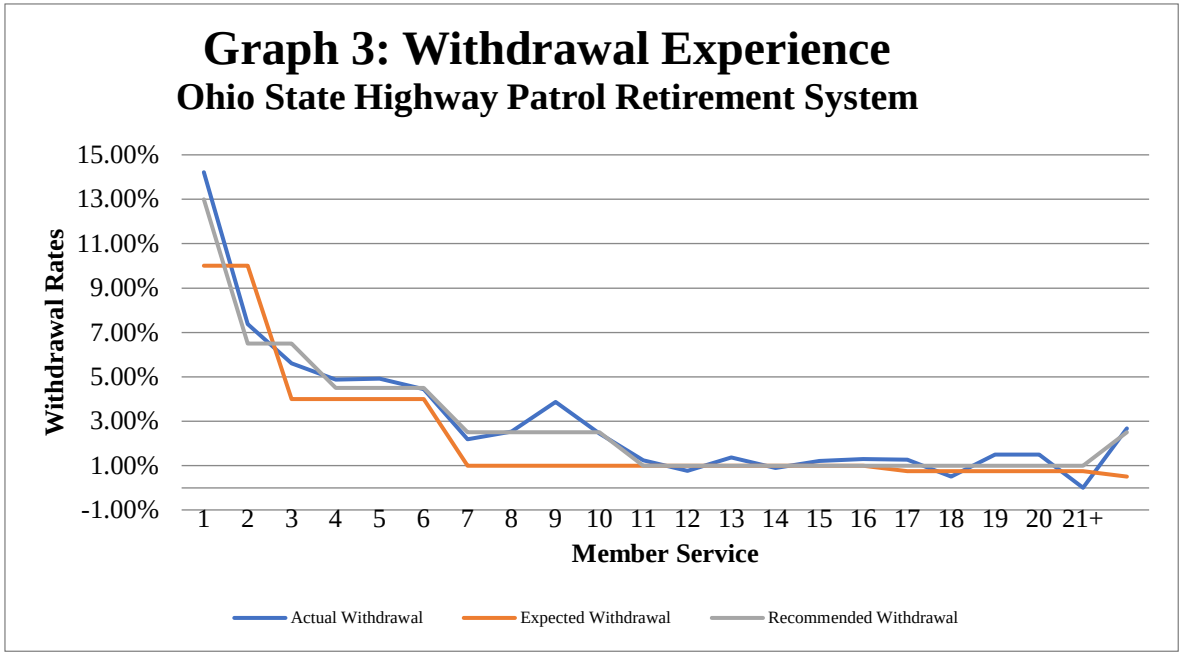
Table 3: Withdrawal Experience *

Service	Exposures	Actual Terminations	Expected Terminations	Recommended Terminations	Actual Withdrawal	Expected Withdrawal	Recommended Withdrawal
0	211	30	21.1	27.4	14.22%	10.00%	13.00%
1	502	37	50.2	32.6	7.37%	10.00%	6.50%
2	463	26	18.5	30.1	5.62%	4.00%	6.50%
3	390	19	15.6	17.6	4.87%	4.00%	4.50%
4	325	16	13.0	14.6	4.92%	4.00%	4.50%
5	270	12	10.8	12.2	4.44%	4.00%	4.50%
6	183	4	1.8	4.6	2.19%	1.00%	2.50%
7	158	4	1.6	4.0	2.53%	1.00%	2.50%
8	155	6	1.6	3.9	3.87%	1.00%	2.50%
9	205	5	2.1	5.1	2.44%	1.00%	2.50%
10	242	3	2.4	2.4	1.24%	1.00%	1.00%
11	264	2	2.6	2.6	0.76%	1.00%	1.00%
12	291	4	2.9	2.9	1.37%	1.00%	1.00%
13	336	3	3.4	3.4	0.89%	1.00%	1.00%
14	331	4	3.3	3.3	1.21%	1.00%	1.00%
15	384	5	3.8	3.8	1.30%	1.00%	1.00%
16	395	5	3.0	4.0	1.27%	0.75%	1.00%
17	394	2	3.0	3.9	0.51%	0.75%	1.00%
18	333	5	2.5	3.3	1.50%	0.75%	1.00%
19	268	4	2.0	2.7	1.49%	0.75%	1.00%
20	179	0	1.3	1.8	0.00%	0.75%	1.00%
21+	672	18	3.4	16.8	2.68%	0.50%	2.50%
Total	**6,951**	**214**	**169.9**	**203.0**	**3.08%**	**2.44%**	**2.92%**
			Prior Experience				
2010-2014	**6,702**	**156**	**90.0**		**2.33%**	**1.34%**	

*Data from December 31, 2013 through December 31, 2018.


Graph 3: Withdrawal Experience
Ohio State Highway Patrol Retirement System
Withdrawal Rates
15.00%
13.00%
11.00%
9.00%
7.00%
5.00%
3.00%
1.00%
-1.00%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21+
Member Service
Actual Withdrawal
Expected Withdrawal
Recommended Withdrawal

Disability Rates

Overview

The disability rate assumption is the probability that a Member will become disabled while he or she is an active participant in the retirement system.

The overall cost due to disability depends on the plan's disability provisions. The benefit provisions for Members who separate employment due to disability are different than the provisions for Normal Retirement and can be more valuable. It is possible that an active Member who is already eligible to retire becomes disabled, and as a result of that disability, is entitled to receive a larger immediate benefit than if he or she had retired.

It is also important to note that the level of disability benefits received depends on whether the disability was service-related or non-service-related. For example, to receive benefits for non-service-related disabilities in the retirement system, there is a five year eligibility requirement. Therefore, to measure the liabilities associated with the disability contingency, an assumption for the portion of disabilities due to service-related disabilities is necessary.

Determining future incidence of disability is difficult. Therefore, a review of past experience compared to the current assumption will provide the basis for examining the assumption.

Current Assumption

Currently, the assumed disability rates are expressed by age. The rates vary by age, with the probabilities of disability being 0.08% at age 20 to 1.32% at age 52. 50% of disabilities assumed to be service-incurred.

Experience

As can be seen on the following table, the overall disability experience has been about 47% lower than expected. We also reviewed the incidence of service-related disabilities versus non-service-related disabilities. Over the studied period, approximately 58% of the disabilities were service-related.

- Table 4: Disability Experience
- Graph 4: Disability Experience

Recommended Assumption for Consideration

We are proposing slight decreases to the age-based disability rates. The recommended rates are detailed in the experience charts. We are also proposing an increase from 50% to 55% of disabilities that are assumed to be service-incurred.

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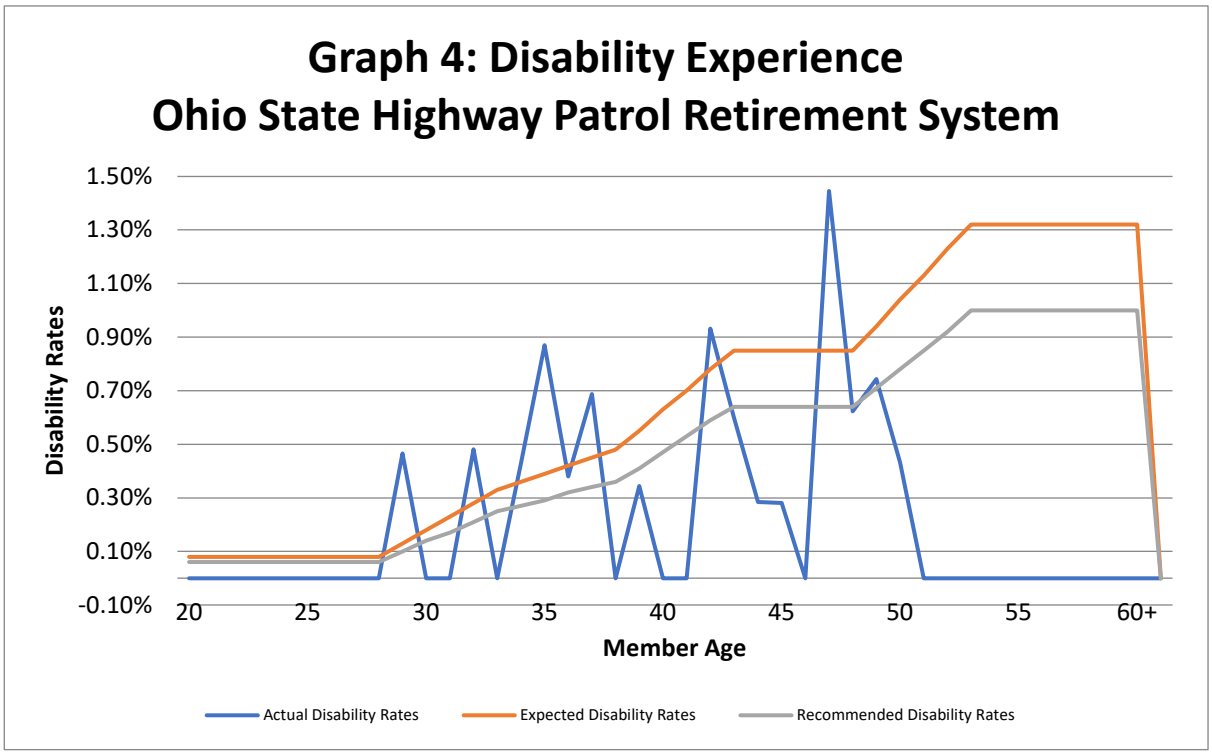
Table 4: Disability Experience *

Age	Exposures	Actual Disabilities	Expected Disabilities	Recommended Disabilities	Actual Disability Rates	Expected Disability Rates	Recommended Rates
<20	0	0	0.0	0.0	0.00%	0.08%	0.06%
20	0	0	0.0	0.0	0.00%	0.08%	0.06%
21	23	0	0.0	0.0	0.00%	0.08%	0.06%
22	96	0	0.1	0.1	0.00%	0.08%	0.06%
23	156	0	0.1	0.1	0.00%	0.08%	0.06%
24	203	0	0.2	0.1	0.00%	0.08%	0.06%
25	212	0	0.2	0.1	0.00%	0.08%	0.06%
26	250	0	0.2	0.2	0.00%	0.08%	0.06%
27	232	0	0.2	0.1	0.00%	0.08%	0.06%
28	215	1	0.3	0.2	0.47%	0.13%	0.10%
29	212	0	0.4	0.3	0.00%	0.18%	0.14%
30	206	0	0.5	0.4	0.00%	0.23%	0.17%
31	208	1	0.6	0.4	0.48%	0.28%	0.21%
32	232	0	0.8	0.6	0.00%	0.33%	0.25%
33	234	1	0.8	0.6	0.43%	0.36%	0.27%
34	230	2	0.9	0.7	0.87%	0.39%	0.29%
35	263	1	1.1	0.8	0.38%	0.42%	0.32%
36	291	2	1.3	1.0	0.69%	0.45%	0.34%
37	270	0	1.3	1.0	0.00%	0.48%	0.36%
38	291	1	1.6	1.2	0.34%	0.55%	0.41%
39	329	0	2.1	1.5	0.00%	0.63%	0.47%
40	334	0	2.3	1.8	0.00%	0.70%	0.53%
41	322	3	2.5	1.9	0.93%	0.78%	0.59%
42	334	2	2.8	2.1	0.60%	0.85%	0.64%
43	352	1	3.0	2.3	0.28%	0.85%	0.64%
44	356	1	3.0	2.3	0.28%	0.85%	0.64%
45	354	0	3.0	2.3	0.00%	0.85%	0.64%
46	346	5	2.9	2.2	1.45%	0.85%	0.64%
47	321	2	2.7	2.1	0.62%	0.85%	0.64%
48	269	2	2.5	1.9	0.74%	0.94%	0.71%
49	231	1	2.4	1.8	0.43%	1.04%	0.78%
50	192	0	2.2	1.6	0.00%	1.13%	0.85%
51	153	0	1.9	1.4	0.00%	1.23%	0.92%
52	123	0	1.6	1.2	0.00%	1.32%	1.00%
53	107	0	1.4	1.1	0.00%	1.32%	1.00%
54	85	0	1.1	0.9	0.00%	1.32%	1.00%
55	56	0	0.6	0.6	0.00%	1.32%	1.00%
56	41	0	0.4	0.4	0.00%	1.32%	1.00%
57	20	0	0.2	0.2	0.00%	1.32%	1.00%
58	14	0	0.1	0.1	0.00%	1.32%	1.00%
59	10	0	0.0	0.1	0.00%	1.32%	1.00%
60+	3	0	0.0	0.0	0.00%	0.00%	0.00%
Total	**8,176**	**26.0**	**49.3**	**37.7**	**0.32%**	**0.60%**	**0.46%**
				Prior Experience			
2010-2014	**6,451**	**29**	**36.0**		**0.45%**	**0.56%**	

*Data from December 31, 2013 through December 31, 2018.


Graph 4: Disability Experience
Ohio State Highway Patrol Retirement System
1.50%
1.30%
1.10%
0.90%
0.70%
0.50%
0.30%
0.10%
-0.10%
Disability Rates
20
25
30
35
40
45
50
55
60+
Member Age
Actual Disability Rates
Expected Disability Rates
Recommended Disability Rates

Mortality Rates

Overview

The rate of mortality is the probability of death at a given age. While mortality is a contingency for both the active and retiree populations, it has the greatest cost implications for retirees. If retirees live longer than anticipated by the assumptions, benefits will be paid longer than expected and experience losses will develop. If retirees do not live as long as anticipated by the assumptions, experience gains will develop.

The actuarial profession has increasingly become more focused on the issue of future mortality improvement. Mortality rates have declined over time as advances in medical care have evolved. The extent of future mortality improvement will impact the magnitude of pension costs and liabilities for future benefit commitments. ASOP No. 35 discusses the importance of actuaries considering mortality improvements when measuring pension obligations. Specifically, an actuary should make and disclose a specific recommendation with respect to future mortality improvement after the measurement date. Mortality improvement can be accounted for with static or generational mortality tables. A static table includes a projection of the base mortality rates to a specific date or equivalently for a specific number of years. The same mortality rates at any given age apply to everyone. A generational table anticipates future improvements in mortality by using a different static mortality table for each year of birth, with the tables for later years of birth assuming lower mortality than the tables of earlier years of birth.

Credibility procedures employed in our analysis used a statistical approach to combine actual mortality experience with standard mortality tables to improve the estimate of future mortality.

Current Assumption

The current mortality assumption is the RP-2014 mortality table for males and females, adjusted for mortality improvement back to the base year of 2006 for males and 2012 for females, with generational mortality improvements using Scale MP-2018. Separate tables are used for employees, healthy and disabled annuitants.

Experience

Experience was reviewed for annuitants and actives separately. For a plan to develop a mortality table based solely on its own experience it must have hundreds of thousands of lives and thousands of deaths at each age and sex. However, many plans provide enough credible experience to adjust a published table by multiplying the mortality rates in the published table by the ratio of actual to expected deaths over a studied period. We employed this methodology by first identifying a standard published table with mortality rates that have a similar shape as the actual plan membership. Since the rate at each age in the adjusted mortality table will be a multiple of the rate at that age from the standard published table, close attention was given to the shape of the standard published table in making the selection.

Once the appropriate standard published table was selected, we determined the multiple to adjust rates based on OHPRS experience by using the limited fluctuation approach to credibility, as described in the Society of Actuaries Credibility Educational Resource for Pension Actuaries, issued in August 2017. Using this approach, 1,082 deaths (on a counts-weighted basis) are needed to provide full credibility based on a 90% confidence level and a 5% margin of error, but more than 1,082 deaths are needed on an amounts-weighted basis. If the experience data is fully credible, then the rates from the standard published table are multiplied by the ratio of the actual to expected deaths to create the plan mortality table. When there are fewer than the 1,082 deaths needed for full credibility, the limited fluctuations approach allows some of the plan's actual experience to be used to adjust the standard published table.

Annuitants:
Mortality rates for retirees and survivors are much more significant to the valuation since mortality rates are significantly higher for this group. Given that the vast majority of healthy OHPRS retirees are male and survivors are female, we reviewed the mortality experience of healthy male retirees and female survivors during the five-year study period. Total actual deaths are less than the current valuation assumption expected for retirees and about the same for survivors. Using the credibility approach described on the previous page, we found that with 90 deaths, benefit payments in the amount of $3.1 million for male annuitants, the experience was 27.2% credible on an amounts-weighted basis. For female survivor annuitants, the plan experienced 63 deaths, benefit payments in the amount of $1.0 million, resulting in the experience being 23.5% credible on an amounts-weighted basis. In selecting a standard published table, we considered the current RP-2014 Combined Healthy Mortality table and the PubS-2010 (amount-weighted) Public Retirement Plans Mortality Table (PubS-2010) published by the Society of Actuaries for annuitants and survivors.

We found that for male annuitants, the PubS-2010 table provided a closer match to the total Actual/Expected (A/E) ratio, while the current RP-2014 table is closer for female survivor annuitants. The A/E ratios using the current RP-2014 were 0.66 and 0.99 for male annuitants and female survivor annuitants respectively. The corresponding ratios using the PubS-2010 tables were 0.78 and 1.22 for male annuitants and female survivor annuitants, respectively. In addition, after adjusting the standard published tables with the multiples determined using the credibility method, the PubS-2010 tables provided the closer overall fit to actual plan experience. Therefore, the recommended mortality table for annuitants is the PubS-2010 healthy retiree table adjusted by a factor of 94%; for survivor annuitants, we recommend the PubS-2010 contingent survivor table adjusted by 105%.

Active Mortality:
Mortality rates for active members are much less significant to the valuation since mortality rates are significantly lower for active members than for retirees. The low number of active member deaths results in an insufficient number of deaths needed to provide fully credible experience on which to develop the system's mortality rates. Using the credibility approach previously identified, we found that with 5 deaths, the plan's experience was only 6.8% credible (on a counts-weighted basis). Given the low credibility ratings of the data and minimal impact of active mortality experience on liabilities, we recommend using the standard published mortality table, PubS-2010 employee tables.

Disability Retiree Mortality:
Over the studied period, disabled mortality experience was not sufficient to be credible (6 deaths in total). Given this limited experience, we recommend using the standard published mortality table, PubS-2010 disabled retiree tables.

Future Mortality Improvement:
To address expected future mortality improvement, we recommend adjusting the above base tables using the most recently published mortality improvement scale, Scale MP-2019. The charts and graphs listed below compare actual experience to expected experience using the current and recommended assumption tables. Experience was reviewed separately for Retirees and for Survivors.

- Table 5: Retirees Mortality Experience
- Graph 5: Retirees Mortality Experience
- Table 6: Survivor Mortality Experience
- Graph 6: Survivor Mortality Experience

Recommended Assumption for Consideration
We recommend replacing the current RP-2014 Combined Healthy mortality tables to the following:

- Active members – PubS-2010 (amount-weighted) employee tables
- Retirees/VTs – PubS-2010 (amount-weighted) healthy retiree tables adjusted by 94%
- Survivors – PubS-2010 (amount-weighted, above-median) contingent survivor tables adjusted by 105%
- Disabled – PubS-2010 (amount-weighted) disabled retiree tables

We also recommend updating the mortality improvement projection scale from Scale MP-2018 to Scale MP-2019.

Ohio State Highway Patrol Retirement System

Table 5: Retirees Mortality Expereince - Healthy Male Retirees

Age	Actual Death Weighted by Annuity $ in thousand	Total Annuity $ in thousand	Actual Rate	Assumed Rate		Expected Deaths Weighted By Annuity $ in thousand		Actual/Expected	
				Current	Recommended	Current (3) * (5)	Recommended (3) * (6)	Current (2) / (7)	Recommended (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
45-49	$ -	$ 1,770.2	0.000000	0.001532	0.001352	$ 2.7	$ 2.4	0%	0%
50-54	49.6	19,111.9	0.002594	0.005075	0.002028	97.0	38.8	51%	128%
55-59	93.0	42,285.3	0.002199	0.006831	0.003459	288.8	146.2	32%	64%
60-64	76.2	44,395.1	0.001716	0.009467	0.006113	420.3	271.4	18%	28%
65-69	365.3	53,960.7	0.006769	0.013958	0.010095	753.2	544.7	48%	67%
70-74	451.1	47,965.1	0.009404	0.021070	0.016926	1010.6	811.9	45%	56%
75-79	731.2	24,607.0	0.029715	0.034157	0.029999	840.5	738.2	87%	99%
80-84	383.2	9,166.8	0.041799	0.059073	0.054817	541.5	502.5	71%	76%
85-89	646.4	5,316.0	0.121592	0.100791	0.098761	535.8	525.0	121%	123%
90-94	247.0	1,122.8	0.220030	0.168441	0.166976	189.1	187.5	131%	132%
95-99	73.2	217.9	0.336107	0.261903	0.236489	57.1	51.5	128%	142%
Totals	$3,116.1	$249,918.8				$4,736.7	$3,820.1	66%	82%

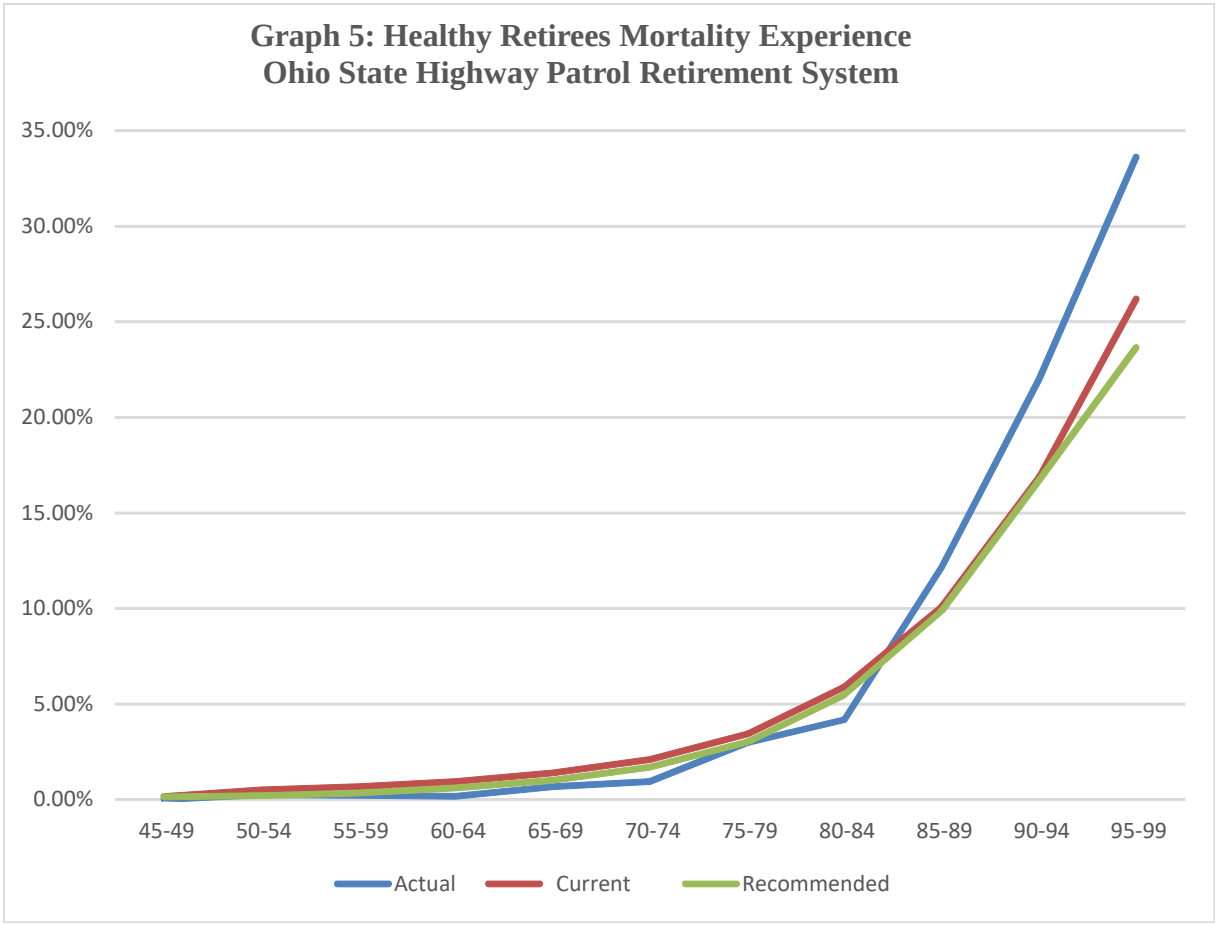
Data from December 31, 2013 through December 31, 2018.

Current Mortality Table RP-2014 Healthy Annuitant mortality table for males; based year=2006; Fully Generational with MP-2018

Propsoed Mortality Table PubS-2010 (amount-weighted) healthy retiree table; based year=2010; project 5 years beyond the valuation date with MP-2019; Adjusted by 0.94

Credibility factor 27.2%

Number of deaths needed for full credibility on an amounts-weighted basis: 1219


Graph 5: Healthy Retirees Mortality Experience
Ohio State Highway Patrol Retirement System
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
Actual
Current
Recommended

Ohio State Highway Patrol Retirement System

Table 6: Survivors Mortality Experience -Healthy Female Survivors

Age	Actual Death Weighted by Annuity $ in thousand	Total Annuity $ in thousand	Actual Rate	Assumed Rate		Expected Deaths Weighted By Annuity $ in thousand		Actual/Expected	
				Current	Recommended	Current (3) * (5)	Recommended (3) * (6)	Current (2) / (7)	Recommended (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
45-49	$ -	$ 328.0	0.000000	0.000904	0.002866	$ 0.3	$ 0.9	0%	0%
50-54	-	655.2	0.000000	0.003200	0.003754	2.1	2.5	0%	0%
55-59	2.8	632.2	0.004463	0.004749	0.005498	3.0	3.5	94%	81%
60-64	-	1,455.6	0.000000	0.007677	0.007341	11.2	10.7	0%	0%
65-69	14.0	3,137.9	0.004474	0.011863	0.009586	37.2	30.1	38%	47%
70-74	31.2	3,639.2	0.008580	0.018405	0.014185	67.0	51.6	47%	60%
75-79	56.7	2,697.4	0.021011	0.030042	0.023529	81.0	63.5	70%	89%
80-84	157.9	3,325.1	0.047501	0.052320	0.041603	174.0	138.3	91%	114%
85-89	390.6	3,770.7	0.103599	0.090332	0.076678	340.6	289.1	115%	135%
90-94	225.9	1,240.0	0.182212	0.145636	0.135010	180.6	167.4	125%	135%
95-99	114.5	459.0	0.249465	0.230677	0.219941	105.9	101.0	108%	113%
100-104	16.4	55.6	0.294461	0.311012	0.327248	17.3	18.2	95%	90%
Totals	$1,010.2	$21,396.0				$1,020.2	$876.8	99%	115%

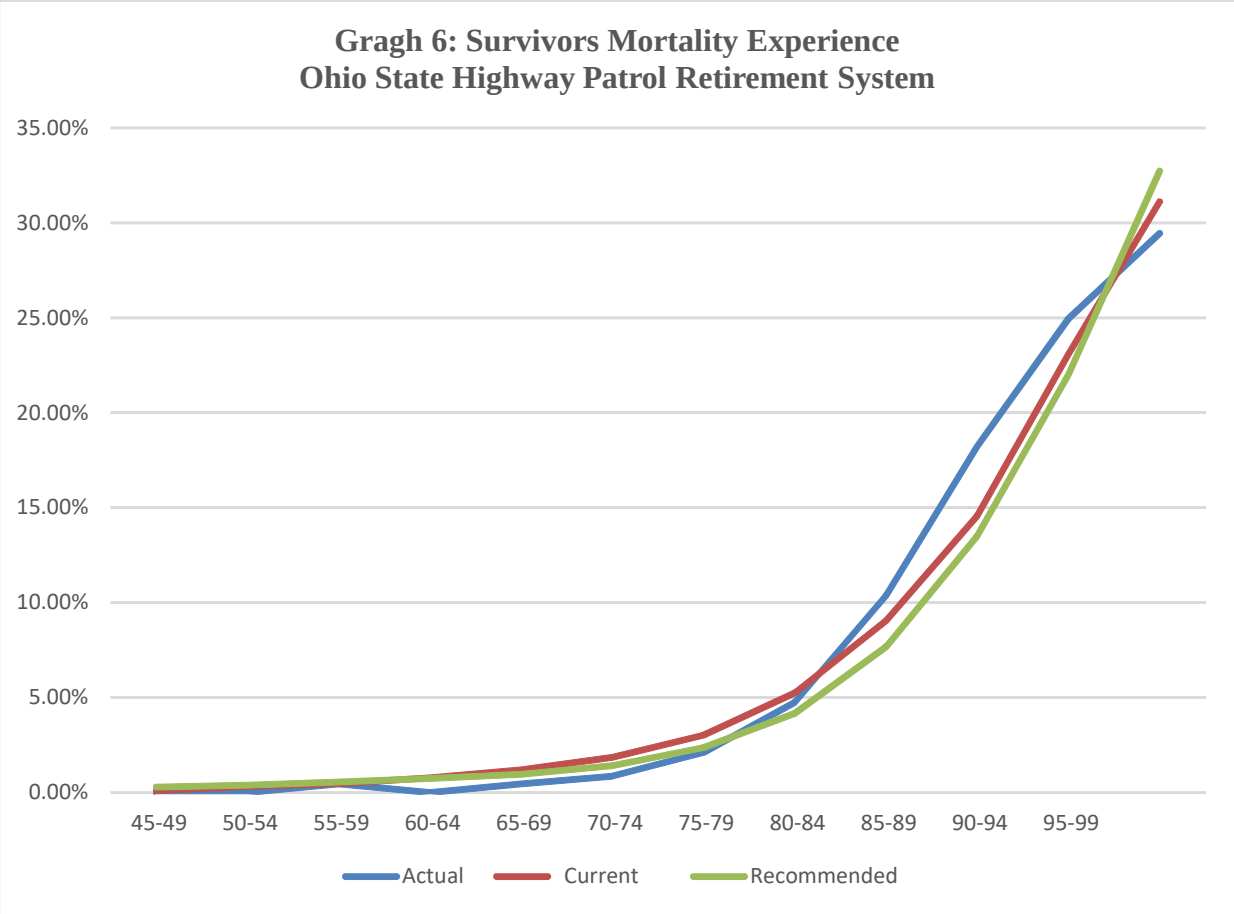
Data from December 31, 2013 through December 31, 2018.

Current Mortality Table RP-2014 Healthy Annuitant mortality table for females; based year=2012; Fully Generational with MP-2018

Propsoed Mortality Table PubS-2010 (amount-weighted, above-median) contingent survivor tables; based year=2010; project 5 years beyond the valuation date with MP-2019; Adjusted by 1.05

Credibility factor 23.5%

Number of deaths needed for full credibility on an amounts-weighted basis: 1137


Gragh 6: Survivors Mortality Experience
Ohio State Highway Patrol Retirement System
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85-89
90-94
95-99
Actual
Current
Recommended

DROP Experience

Overview

The DROP program was established in 2006 and affords eligible members a one-time election to "DROP in" upon attainment of unreduced retirement eligibility. The primary features of DROP include:

- During participation in DROP, members continue to make contributions based upon the member contribution rate. While participating in DROP, 100% of member contributions, up to 10% of payroll, are deposited to their DROP account. Any member contributions above 10% of pay are retained by the System
- 100% of the member's computed benefit (based upon service and salary at the time of DROP), including any scheduled post-retirement increases, is credited to the member's DROP account.
- The DROP account is credited with interest based upon a rate of return set by the Board.
- A member who enters DROP must stay in DROP for a minimum period of time based on age at the time of DROP entry. There is a minimum participation period of three (3) years for members who enter DROP prior to age 52, and two (2) years for members who enter DROP on or after age 52. After a maximum of eight (8) years in the DROP program or attaining age 60, whichever comes first, the member who entered the DROP program must retire.
- Once a member elects to participate in DROP, his/her contributions are committed for the minimum period (2 or 3 years). If the member voluntarily discontinues DROP participation prior to the minimum participation period, the member will not receive any interest credits to the DROP account but will receive all accumulated pension benefits and pension contributions deposited into the DROP account at the end of the minimum participation period.

Current Assumption

Currently, the valuation assumes that members eligible to DROP would either retire or "DROP in" at first eligibility for unreduced retirement. 100% of members still working 8 years after first reaching retirement eligibility are assumed to retire.

Experience

In Table 7 that follows, we have summarized members who were eligible to participate in the DROP over the period January 1, 2014 through December 31, 2018 and found that the DROP program is being utilized quite extensively. Based on the details presented on Table 7, 18.3% of active members did not retire or "DROP in" at first eligibility during the five-year study period. In addition, we also analyzed the average number of years of participation for members who elected to enter the DROP, as shown below:

Year	DROP Retirees	Average Years in DROP
2014	32	5.35
2015	28	4.57
2016	30	4.78
2017	43	4.91
2018	24	4.41
2014-2018	157	4.84

Recommended Assumption for Consideration

Given these results, we propose lowering the number of assumed years of DROP participation from 8 years to 5 years. Further, we propose incorporating an assumption that 15% of active members eligible for unreduced retirement/DROP do not enter DROP or retire at any given age prior to age 60.

Ohio State Highway Patrol Retirement System

Table 7: Retirement and DROP Experience

January 1, 2014 through December 31, 2018

	2013		2014		2015		2016		2017	
Active Members First Eligible for Unreduced Retirement/DROP	46		40		54		49		68	
Members Who Did Not DROP or Retire	9	19.6%	5	12.5%	12	22.2%	7	14.3%	14	20.6%
DROPed*	30	65.2%	24	60.0%	26	48.1%	31	63.3%	36	52.9%
Retired	7	15.2%	11	27.5%	16	29.6%	11	22.4%	18	26.5%
		100.0%		100.0%		100.0%		100.0%		100.0%
What Happened to Members Who Did Not DROP or Retire when First Eligible??	9 Continuing Active		5 Continuing Active		12 Continuing Active		7 Continuing Active		14 Continuing Active	
Retired in 2018	1		0		2		0		1	
Retired in 2017	0		0		3		0			
Retired in 2016	1		1		0					
Retired in 2015	2		1							
Retired in 2014	3									
Remain in Employment as of December 31, 2018	2		3		7		7		13	
DROPed After 1st Year of Eligibility	3		1		6		4		7	
What Happened to DROP Members??	30 DROPed in		24 DROPed in		26 DROPed in		31 DROPed in		36 DROPed in	
Retired in 2018	1		5		2		4		3	
Retired in 2017	7		4		2		7			
Retired in 2016	6		3		4					
Retired in 2015	7		2							
Retired in 2014	3									
Remain in Employment as of December 31, 2018	5		10		18		20		33	
Deceased without beneficary	1									

** Includes members who DROPed and retired in the same year.*

SECTION III. EXPERIENCE ANALYSIS – ECONOMIC ASSUMPTIONS

ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations,* provides guidance to actuaries in selecting (including giving advice on selecting) economic assumptions – primarily investment return, discount rate, and salary scale – for measuring obligations under defined benefit pension plans.

Throughout the remainder of this section, we have used the standards set forth in ASOP No. 27 as a guideline for reviewing and if applicable, selecting recommended changes to the following economic actuarial assumptions:

- Investment Return
- Salary Increases
- Inflation
- Payroll Growth Rate (used for amortizing the Unfunded Actuarial Accrued Liability)

Please keep in mind that ASOP No. 27 states that "the best an actuary can do is to use professional judgment to estimate possible future economic outcomes based on past experience and future expectations, and to select assumptions based upon that application of professional judgment."

Investment Return Assumption

Overview

The investment return assumption used in actuarial valuations should be set in accordance with Actuarial Standard of Practice No. 27. Beginning with valuation dates after September 30, 2014, the ASOP eliminates the requirement that the investment return assumption falls within a "best-estimate range of anticipated future experience." The new standard requires each economic assumption be set based on the actuary's estimate of future experience or on the actuary's observations of market estimates. Therefore, the assumption should be set based on the long-term expectation of the plan as determined by the investment policy statement, target asset allocation and capital market assumptions.

Current Assumption

The current assumption is 7.25% per year, net of investment-related expenses.

Experience and Analysis

Historical Returns

ASOP No. 27 states that the actuary should evaluate relevant data, such as recent and long-term historical economic data, without giving undue weight to recent experience. Historical experience is not a reliable indicator of future experience. Future performance by asset class may vary significantly from historical performance and the current (and target) asset allocation of the trust, which significantly impacts future performance, is likely different than prior allocations.

Historical returns are summarized in the table below. Over the past ten (10) years, the average rates of return were 8.35% and 6.75% on market and actuarial value basis, respectively. During those 10 years, the annual rate of return has exceeded the 7.25% assumption 50% of the time on the market value basis and 40% of the time on the actuarial value basis.

	Rate of Return	
Year	Market value	Actuarial Value
2018	-5.00%	3.60%
2017	14.40%	6.40%
2016	6.60%	7.10%
2015	-0.90%	8.20%
2014	6.20%	8.00%
2013	18.40%	9.50%
2012	10.70%	9.60%
2011	-2.70%	3.10%
2010	13.10%	5.80%
2009	22.70%	6.20%

Average	8.35%	6.75%

Expected Return from GASB 67

In determining the investment return assumption, we determine the average rate of return the Fund expects to achieve based on the target allocation along with the corresponding capital market assumptions. Foster & Foster is an actuarial firm, and we do not have the required expertise to produce our own capital market assumptions. For purposes of illustrating this concept, we have included long term expected real rate of return information disclosed in the December 31, 2018 GASB 67 report.

The Fund's current investment policy statement is based on recommendations of the Investment Consultant, the Chief Investment Officer and Staff. The 2020 target allocations are as follows:

Asset Class	Target Allocation	Long-Term Expected Real Rate of Return	Expected Investment Return
Fixed Income			
Opportunistic	8.0%	2.66%	0.21%
Core Fixed Income	10.0%	1.03%	0.10%
Cash	2.0%	0.05%	0.00%
Domestic Equity			
Large/Mid Cap	25.0%	4.78%	1.20%
Small/Micro Cap	5.0%	5.77%	0.29%
International Equity			
Developed Markets	14.0%	5.94%	0.83%
Emerging Market	4.0%	8.01%	0.32%
Alternative Investments			
Absolute Return	9.0%	3.87%	0.35%
Private Equity	11.0%	8.02%	0.88%
Real Assets	5.0%	3.70%	0.19%
Real Estate	7.0%	4.30%	0.30%
Total	**100.0%**		**4.67%**

Based on this target allocation and long term expected real rate of return information disclosed in the December 31, 2018 GASB 67 report, the average arithmetic expected return is 7.17%. Please keep in mind this return is net of investment-related expenses, as well as the assumed 2.50% inflation rate.

Other Investment Consultants

We referenced Horizon Actuarial Services, LLC, 2019 survey of other consulting firms to assess how the above return expectations compare to other consulting firms. The 2019 survey is based upon the capital market assumptions of 34 investment advisors participating in the survey. Of the participating advisors, 18 provided one set of assumptions for varying terms of 10 to 15 years. The remaining 16 advisors provided assumptions over both shorter-term (5 to 10 years) and longer-term (20 years or more) horizons. The survey refers to the longer term returns as 20-year assumptions and states that the longer-term horizon is more appropriate for mature ongoing pension plans without solvency issues, similar to OHPRS.

We mapped the Fund's target portfolio allocation to the average 10-year and 20-year survey assumptions. Using the survey's average expected returns for all asset categories, and the associated standard deviation and covariance matrix, but substituting the inflation assumption of 2.20% and 2.50%, the resulting expected long-term nominal returns are summarized in the table below:

	Expected Geometric Return	
Inflation	10 - Year Average	20 - Year Average
2.20%	6.69%	7.51%
2.50%	7.01%	7.82%

The returns in the survey are generally considered to be indexed and net of fees, so they are comparable to the assumptions used to determine the expected arithmetic return of 7.17% previously described. Therefore, the 7.25% expected return assumption currently utilized is not unsupported.

Recommended Assumption for Consideration

Based on our analysis, we do not recommend any particular change to the assumed rate of investment returns at this time. We believe the decision to modify the investment return assumption should be made based on advice from your investment consultants. For illustration purposes, we have determined the actuarial impact of potential changes to the assumed rate of investment return in Section VI.

Salary Increases

Overview

The salary increase assumption is used to project a member's salary from the valuation date until the assumed retirement age. Salary increase assumptions are typically represented as a flat salary scale assumption or as a service-based assumption. A flat salary scale assumption assumes that a member will get the same rate of salary increase for all years, whereas a service-based table may assume different rates based on the member's longevity with the System.

The salary increase assumption plays an important role in measuring individual pension costs and obligations.

Current Assumption

Currently, the valuation assumes a service-related salary scale with rates grading from 13.5% to 3.8%.

Experience

On the following pages, we have included a service-based chart that compares the actual experience to the current assumption. The average salary increases over the studied period was 6.04%, which is more than the assumed average increase of 5.52%. As can be seen in the following charts, members generally received higher than assumed salary increases prior to completion of 12 years of service.

- Table 8: Average Salary Increases by Service
- Graph 8: Average Salary Increases by Service

Recommended Assumption for Consideration

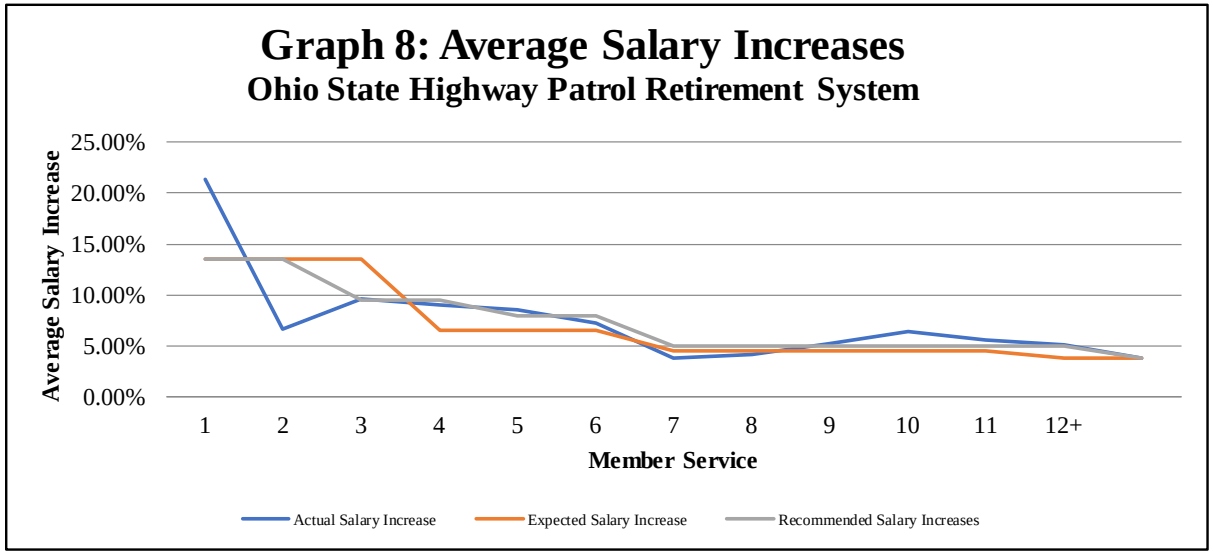
Given these results, we propose amending the current salary increase table to reflect the actual plan experience, as shown on the following charts. Please note the recommendation includes no change to the assumed rate upon completion of 12 or more years of service.

Ohio State Highway Patrol Retirement System

Table 8: Average Salary Increases by Service*

Service	Eligible Members	Prior Year Salary	Actual Salary	Expected Salary	Recommended Salary	Actual Salary Increase	Expected Salary Increase	Recommended Salary Increase
0	865	35,521,687	43,105,483	40,317,115	40,317,115	21.35%	13.50%	13.50%
1	378	18,616,771	19,857,451	21,130,035	21,130,035	6.66%	13.50%	13.50%
2	330	16,850,579	18,479,473	19,125,407	18,451,384	9.67%	13.50%	9.50%
3	282	15,454,828	16,851,415	16,459,391	16,923,037	9.04%	6.50%	9.50%
4	245	14,549,591	15,790,933	15,495,315	15,713,558	8.53%	6.50%	8.00%
5	156	9,274,961	9,952,059	9,877,833	10,016,958	7.30%	6.50%	8.00%
6	157	9,363,792	9,721,018	9,785,162	9,831,982	3.81%	4.50%	5.00%
7	172	10,221,250	10,647,231	10,681,207	10,732,313	4.17%	4.50%	5.00%
8	212	12,672,935	13,337,747	13,243,217	13,306,582	5.25%	4.50%	5.00%
9	254	15,813,044	16,835,136	16,524,631	16,603,696	6.46%	4.50%	5.00%
10	274	17,547,742	18,525,948	18,337,391	18,425,129	5.57%	4.50%	5.00%
11	305	19,692,885	20,700,206	20,441,215	20,677,529	5.12%	3.80%	5.00%
12+	4,073	292,210,187	303,453,942	303,314,174	303,314,174	3.85%	3.80%	3.80%
Total	**7,703**	**487,790,252**	**517,258,042**	**514,732,093**	**515,443,492**	**6.04%**	**5.52%**	**5.67%**

*Data from December 31, 2013 through December 31, 2018.


Graph 8: Average Salary Increases
Ohio State Highway Patrol Retirement System
Average Salary Increase
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
1
2
3
4
5
6
7
8
9
10
11
12+
Member Service
Actual Salary Increase
Expected Salary Increase
Recommended Salary Increases

Inflation

Overview
The assumed rate of inflation is a component of both the investment return assumption and the salary increase assumption. Since inflation underlies the salary increase assumption and the investment return assumption, we recommend that a specific inflation assumption be adopted in conjunction with this Experience Study.

Current Assumption
Currently, the fund assumes a 2.50% inflation assumption.

Historical Inflation
Inflation has been relatively low over the past 20 years, particularly over the last five years. The table below shows the average annual historical change in the CPI-U, over various periods.

Average Annual Increase Consumer Price Index - All Urban Consumers	
Periods Ending December 2019	
Last 5 years	1.8%
Last 10 years	1.8%
Last 20 years	2.1%

Forecasts of Inflation
The Federal Reserve Bank of Philadelphia conducts a quarterly survey of the Society of Professional Forecasters and publishes a mid-term expectation. Their most recent forecast (first quarter of 2020) predicts average inflation over the next ten years (2020-2029) will be 2.20%. The Philadelphia Fed's Livingston Survey summarizes the forecasts of economists from industry, government, banking, and academia. The December 2019 report shows an average 10-year inflation expectation of 2.22%.
The Social Security Administration's 2019 Trustees Report includes the Office of the Chief Actuary's projection of ultimate long-term (75 year) average annual inflation. The intermediate cost assumption is 2.60%. The report provides a low-to-high range of 2.00% to 3.20%.

Forecasts from Investment Consulting Firms
Horizon Actuarial Services, LLC, compiles and summarizes expected returns and volatility by asset class for 34 different investment consulting firms. The results of the survey are provided in a report titled Horizon Survey of Capital Market Assumptions: 2019 Edition. Sixteen of the participating firms provided short-term and long-term assumptions. The report defines the short-term horizon as 10 years and the long-term horizon as 20-years. The average inflation assumption used by these 16 firms for the short-term horizon is 2.30%, while the average inflation assumption used for the long-term horizon is 2.29%.

Recommended Assumption for Consideration
The Federal Reserve forecaster survey responses would appear to support an inflation assumption of 20 to 30 basis points below the current assumption. However, these are 10-year forecasts and longer-term forecasts (25-30 years) would likely result in forecasts closer to the current assumption. This is supported by the much higher inflation assumption used by the Social Security administration in their intermediate cost projection. Therefore, we recommend retaining the 2.50% long-term inflation assumption.

Payroll Growth Rate

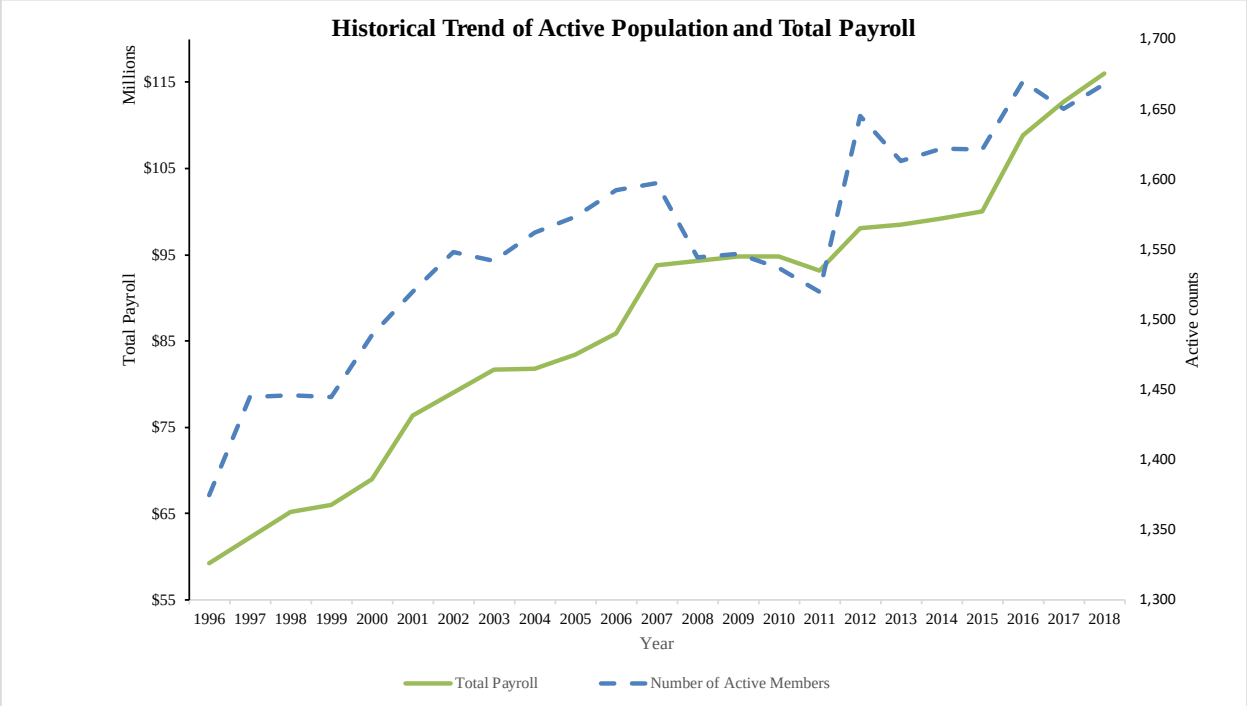
Overview

The payroll growth rate is the assumption used to predict how the aggregate payroll of a fund will increase on average from one year to the next. It is a necessary assumption when valuing a pension fund because it is used for purposes of amortizing the unfunded actuarial liabilities. Currently, the payroll growth assumption is equal to 3.50% per year.

The payroll growth assumption should reflect factors other than the expected individual salary increases year over year. In addition, it is important to consider the growth (or reduction) in the active population for a Fund. For example, if each active member of a population happens to receive a 5.50% salary increase, but in that same time no members terminate employment and 5 additional members are hired onto the workforce, then the payroll will have grown by greater than 5.50% for that year. Likewise, the aggregate payroll of a fund could decrease from one year to the next if several people retire or terminate over the course of the year. The payroll for any fund is also affected as longer service members who are earning higher salaries begin to retire and are replaced with new entrants with lower pay. The purpose of the payroll growth rate is to determine a long-term expected average of the rate in which payroll will grow, even if the year-over-year experience does not always follow the pattern of the assumption.

Experience

As shown in the chart below, we have calculated the long-term averages from 1996 to 2018, which indicated that payroll has averaged around 3.15% growth and the numbers of active members has increased around 0.91% per year.



Recommended Assumption for Consideration

Based on the above observation, we feel that the current payroll growth assumption of 3.50% per year is aggressive. We recommend that the Board consider lowering the payroll growth assumption to a rate that is no greater than 3.00% per year.

SECTION IV. EXPERIENCE ANALYSIS – OTHER NON-ECONOMIC ASSUMPTIONS

The following non-economic assumptions have a minor effect on overall actuarial valuation results but are needed for actuarial valuation purposes.

- Current Marriage Assumption:
  - 75% of active members are assumed to be married for purposes of the automatic survivor coverage.
  - For active valuations, female spouses are assumed to be 3 years younger than male spouses.

  Plan Experience**:** To assess the reasonability of the current assumption, we analyzed the number of marriages and age difference for the retirees over the course of the studied period. The results are as follows:

Year	Numbers of Retirees	Number Married	Percentage of Marriage	Average age difference between retiree and beneficiary
2018	1,389	1,087	78%	2.54
2017	1,361	1,091	80%	2.56
2016	1,303	1,067	82%	2.58
2015	1,274	1,061	83%	2.63
2014	1,246	1,055	85%	2.68
2014~2018	6,573	5,361	82%	2.60

  Recommended Marriage Assumption: We propose the Board consider:
  - Keeping the current age difference assumption for valuations and,
  - Increasing from 75% to 80% of active members that are assumed to be married for purposes of the automatic survivor coverage.

- Current Administrative Expense Load assumption: A 1.20% of payroll load is added to the normal cost rate to account for administrative expense.

  Plan Experience: The table below shows the administrative expense information in the five-year period ending 2018.

  $ In Million

Year	2018	2017	2016	2015	2014	2018-2014
Payroll	$ 116.01	$ 112.71	$ 108.79	$ 99.98	$ 99.21	$ 536.70
Administrative expense	$ 1.64	$ 1.64	$ 1.55	$ 1.24	$ 1.19	$ 7.26
% of Payroll	1.41%	1.46%	1.42%	1.24%	1.20%	1.35%

  Recommended Administrative Expense Load assumption: We recommend the Board consider amending the administrative expense load to be based on the average of actual expenses incurred in the prior two years as of the valuation date, instead of using a fixed rate.

Due to lack of detailed actual experience in the studied period for the following assumptions, we continue to believe that the following assumptions are acceptable at this time:

- For valuations, members who receive a death-in-service benefit are assumed to have two children for whom benefits are paid for 10 years.
- A load of 0.75% of payroll is included in pension normal cost calculations for the purchase of military service.

SECTION V. EXPERIENCE ANALYSIS – HEALTHCARE ELECTION AND SPOUSE COVERAGE ASSUMPTIONS

ASOP No. 6, *Measuring Retiree Group Benefits Obligations and Determining Retiree Group Benefits Program Periodic Costs or Actuarially Determined Contributions*, provides guidance to actuaries in selecting (including giving advice on selecting) demographic and other noneconomic assumptions for the purpose of measuring defined benefit other postemployment benefit (OPEB) plan obligations.

The design of the OPEB plan determines how plan costs are shared with members. Since the vast majority of OPEB plans require members to make contributions in order to maintain coverage, some eligible members may choose not to enroll for coverage or they might decide not to enroll their dependent(s) in one or more available coverage options—especially if they can obtain less expensive coverage or a higher-level of coverage for the same price elsewhere. As a result, measurements of OPEB plan obligations will be based on healthcare election and spouse (dependent) coverage assumptions, and their impact on the overall magnitude of OPEB plan liabilities can be significant.

We reviewed member and spouse coverage election rates for medical and prescription drug (Rx) coverages, and for dental and vision coverages during the four-year period beginning on January 1, 2015 and ending on December 31, 2018.

The Post-Retirement Health Care Plan sponsored by OHPRS shares medical/Rx costs based on age. Thus, we would expect member and spouse medical/Rx elections to vary based on age. Spouse ages could not be reliably determined based on the data provided for the purposes of studying this experience, so we based all the rates provided in the exhibits that follow on member ages. For dental and vision coverage options, member and spouse cost-sharing amounts do not depend on either member or spouse ages. However, since these elections appear to be correlated with medical/Rx elections, we have also based our analyses of member and spouse dental/vision election rates on member age.

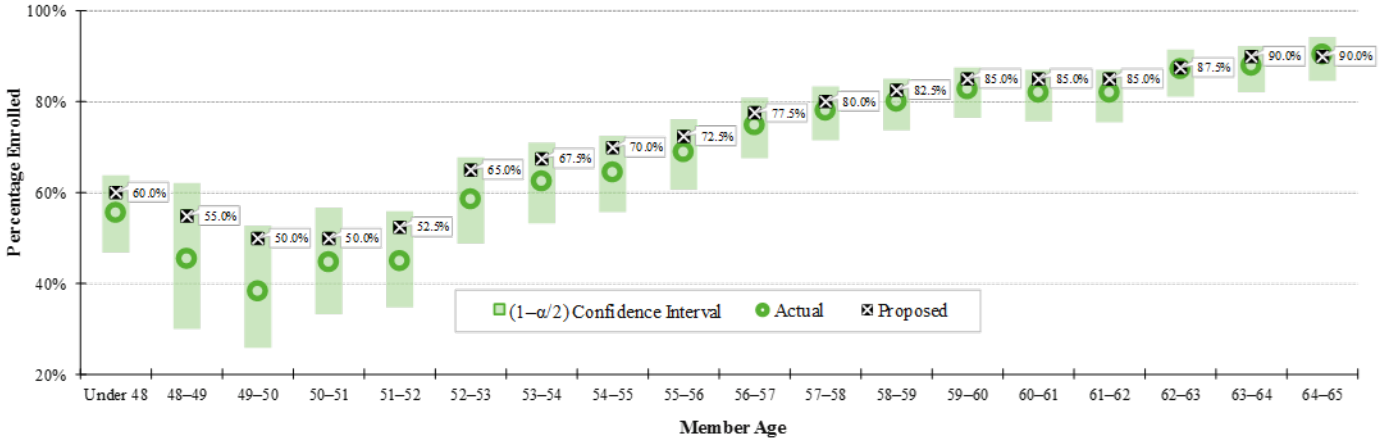
Certain analyses looked promising initially, but they were ultimately discarded due to credibility concerns. For example, one might expect initial election rates to be different than subsequent election rates, and we did observe this phenomenon in the data. However, these observations were not credible—no members had more than four consecutive periods since any retirement age, and they had relatively few exposures in each group. Likewise, the observed differences in the election rates of female members could not be differentiated from noise due to the low number of female member exposures in each age group.

Proposed member and spouse election rates for pre-Medicare and Medicare eligible healthy lives are provided in the exhibits on the pages that follow. For disabled lives, we propose the following member and spouse election rates for medical/Rx and dental/vision coverages:

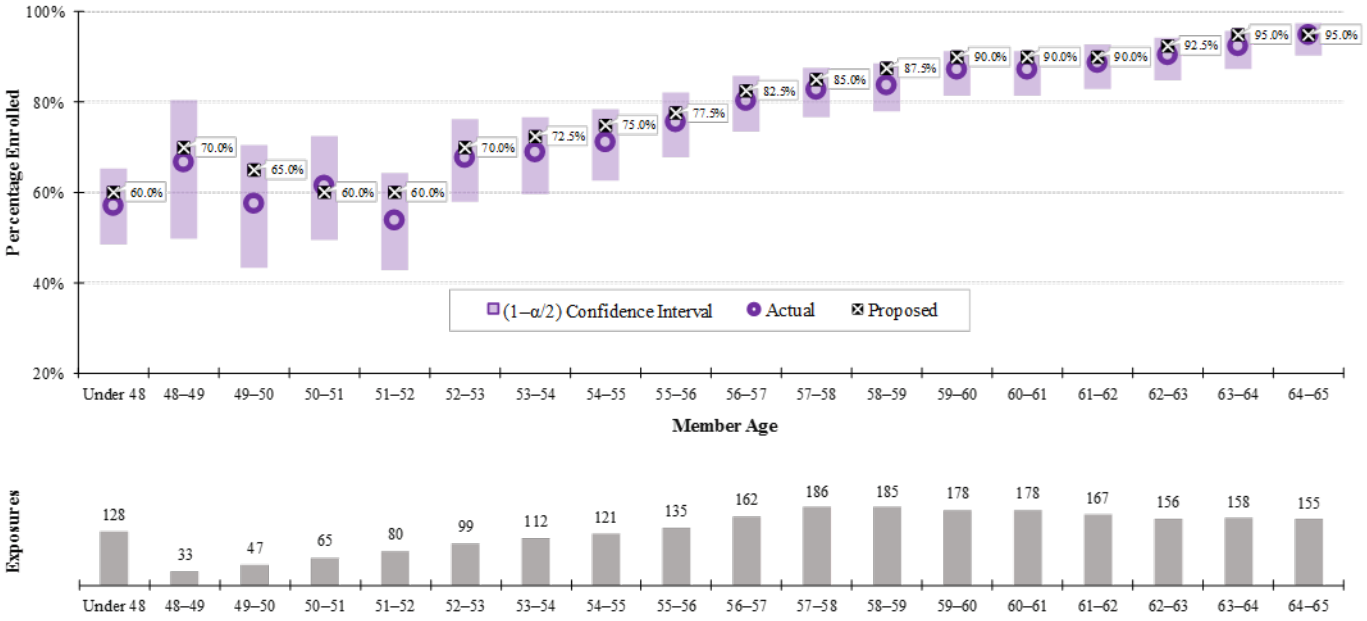
Disabled Member Age	Pre 65	Post 64
Member Election Rates	0.75	0.95
Spouse Election Rates	0.40	0.55

Adopting the proposed member and spouse election rates as of December 31, 2018 for the System's OPEB Plan would increase the Plan's actuarial accrued liability (AAL) and reduce its normal cost as of that date.

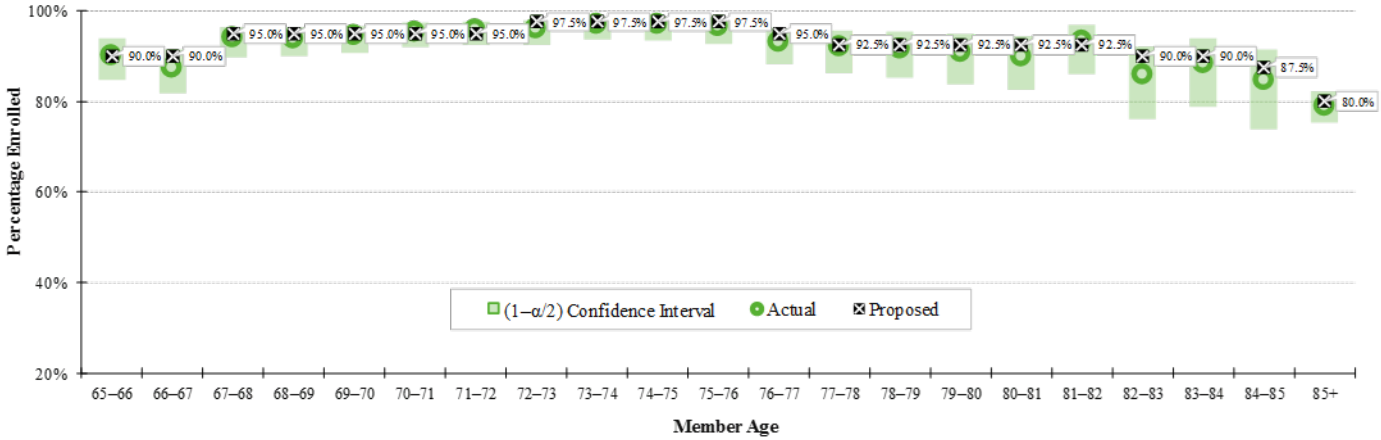
Member Medical / Prescription Drug Plan Election Rates—Not Medicare Eligible (α = 5.00%)



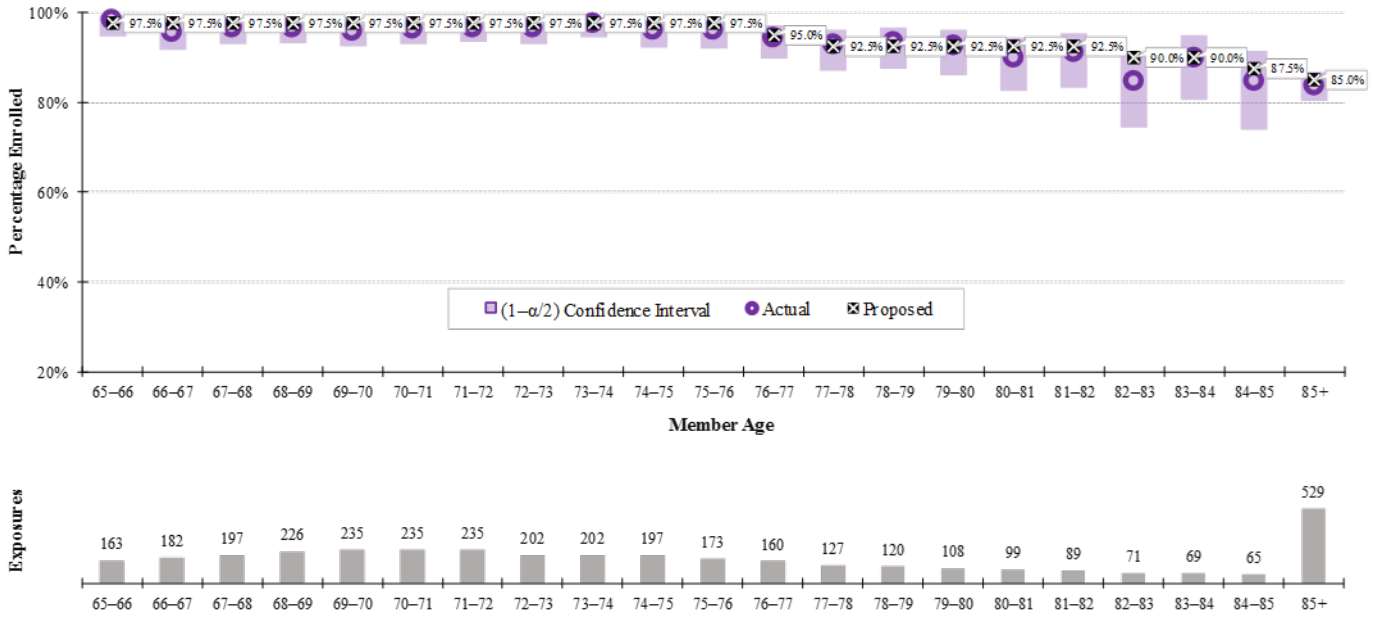
Member Dental / Vision Plan Election Rates—Not Medicare Eligible (α = 5.00%)



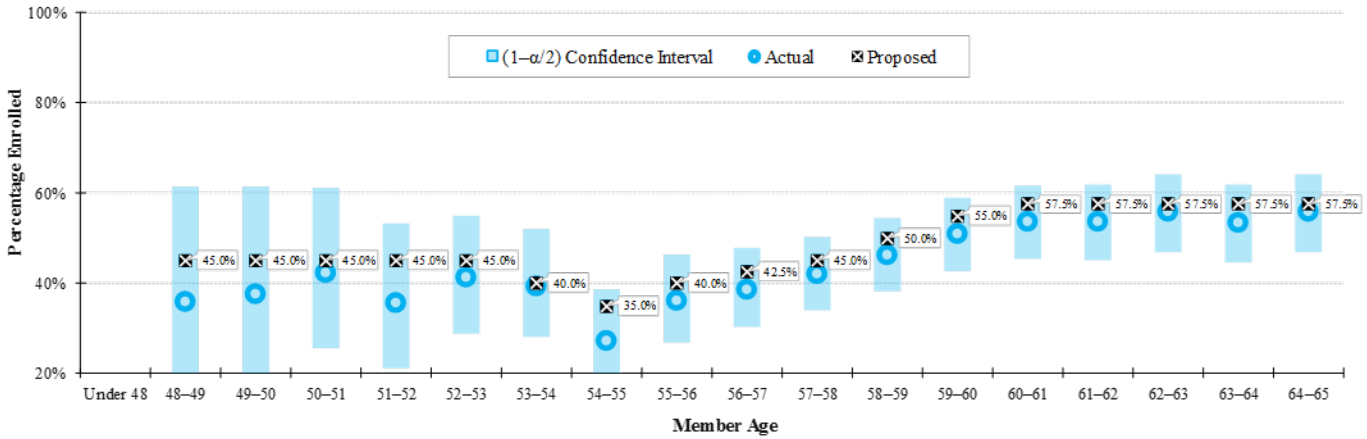
Member Medical / Prescription Drug Plan Election Rates—Medicare Eligible (α = 5.00%)



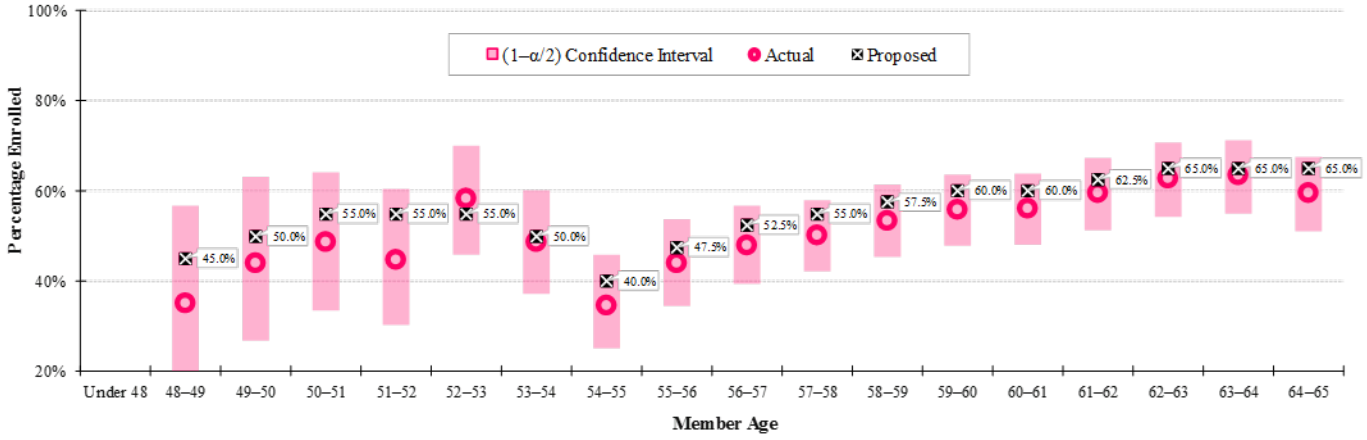
Member Dental / Vision Plan Election Rates—Medicare Eligible (α = 5.00%)



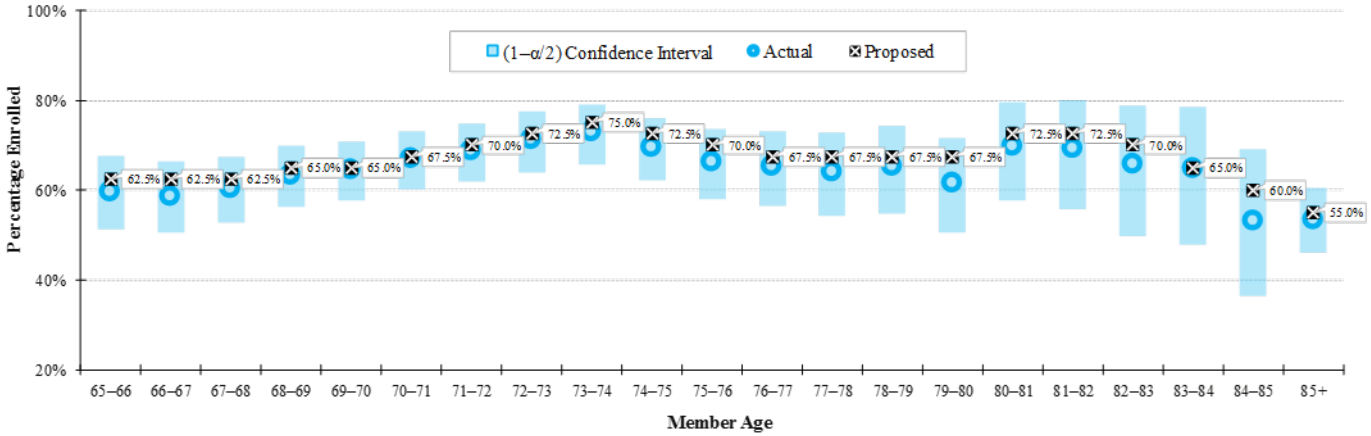
Medical / Prescription Drug Plan Spouse Coverage Election Rates—Member Not Medicare Eligible (α = 5.00%)



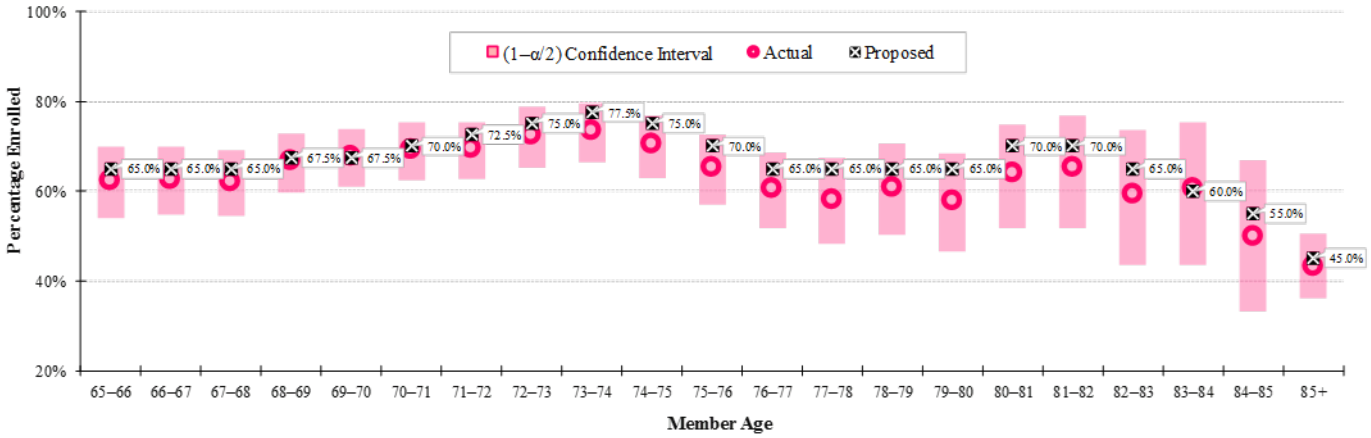
Dental / Vision Plan Spouse Coverage Election Rates—Member Not Medicare Eligible (α = 5.00%)



Medical / Prescription Drug Plan Spouse Coverage Election Rates—Member Medicare Eligible (α = 5.00%)



Dental / Vision Plan Spouse Coverage Election Rates—Member Medicare Eligible (α = 5.00%)



PROPOSED HEALTHCARE ELECTION AND SPOUSE COVERAGE RATES

Member Attained Age	Medical / Rx Annual Member Election Rate	Medical / Rx Annual Spouse Coverage Rate	Dental / Vision Annual Member Election Rate	Dental / Vision Annual Spouse Coverage Rate
Under 48	0.600	0.000	0.600	0.000
48	0.550	0.450	0.700	0.450
49	0.500	0.450	0.650	0.500
50	0.500	0.450	0.600	0.550
51	0.525	0.450	0.600	0.550
52	0.650	0.450	0.700	0.550
53	0.675	0.400	0.725	0.500
54	0.700	0.350	0.750	0.400
55	0.725	0.400	0.775	0.475
56	0.775	0.425	0.825	0.525
57	0.800	0.450	0.850	0.550
58	0.825	0.500	0.875	0.575
59	0.850	0.550	0.900	0.600
60	0.850	0.575	0.900	0.600
61	0.850	0.575	0.900	0.625
62	0.875	0.575	0.925	0.650
63	0.900	0.575	0.950	0.650
64	0.900	0.575	0.950	0.650
65	0.900	0.625	0.975	0.650
66	0.900	0.625	0.975	0.650
67	0.950	0.625	0.975	0.650
68	0.950	0.650	0.975	0.675
69	0.950	0.650	0.975	0.675
70	0.950	0.675	0.975	0.700
71	0.950	0.700	0.975	0.725
72	0.975	0.725	0.975	0.750
73	0.975	0.750	0.975	0.775
74	0.975	0.725	0.975	0.750
75	0.975	0.700	0.975	0.700
76	0.950	0.675	0.950	0.650
77	0.925	0.675	0.925	0.650
78	0.925	0.675	0.925	0.650
79	0.925	0.675	0.925	0.650
80	0.925	0.725	0.925	0.700
81	0.925	0.725	0.925	0.700
82	0.900	0.700	0.900	0.650
83	0.900	0.650	0.900	0.600
84	0.875	0.600	0.875	0.550
85 +	0.800	0.550	0.850	0.450
Disabled Pre-65	0.750	0.400	0.750	0.400
Disabled Post-64	0.950	0.550	0.950	0.550

SECTION VI. IMPACT OF RECOMMENDED ASSUMPTIONS

Below is an analysis of the impact of the recommended valuation assumptions on the December 31, 2018 accrued liability, normal cost and amortization period.

Impact on Accrued Liability

Assumption	Accrued Liability	Dollar Change	Percentage Change
Baseline (Interest rate=7.25%; Payroll Growth Rate - 3.50%)	1,174,864,766		
Retirement Rates	1,172,144,907	(2,719,859)	-0.23%
Withdrawal Rates	1,171,859,430	(3,005,336)	-0.26%
Disability Rates	1,175,336,622	471,856	0.04%
Mortality Rates	1,191,333,725	16,468,959	1.40%
Salary Increases	1,173,573,626	(1,291,140)	-0.11%
Marriage Assumptions	1,174,877,953	13,187	0.00%
DROP Duration	1,166,592,929	(8,271,837)	-0.70%
DROP Election	1,153,083,567	(21,781,199)	-1.85%
Interest Rate - 6.75%	1,235,518,656	60,653,890	5.16%
Interest Rate - 7.00%	1,204,523,212	29,658,446	2.52%
Interest Rate - 7.50%	1,146,463,344	(28,401,422)	-2.42%
All Changes & Interest Rate - 6.75%	1,218,034,161	43,169,395	3.67%
All Changes & Interest Rate - 7.00%	1,187,921,661	13,056,895	1.11%
All Changes & Interest Rate - 7.25%	1,159,080,201	(15,784,565)	-1.34%
All Changes & Interest Rate - 7.50%	1,131,428,120	(43,436,646)	-3.70%

Impact on Total Normal Cost

Assumption	Total Normal Cost	Dollar Change	Percentage Change	Total Normal Cost Rate
Baseline (Interest rate=7.25%; Payroll Growth Rate - 3.50%)	22,798,648			20.76%
Retirement Rates	22,646,403	(152,245)	-0.67%	20.63%
Withdrawal Rates	21,913,519	(885,129)	-3.88%	20.03%
Disability Rates	22,727,770	(70,878)	-0.31%	20.70%
Mortality Rates	23,164,418	365,770	1.60%	21.06%
Salary Increases	23,440,170	641,522	2.81%	21.25%
Marriage Assumptions	22,806,716	8,068	0.04%	20.76%
DROP Duration	22,056,256	(742,392)	-3.26%	20.36%
DROP Election	21,953,184	(845,464)	-3.71%	19.87%
Interest Rate - 6.75%	25,426,398	2,627,750	11.53%	22.92%
Interest Rate - 7.00%	24,068,803	1,270,155	5.57%	21.81%
Interest Rate - 7.50%	21,608,694	(1,189,954)	-5.22%	19.78%
All Changes & Interest Rate - 6.75%	23,679,915	881,267	3.87%	21.67%
All Changes & Interest Rate - 7.00%	22,425,225	(373,423)	-1.64%	20.64%
All Changes & Interest Rate - 7.25%	21,249,666	(1,548,982)	-6.79%	19.67%
All Changes & Interest Rate - 7.50%	20,146,011	(2,652,637)	-11.64%	18.76%

Impact on Amortization Period

Assumption	Amortization Period	Statue Employer Contribution Rate	Statue Member Contribution Rate	Total Normal Cost Rate	Contribution to UAAL as % of Payroll
Baseline (Interest rate=7.25%; Payroll Growth Rate - 3.50%)	26	26.50%	14.00%	20.76%	19.74%
Retirement Rates	26	26.50%	14.00%	20.63%	19.87%
Withdrawal Rates	24	26.50%	14.00%	20.03%	20.47%
Disability Rates	26	26.50%	14.00%	20.70%	19.80%
Mortality Rates	29	26.50%	14.00%	21.06%	19.44%
Salary Increases	27	26.50%	14.00%	21.25%	19.25%
Marriage Assumptions	26	26.50%	14.00%	20.76%	19.74%
DROP Duration	25	26.50%	14.00%	20.36%	20.14%
DROP Election	22	26.50%	14.00%	19.87%	20.63%
Interest Rate - 6.75%	36	26.50%	14.00%	22.92%	17.58%
Interest Rate - 7.00%	31	26.50%	14.00%	21.81%	18.69%
Interest Rate - 7.50%	22	26.50%	14.00%	19.78%	20.72%
All Changes & Interest Rate - 6.75%	30	26.50%	14.00%	21.67%	18.83%
All Changes & Interest Rate - 7.00%	26	26.50%	14.00%	20.64%	19.86%
All Changes & Interest Rate - 7.25%	23	26.50%	14.00%	19.67%	20.83%
All Changes & Interest Rate - 7.50%	20	26.50%	14.00%	18.76%	21.74%
Payroll Growth Rate - 2.50%	32	26.50%	14.00%	20.76%	19.74%
Payroll Growth Rate - 3.00%	29	26.50%	14.00%	20.76%	19.74%
All Changes & Interest Rate - 6.75% & Payroll Growth Rate - 2.50%	39	26.50%	14.00%	21.67%	18.83%
All Changes & Interest Rate - 7.00% & Payroll Growth Rate - 2.50%	32	26.50%	14.00%	20.64%	19.86%
All Changes & Interest Rate - 7.25% & Payroll Growth Rate - 2.50%	26	26.50%	14.00%	19.67%	20.83%
All Changes & Interest Rate - 7.50% & Payroll Growth Rate - 2.50%	22	26.50%	14.00%	18.76%	21.74%
All Changes & Interest Rate - 6.75% & Payroll Growth Rate - 3.00%	34	26.50%	14.00%	21.67%	18.83%
All Changes & Interest Rate - 7.00% & Payroll Growth Rate - 3.00%	28	26.50%	14.00%	20.64%	19.86%
All Changes & Interest Rate - 7.25% & Payroll Growth Rate - 3.00%	24	26.50%	14.00%	19.67%	20.83%
All Changes & Interest Rate - 7.50% & Payroll Growth Rate - 3.00%	21	26.50%	14.00%	18.76%	21.74%