Teachers' Retirement System of Oklahoma

Actuarial Experience Study for Data Through June 30, 2023

Presented to the Board of Trustees on May 22, 2024

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May 24, 2024

Board of Trustees
Teachers' Retirement System of Oklahoma
Oliver Hodge Education Building
2500 N. Lincoln Boulevard, 5th Floor
Oklahoma City, Oklahoma 73105

Subject: Results of 2024 Actuarial Experience Study

Members of the Board:

We are pleased to present our report on the results of the 2024 Actuarial Experience Study for the Teachers' Retirement System of Oklahoma (OTRS). It includes our recommendations for new actuarial assumptions and methods to be effective for the June 30, 2024 actuarial valuation, and it describes the actuarial impact produced by these recommendations as though they had been effective for the June 30, 2023 actuarial valuation.

With the Board's approval of the recommendations in this report, we believe the actuarial condition of OTRS will be more accurately portrayed. The Board's decisions should be based on the appropriateness of each recommendation individually, not on their collective effect on the funding period or the unfunded liability.

This study was conducted in accordance with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board. The signing actuaries are independent of the plan sponsor. They are Members of the American Academy of Actuaries and meet all of the Qualification Standards of the American Academy of Actuaries. Joseph Newton and Bill Detweiler are Enrolled Actuaries. The undersigned are experienced in performing valuations for large public retirement systems.

Respectfully submitted,
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EXECUTIVE SUMMARY

Summary of Recommendations

Our recommended changes to the current actuarial assumptions may be summarized as follows:

Economic Assumptions

1. Recommend increasing the inflation assumption from 2.25% to 2.50%.

2. No change to the nominal investment return assumption of 7.00%. This recommended assumption of 7.00% is comprised of an inflation assumption of 2.50% and a real return assumption of 4.50%.

3. Recommend assuming administrative expenses will be 0.12% of payroll.

4. No change to the nominal general wage inflation assumption of 3.00%. This assumption is used to project future increases in salary for all members (regardless of service) and to index each cohort of new entrants used in the projections to determine the funding period.

5. Recommend slight increases to the service-based merit component of the salary increase assumption, consistent with observed experience.

6. Recommend lowering the overall payroll and tax base growth rates to equal the 2.50% inflation assumption.

Mortality Assumptions

7. No change to the post-retirement mortality tables for non-disabled (healthy) retirees.

8. No change to the post-retirement mortality tables for disabled retirees.

9. No change to the pre-retirement mortality tables for active employees.

10. Recommend updating the projection scales for mortality improvement to be based on the most recent MP scale published by the Society of Actuaries, with immediate convergence.

Other Demographic Assumptions

11. Recommend adjustments to the turnover assumptions to reflect observed plan experience and to simplify the assumption.

12. Recommend adjustments to the retirement assumptions, especially lowering patterns at first eligibility to retire, to reflect observed plan experience and to simplify the assumption.

13. Recommend generally lowering disability patterns based on experience.

14. Recommend lowering portion of members electing the supplemental medical insurance benefit to 40%.

15. No change to the current process of estimating the valuation payroll for the upcoming fiscal year.

16. No change to the actuarial cost method nor the asset smoothing method except to allow for offsetting asset gains and losses.

The impact to key actuarial results as of June 30, 2023 are shown below based on current and recommended assumptions:

	Current Assumptions	Recommended Assumptions
Unfunded AAL	$7,104 million	$6,788 million
Funded ratio	75.1%	75.9%
Funding Period	12 years	12 years

SECTION B

INTRODUCTION

Introduction

A periodic review and selection of the actuarial assumptions is one of many important components of understanding and managing the financial aspects of the Teachers' Retirement System of Oklahoma (OTRS). Use of outdated or inappropriate assumptions can result in understated costs which will lead to higher future contribution requirements or perhaps an inability to pay benefits when due; or, on the other hand, produce overstated costs which place an unnecessarily large burden on the current generation of members, employers, and taxpayers.

A single set of assumptions is typically not expected to be suitable forever. As the actual experience unfolds or the future expectations change, the assumptions should be reviewed and adjusted accordingly.

It is important to recognize that the impact from various outcomes and the ability to adjust from experience deviating from the assumption are not symmetric. Due to compounding economic forces, legal limitations, and moral obligations, outcomes from underestimating future liabilities are much more difficult to manage than outcomes of overestimates. That asymmetric risk should be considered when the assumption set, investment policy and funding policy are created. As such, the assumption set used in the valuation process needs to represent the best estimate of the future experience of the retirement system and be at least as likely, if not more likely, to overestimate the future liabilities versus underestimate them.

Using this strategic mindset, each assumption was analyzed compared to the actual experience of OTRS and general experience of other large public employee retirement systems. Changes in certain assumptions and methods are suggested upon this comparison to remove any bias that may exist and to perhaps add in a slight margin for future adverse experience where appropriate. Next, the assumption set as a whole was analyzed for consistency and to ensure that the projection of liabilities was reasonable and consistent with historical trends.

The following report provides our recommended changes to the current actuarial assumptions.

Summary of Process

In determining liabilities and contribution rates for retirement plans, actuaries must make assumptions about the future. Among the assumptions that must be made include:

- Retirement rates
- Mortality rates
- Turnover rates
- Disability rates
- Investment return rate
- Salary increase rates
- Inflation rate

For some of these assumptions, such as the mortality rates, past experience provides important evidence about the future. For others, such as the investment return assumption, the link between past and future results is much weaker. In either case, actuaries should review the plan's assumptions periodically and

determine whether these assumptions are consistent with actual past experience and with anticipated future experience.

In conducting experience studies, actuaries generally use data over a period of several years. This is necessary in order to gather enough data so that the results are statistically significant. In addition, if the study period is too short, the impact of the current economic conditions may lead to misleading results. It is known, for example, that the health of the general economy can impact salary increase rates and withdrawal rates. Using results gathered during a short-term boom or bust will not be representative of the long-term trends in these assumptions. Also, the adoption of legislation, such as plan improvements or changes in salary schedules, will sometimes cause a short-term distortion in the experience. For example, if an early retirement window was opened during the study period, we would usually see a short-term spike in the number of retirements followed by a dearth of retirements for the following two-to-four years. Using a longer period prevents giving too much weight to such short-term effects. On the other hand, using a much longer period could water down real changes that may be occurring, such as mortality improvement or a change in the ages at which members retire.

The last such actuarial experience investigation was performed following the June 30, 2019 actuarial valuation. For this experience study, we have reviewed OTRS's experience through June 30, 2023. However, for some of the analyses, such as salary and mortality, we utilized data from previous experience studies as well.
The following is a list of the time periods utilized throughout the analysis.

Assumption	Data Used	Comment
Wage Inflation and Payroll Growth	20 Years	Long-term trends are needed, also prospective changes must be considered
Individual Salary Increases	10 Years	Longer period will capture a longer economic cycle
Termination	10 Years	Longer period will capture a longer economic cycle
Post-Retirement Mortality	9 Years	Longer period allows for low volatility in the assumption and more credibility
All Other	4 Years	The assumptions react quicker to changing trends and are less correlated with the economic cycle

In an experience study, we first determine the number of deaths, retirements, etc. that occurred during the period. Then we determine the number expected to occur, based on the current actuarial assumptions. The number of "expected" decrements is determined by multiplying the probability of the occurrence at the given age, by the "exposures" at that same age. For example, let's look at a rate of retirement of 15% at age 55. The number of exposures can only be those members who are age 55 and eligible for retirement at that time. Thus they are considered "exposed" to that assumption. Finally, we calculate the A/E ratio, where "A" is the actual number (of retirements, for example) and "E" is the expected number. If the current assumptions were "perfect", the A/E ratio would be 100%. When it varies much from this figure, it is a sign that new assumptions may be needed. (However, in some cases we prefer to set our assumptions to produce an A/E ratio a little above or below 100%, in order to introduce some conservatism.) Of course we

not only look at the assumptions as a whole, but we also review how well they fit the actual results by gender, by age, and by service.

In many circumstances, we enhance this process by using a liability-weighted analysis. From the perspective of the mortality assumption, 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 in an actuarial valuation associated with expected deaths. By weighting the data by liability amounts, we are giving more weight to members who have larger annuities (and thus have larger liabilities). The same concepts apply when the liability-weighted approach is applied to other demographic assumptions such as termination and retirement, where the concern is how much liability is turning over or retiring more so than how many individual people are doing so.

If the data leads the actuary to conclude that new tables are needed, the actuary may "graduate" or smooth the results, since the raw results can be quite uneven from age to age or from service to service.

Please bear in mind that, while the recommended assumption set represents our best estimate, there are other reasonable assumptions sets that could be supported. Some reasonable assumption sets would show higher or lower liabilities or costs. However, we do not believe the recommend assumption set has a bias towards conservatism or aggressiveness.

SECTION C

ANALYSIS OF EXPERIENCE AND RECOMMENDATIONS

Analysis of Experience and Recommendations

We will begin by discussing the economic assumptions: inflation, the investment return rate, the general wage increase assumption, the salary increase assumption for individuals, and cost-of-living increases, if applicable. Then we will discuss the demographic assumptions: mortality, disability, termination and retirement. Finally we will discuss the actuarial methods used.

Inflation and Investment Return Assumptions

Actuarial Standards of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries on giving advice on selecting economic assumptions for measuring obligations for defined benefit plans.

As no one knows what the future holds, it is necessary for an actuary to estimate possible future economic outcomes. Recognizing that there is not one right answer, the current standard calls for an actuary to develop a reasonable economic assumption. A reasonable assumption is one that is:

1. appropriate for the purpose of the measurement,
2. reflects the actuary's professional judgment,
3. takes into account historical and current economic data that is relevant as of the measurement date,
4. is an estimate of future experience; an observation of market data; or a combination thereof,
5. and has no significant bias except when provisions for adverse deviation or plan provisions that are difficult to measure are included.

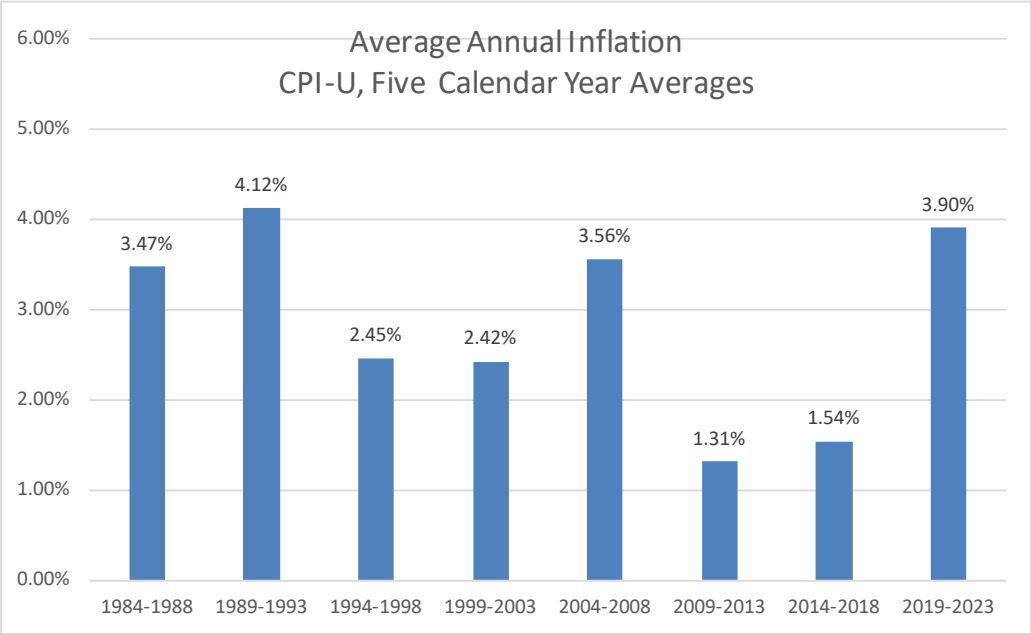
However, the standard explicitly advises an actuary not to give undue weight to recent experience.

Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period. Generally, the economic assumptions are much more subjective in nature than the demographic assumptions.

Inflation Assumption

By "inflation," we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). There is no direct usage of the inflation assumption in the valuation model, but it does underlie most of the other economic assumptions based on a building block approach. The current annual inflation assumption is 2.25%.

The following chart shows the average annual inflation, as measured by the increase in the Consumer Price Index (CPI-U), in each of the eight consecutive five-year periods over the last 40 years.



Source: Bureau of Labor Statistics, CPI-U, all items, not seasonally adjusted, Calendar Years

The table below shows the average inflation over various periods, ending June 2023.

Periods Ending June 2023	Average Annual Increase in CPI-U
Last five (5) years	3.90%
Last ten (10) years	2.71%
Last fifteen (15) years	2.24%
Last twenty (20) years	2.57%
Last twenty-five (25) years	2.54%
Last thirty (30) years	2.52%
Since 1913 (first available year)	3.16%

Source: Bureau of Labor Statistics, CPI-U, all items, not seasonally adjusted

As you can see, inflation has been relatively high recently following a historically low period. However, looking historically at periods ending in 2023, all but the 15-year period experienced inflation at or above 2.5%.

Forecasts from Investment Consulting Firms

We examined the 2024 capital market assumption sets for 12 investment consulting firms and the average assumption for inflation was 2.39%, with a range of 2.13% to 2.70%. This was up from 2.18% in the previous study.

Expectations Implied in the Bond Market

Another source of information about future inflation is the market for US Treasury bonds. Simplistically, the difference in yield between non-indexed and indexed treasury bonds should be a reasonable estimate of what the bond market expects on a forward looking basis for inflation. As of the end of December, the

difference for 20-year bonds implies that inflation over the next twenty years would average 2.37%. This is up from 1.85% in the previous study.

However, this analysis is known to be imperfect as it ignores the inflation risk premium that buyers of US Treasury bonds often demand as well as possible differences in liquidity between US Treasury bonds and TIPS.

Forecasts from Social Security Administration

In the Social Security Administration's 2023 Trustees Report, the Office of the Chief Actuary is projecting a long-term average annual inflation rate of 2.4% under the intermediate cost assumption.

Survey of Professional Forecasters and Fed Policy

The Philadelphia Federal Reserve conducts a quarterly survey of the Society of Professional Forecasters. Their most recent forecast (fourth quarter of 2023) was for inflation over the next ten years (2024 to 2033) to average 2.40%.

Additionally, the Fed has openly stated that they have a target 2.00% inflation rate.

Recommendation

As a result, we find a reasonable range for this assumption to be 2.25% to 2.60% and are recommending increasing the assumption to 2.50%. This change will bring the assumption closer to recent inflation levels and closer to the levels expected in the financial markets. While this change could impact the other economic assumptions, the spreads for the other assumptions have generally been lower during this period of high inflation, thus the impact to the nominal assumptions is minimal.

Investment and Administrative Expenses

Since the trust fund pays expenses in addition to member benefits and refunds, we must make some assumptions about these. Almost all actuaries treat investment expenses as an offset to the investment return assumption. That is, the investment return assumption represents expected return after payment of investment expenses.

In regards to investment expenses, investment consulting firms periodically issue reports that describe their capital market assumptions. The estimates for core investments (i.e., fixed income, equities, and real estate) are generally based on anticipated returns produced by passive index funds that are net of investment related fees. The investment return expectations for the alternative asset class such as private equity and hedge funds are also net of investment expenses. Therefore, we did not make any adjustments to account for investment-related expenses. Some of the retirement systems may also employ active management investment strategies that result in higher investment expenses compared to strategies that invest in passive index funds. We have assumed that active management strategies would result in the same returns, net of investment expenses, as passive management strategies.

On the other hand, there is a divergence of practice on the handling of administrative expenses. Some actuaries make an assumption that administrative expenses will be some fixed or increasing dollar amount. Others assume that the administrative expenses will be some percentage of the plan's actuarial

liabilities or normal cost. And others treat administrative expenses like investment expenses, as an offset to the investment return assumption.

OTRS has treated administrative expense as an explicit assumption, in the form of a direct increase to the annual normal cost, to incorporate the administrative expenses into the actuarial valuation. We recommend no change to that approach going forward. Using an explicit approach maximizes transparency, aligns better with the standards of the Governmental Accounting Standards Board, and maintains a parallel between the investment returns used by the investment consultant and the actuary.

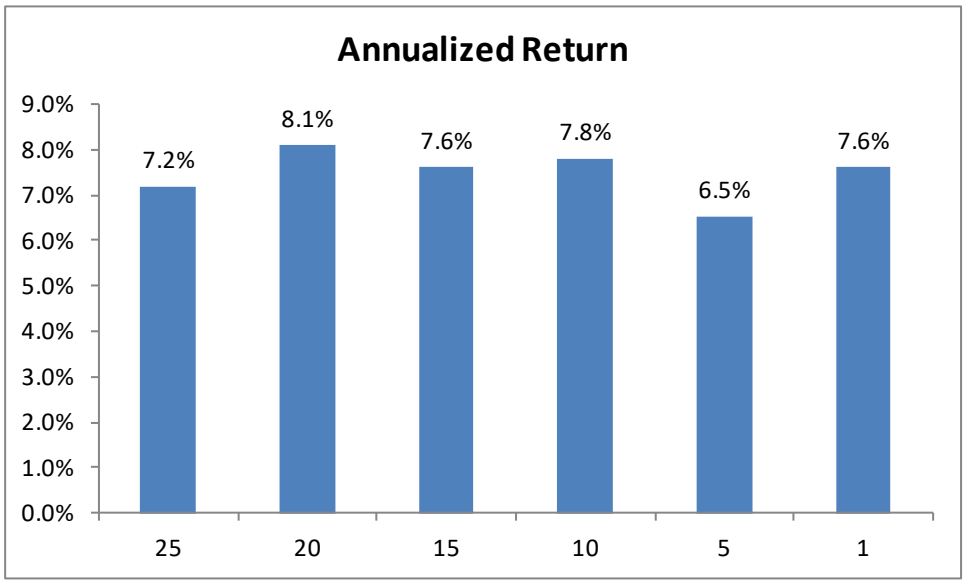
The following table provides the actual administrative expenses as a percentage of covered payroll for the last five years. The current assumption is that administrative expenses will be 0.10% of covered payroll. Based on this recent experience, we recommend slightly increasing the assumption to be 0.12% of covered payroll.

FY23	FY22	FY21	FY20	FY19	Average	Recommended Assumption
0.13%	0.12%	0.11%	0.11%	0.12%	0.12%	0.12%

Investment Return Rate

The investment return assumption is one of the principal assumptions used in any actuarial valuation of a retirement plan. It is used to discount future expected benefit payments to the valuation date in order to determine the liabilities of the plans. Even a small change to this assumption can produce significant changes to the liabilities and contribution rates. Currently, it is assumed that future investment returns will average 7.00% per year, net of investment expenses.

The chart below shows the historical annualized history of OTRS's market returns through FY 2023.

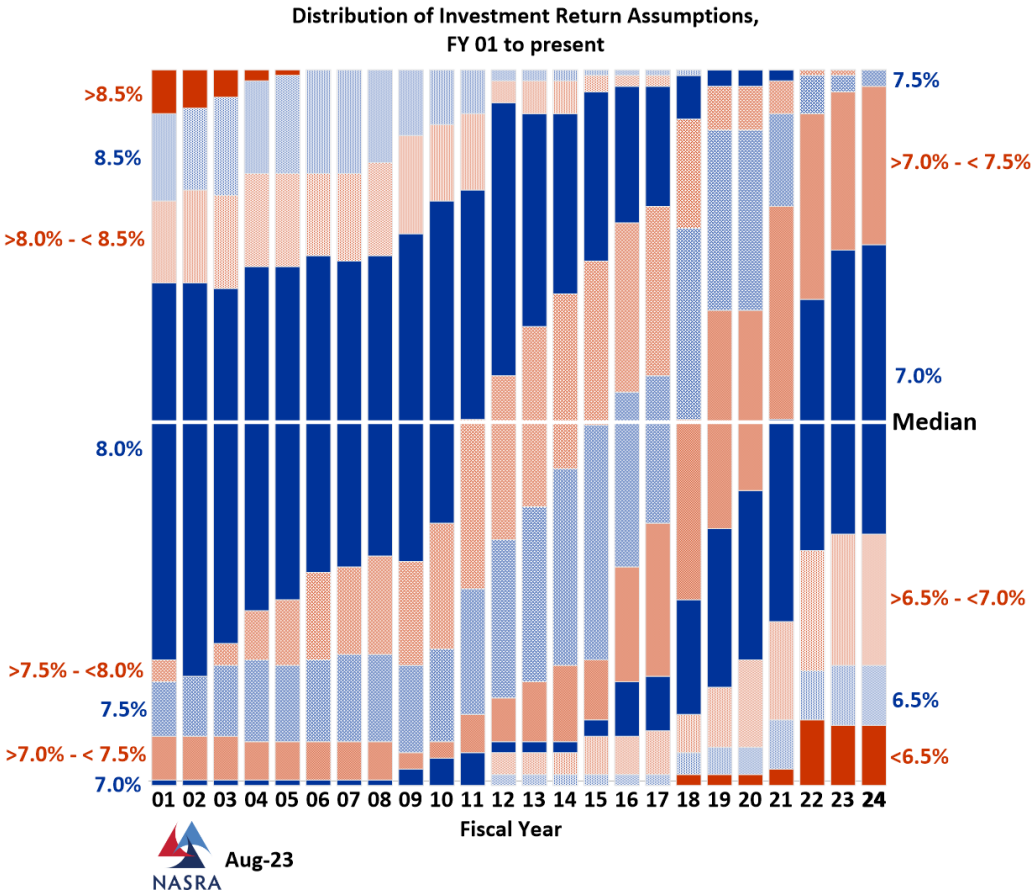


The returns in the chart above are market returns. OTRS did exceed the expected 7.0% return assumption in 14 of the last 25 years, and had an average annualized market return during this period of 7.2%. Over the same period, inflation averaged 2.5%, producing an average realized real return of 4.7%.

However, for this assumption, past performance, even averaged over a twenty-five year period, is not a reliable indicator of future performance. The actual asset allocation of the trust fund and forward-looking capital market expectations will significantly impact the overall performance, so returns achieved under a different allocation are not meaningful.

Assumption Comparison to Peers

We do not recommend the selection of an investment return assumption based on prevalent information. However, it is still informative to identify where the investment return assumption for OTRS is compared to its peers. The chart below shows the distribution of the investment return assumptions, as reported by NASRA in August 2023.



The median rate of return is 7.00%.

Asset Allocation

We believe the most appropriate approach to selecting an investment return assumption is to identify expected returns given the funds' asset allocation mapped to forward-looking capital market assumptions. For this purpose, we have analyzed the OTRS Investment Policy Statement with the following Target Weights:

Asset Class	Target Weight
U.S. Equities	38.3%
International Equities	16.7%
Fixed Income	22.0%
Real Estate	10.0%
Private Equity	8.0%
Private Debt	5.0%
Total	100%

In order to develop an appropriate estimate for an investment return assumption, we have utilized the forward-looking return expectations developed by several investment consulting firms and industry surveys.

Our 2024 survey includes 12 sets of expectations with 7-10 year time horizons. Based on the average of these sets of expectations, and the proposed 2.50% inflation assumption, the expected geometric (compound) return is 6.9% with a range of outcomes from 5.3% to 7.7%. There is a 48.7% chance of exceeding a 7.00% return. The chart below provides more details.

GRS 2024 CMAM				
Capital Market Assumption Set (CMA)	Distribution of 10-Year Average Geometric Net Nominal Return			Probability of exceeding
	40th	50th	60th	7.00%
(1)	(2)	(3)	(4)	(5)
1	4.31%	5.34%	6.37%	34.3%
2	5.07%	6.09%	7.12%	41.1%
3	5.34%	6.36%	7.39%	43.7%
4	5.82%	6.84%	7.88%	48.4%
5	5.88%	6.85%	7.83%	48.4%
6	6.01%	6.97%	7.94%	49.7%
7	6.08%	7.04%	8.01%	50.4%
8	6.11%	7.12%	8.14%	51.2%
9	6.18%	7.17%	8.16%	51.7%
10	6.33%	7.34%	8.35%	53.4%
11	6.42%	7.44%	8.46%	54.3%
12	6.79%	7.74%	8.70%	57.8%
Average	**5.86%**	**6.86%**	**7.86%**	**48.7%**

8 of the consultants also give 20-30 year sets of expectations. Based on the average of these sets of expectations, and the proposed 2.50% inflation assumption, the expected geometric (compound) return is 7.1% with a range of outcomes from 6.0% to 8.0%. There is a 50.4% chance of exceeding a 7.00% return.

Recommendation

Based on this analysis, we recommend no change to the current nominal assumption of 7.00%.

General Wage Inflation

A General Wage Inflation (GWI) assumption represents the real wage growth over time in the general economy, or, is the assumption on how much the pay scales themselves will change year to year, not necessarily how much the pay increases received by individuals are, or even necessarily how the payroll in total may change, which can be impacted by population changes, etc. This assumption should be applicable to a local economy, not necessarily one group inside a retirement system. This assumption is also used to index the pay of each group of new entrants used in the open group projections. In an open group projection, projected terminations from the current active population are replaced with projected new entrants.

Historically, General Wage Inflation has almost always exceeded price inflation. This is because wage inflation is in theory the result of (a) price inflation, and (b) productivity gains being passed through to wages. Since 1951, for the national economy as a whole, wage inflation has been about 1.00% larger than price inflation each year. For the last 20 years, for the national economy as a whole, wage inflation has been outpacing price inflation by about 0.80%.

Over both the past 10 and 20 years, the average salary for an OTRS member has increased 1.6% and 1.8% per year, respectively. This OTRS experience would indicate that pays have actually lagged price inflation, however, when we look at the individual pay increases for long-service members, they have outpaced inflation by about 0.18%. It may be that the covered membership is more heavily distributed to lower paid roles than it has been historically which accounts for the slow growth in the average pay.

While we are recommending an increase in the price inflation, the OTRS specific data suggests a lower real productivity growth assumption, thus we are recommending no change to the nominal 3.00% GWI assumption.

Salary Increase Rates

Salary increases are composed of both wage inflation and service-based promotional or merit increases. Wage inflation is currently assumed to be 3.00% with additional merit increases during the first 25 years of employment. The following will analyze these two components separately in developing our overall salary increase assumption.

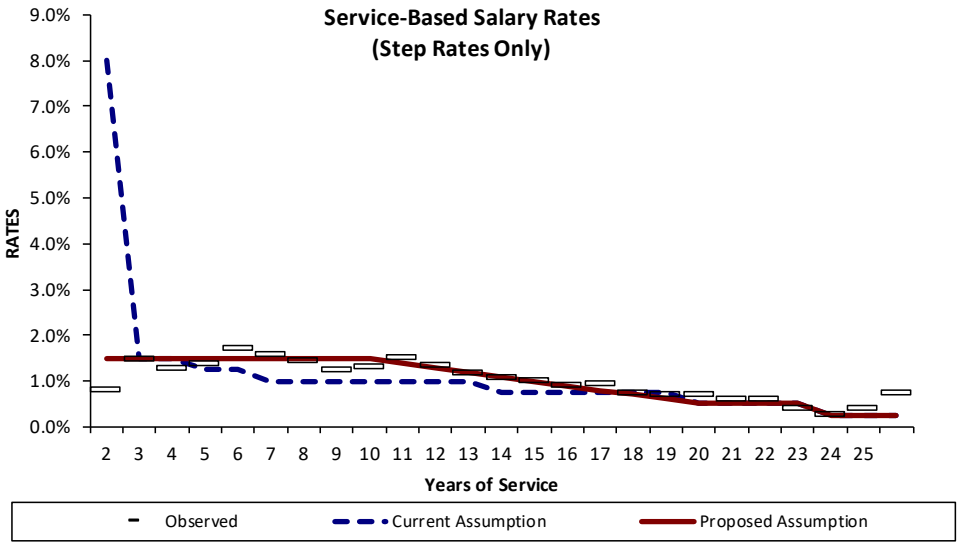
Wage Inflation for Long-Service Employees

Salary increases for longer-service employees are almost entirely driven by wage inflation. Many of the factors that result in pay increases are largely inapplicable or have diminished importance for longer-service employees. Step or service-related increases have ceased or are minimal. Promotions occur with less frequency. Additional training or acquisition of advanced degrees usually occurs early in the career. Thus, longer service employees' wages are assumed to grow at the overall rate of wage inflation. Wage inflation is also the increase in the average wage of all members of the workforce of the employer.

Wage inflation is currently assumed to be 3.00%, and this is the assumed salary increase for longer-service members with at least 25 years of service. For members with 25 or more years of service, the observed average salary increase during the last 10 years was 2.93%. Inflation during this 10-year period averaged 2.75%. Therefore, long-service employees received an average salary increase of 0.18% above inflation. However, there could be a lag between the price inflation and the impact on wages, especially for public sector employees. We are recommending keeping the nominal assumption unchanged at 3.00%, with a productivity assumption at 0.50%.

Additional Service-Based Merit Increases

Members who are early in their career typically have salary increases that include both wage inflation as well as a component for promotion. This additional component is part of the service-based component of the salary scale. This assumed component of the salary scale currently ranges from 8.00% (in addition to wage inflation) in the member's first year of employment to 0.25% in the member's twenty-fourth year of employment. The following graph shows the detail by years of service.

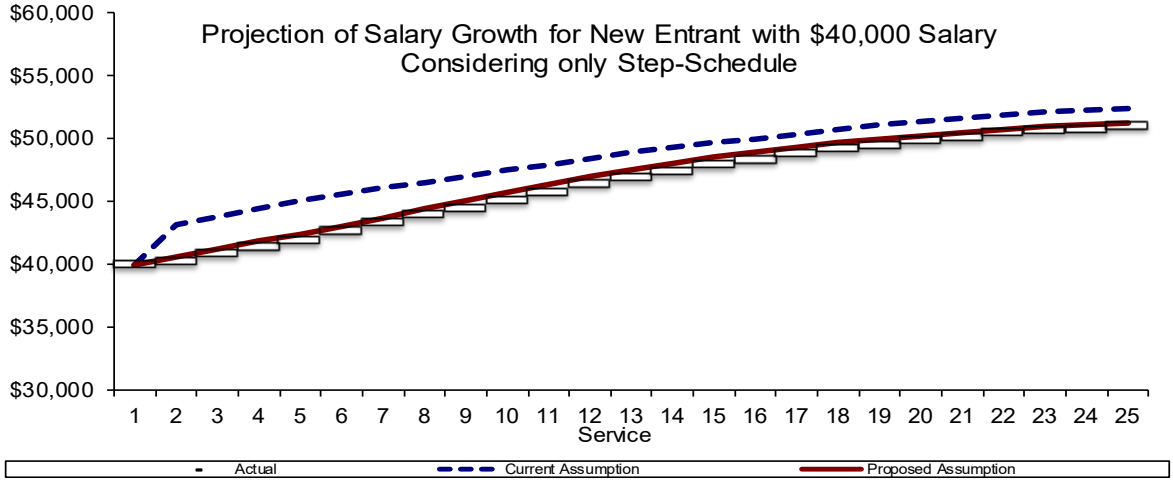


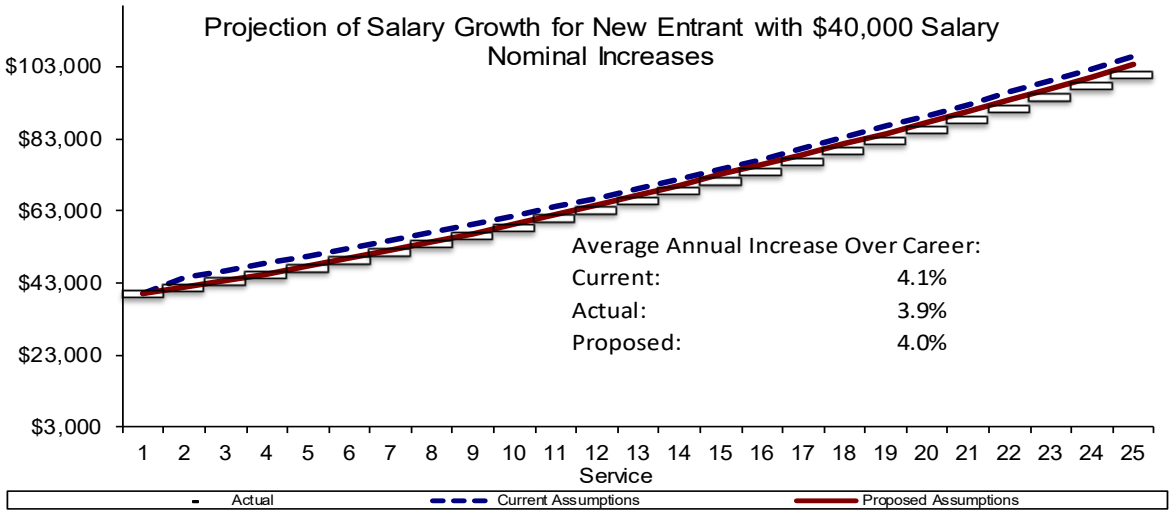
As shown, the large increase in year 1 is not observed in the data, but there are larger increases through the first decade or so of the member's career than currently assumed. We have proposed a new step-rate portion of the salary schedule. The net impact is an approximate 0.1% lower assumed annual salary increase throughout a member's career. The following exhibits and illustration provide more detail on the analysis.

Service-Based Salary Rates

	Current Salary Scale		Actual Experience			Proposed Salary Scale	
Years of Service	Total	Step Rate/ Promotional	Total	Above Inflation	Step Rate/ Promotional	Total	Step Rate/ Promotional
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	11.00%	8.00%	3.70%	0.97%	0.80%	4.50%	1.50%
2	4.50%	1.50%	4.38%	1.65%	1.48%	4.50%	1.50%
3	4.50%	1.50%	4.16%	1.43%	1.26%	4.50%	1.50%
4	4.25%	1.25%	4.29%	1.56%	1.39%	4.50%	1.50%
5	4.25%	1.25%	4.62%	1.89%	1.72%	4.50%	1.50%
6	4.00%	1.00%	4.47%	1.74%	1.56%	4.50%	1.50%
7	4.00%	1.00%	4.33%	1.61%	1.43%	4.50%	1.50%
8	4.00%	1.00%	4.14%	1.42%	1.24%	4.50%	1.50%
9	4.00%	1.00%	4.22%	1.49%	1.31%	4.50%	1.50%
10	4.00%	1.00%	4.42%	1.69%	1.52%	4.40%	1.40%
11	4.00%	1.00%	4.25%	1.52%	1.35%	4.30%	1.30%
12	4.00%	1.00%	4.06%	1.34%	1.16%	4.20%	1.20%
13	3.75%	0.75%	3.97%	1.25%	1.07%	4.10%	1.10%
14	3.75%	0.75%	3.91%	1.18%	1.01%	4.00%	1.00%
15	3.75%	0.75%	3.81%	1.08%	0.91%	3.90%	0.90%
16	3.75%	0.75%	3.83%	1.10%	0.93%	3.80%	0.80%
17	3.75%	0.75%	3.64%	0.91%	0.74%	3.70%	0.70%
18	3.75%	0.75%	3.62%	0.89%	0.72%	3.60%	0.60%
19	3.50%	0.50%	3.61%	0.89%	0.71%	3.50%	0.50%
20	3.50%	0.50%	3.49%	0.76%	0.59%	3.50%	0.50%
21	3.50%	0.50%	3.52%	0.79%	0.62%	3.50%	0.50%
22	3.50%	0.50%	3.29%	0.57%	0.39%	3.50%	0.50%
23	3.25%	0.25%	3.18%	0.45%	0.27%	3.25%	0.25%
24	3.25%	0.25%	3.30%	0.57%	0.40%	3.25%	0.25%
25	3.25%	0.25%	3.62%	0.90%	0.72%	3.25%	0.25%
26+	3.00%	0.00%	2.90%	0.18%	0.00%	3.00%	0.00%

Year	Average Long Service Increase	CPI	Productivity
2014	1.92%	1.99%	-0.07%
2015	3.29%	0.17%	3.12%
2016	1.33%	0.83%	0.50%
2017	-0.50%	1.73%	-2.23%
2018	1.93%	2.95%	-1.02%
2019	8.77%	1.81%	6.96%
2020	4.76%	0.99%	3.78%
2021	1.67%	5.37%	-3.69%
2022	3.73%	8.52%	-4.79%
2023	2.39%	3.18%	-0.78%
Average	2.93%	2.75%	0.18%
Proposed	3.00%	2.50%	0.50%


Projection of Salary Growth for New Entrant with $40,000 Salary
Considering only Step-Schedule
$60,000
$55,000
$50,000
$45,000
$40,000
$35,000
$30,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Service
Actual
Current Assumption
Proposed Assumption


Projection of Salary Growth for New Entrant with $40,000 Salary
Nominal Increases
$103,000
$83,000
$63,000
$43,000
$23,000
$3,000
Average Annual Increase Over Career:
Current: 4.1%
Actual: 3.9%
Proposed: 4.0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Service
Actual
Current Assumptions
Proposed Assumptions

PAYROLL GROWTH RATE

The salary increase rates discussed above are assumptions applied to individuals. They are used in projecting future benefits. We also use an overall payroll growth assumption, currently 3.00%, in determining the contributions needed to amortize the unfunded actuarial accrued liability. The "Funding Period" determined in the valuation is answering the question: "When is the current UAAL expected to be reduced to $0". This calculation reflects the fact that contributions are received as a percentage of payroll, so as payroll increases over time, these contributions do too. Thus, the funding period is dependent on the rate at which payroll is assumed to increase.

Over the past decade, the overall payroll for OTRS has grown by 2.9% per year on average, almost exactly equal to the current 3.0% assumption. However, 1.0% of that has been due to population growth, with the actual underlying payroll only growing at 1.9% per year.

The default should be that the Payroll Growth Rate is equal to the GWI assumption. And over the longer term in a stable population, it will. However, the payroll growth rate used to determine the funding period should reflect how fast payroll is expected to grow *over that specific period* if the demographics of the group are not uniform. For example, due to the baby boom generation, the current demographic of many pension plans has an abnormally high number of people eligible to retire. When those people retire, they will be replaced by members at the beginning of the pay scale. Thus, even if salary increases for individuals are changing as expected, overall payroll growth can be dampened over the short to medium term.

One way to estimate this assumption is to produce an open group projection assuming increases in the pay of the new entrants changes at the GWI assumption and compare the rates of growth. We have performed open group projections that show payroll will grow over the next decades at approximately 2.5% per year as a large number of members reach retirement. Thus, we have slightly discounted the GWI and recommend a 2.50% payroll growth assumption. With the relatively short funding period, this assumption has minimal impact on the results.

Demographic Assumptions

Actuaries are guided by the Actuarial Standards of Practice (ASOP) adopted by the Actuarial Standards Board (ASB). One of these standards is ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This standard provides guidance to actuaries giving advice on selecting noneconomic assumptions for measuring obligations under defined benefit plans. We believe the recommended assumptions in this report were developed in compliance with this standard.

Post-Retirement Mortality Rates

OTRS's liability depends in part on how long retirees live. If members live longer, benefits will be paid for a longer period of time, and the liability will be larger. Additionally, teachers generally have longer life expectancies compared to the general population. This experience is also true for the retired teachers and educators in OTRS, and it will be important to reflect this in the mortality assumption used in the valuation.

The mortality table currently being used for non-disabled retirees and for beneficiaries receiving benefits is:

Healthy males – 2020 GRS Southwest Region Teacher Mortality Table. Generational mortality improvements in accordance with the ultimate mortality improvement rates from the MP-2019 tables projected from the year 2020.

Healthy females – 2020 GRS Southwest Region Teacher Mortality Table. Generational mortality improvements in accordance with the ultimate mortality improvement rates from the MP-2019 tables projected from the year 2020.

These assumptions are considered "generational" mortality projections. A generational mortality projection does not build in a margin up front, but the mortality is assumed to improve every future year in the valuation projection. Since this form of mortality projection assumes continual mortality improvements, there should be less need to periodically reestablish margin for future mortality improvements in the mortality assumption.

Approach and Data

In analyzing the mortality experience, we have weighted the analysis by the amount of liability the member represents based on their monthly annuity and benefit option. By weighting the data by liabilities, we are giving more weight to members who have larger annuities and are married (and thus have larger liabilities). Using this method is expected to minimize gains and losses from mortality.

We begin by determining the expected deaths in each year at each age for males and females. Then we compare the actual to the expected. The ratio of the actual deaths to the expected deaths (the A/E ratio), weighted by benefit amounts, tells us whether the assumptions are reasonable. When using a generational approach for mortality improvement, an A/E of 100% is targeted. However, we will also focus on the pattern across all ages and life expectancy created at individual ages when determining whether the assumption is appropriate. We will discuss this in two parts, the recommended base mortality assumption, and the recommended mortality improvement assumption.

Credibility

When choosing an appropriate mortality assumption, actuaries typically use standard mortality tables, unlike when choosing other demographic assumptions. They may choose to adjust these standard mortality tables, however, to reflect various characteristics of the covered group, and to provide for expectations of future mortality improvement (both up to and after the measurement date). If the plan population has sufficient credibility to justify its own mortality table, then the use of such a table also could be appropriate. Factors that may be considered in selecting and/or adjusting a mortality table include the demographics of the covered group, the size of the group, the statistical credibility of its experience, and the anticipated rate of future mortality improvement.

We first measured the credibility of the dataset to determine whether standard, unadjusted tables should be used or if statistical analysis of OTRS specific data was warranted. The method for this approach can be found in the article *"Selecting Mortality Tables: A Credibility Approach" October 2008*. Statistical analysis suggests 1,082 deaths per gender is sufficient to be considered fully credible, as at that amount of experience we are 90% confident that the observed experience is within +/- 5% of the actual pattern. However, when weighting on benefit amounts, it should be even higher. The following table gives the number of deaths needed by gender to have a given level of confidence that the data is +/- X% of the actual pattern.

Standard Score	Confidence	99% – 101%	97% – 103%	95% – 105%	90% – 110%	80% – 120%
0.674	75%	4,543	505	182	45	11
1.282	80%	16,435	1,826	657	164	41
1.645	90%	27,060	3,007	1,082	271	68
1.96	95%	38,416	4,268	1,537	384	96
2.576	99%	66,358	7,373	2,654	664	166

OTRS had 5,675 male and 9,201 female observed deaths during the period analyzed. The following provides the full details with p=95% and r=5%.

	Male	Female
Actual Deaths	5,675	9,201
Deaths needed for full credibility		
Based on Count	1,537	1,537
Based on Annuity Amount	2,035	1,355
Z Factor		
Based on Count	100.0%	100.0%
Based on Annuity Amount	100.0%	100.0%

Considering there is no published table based on data similar to OTRS in geography or exactly matching by occupation (would need to be a combination of published tables), and that the data from this experience study is much more recent than the data used to create the nationally published mortality tables, we could develop a client specific mortality tables utilizing the OTRS data. However, GRS works

with teacher retirement systems across the country and, in particular, many teacher retirement systems in the Southwest region of the United States. We have generally found that the Society of Actuaries published mortality tables do not provide a good match to the mortality experience of retired teachers in this region. We have also found them to have similar mortality characteristics. As a result, GRS has developed specialized mortality tables for retired teachers in the Southwest region. This also allows for smaller, more frequent adjustments than waiting for the next series of published tables.

Recommended Base Mortality Assumption

Experience used to examine the fit of the current assumption was for non-disabled retirees for the nine-year period ending June 30, 2023. Based on liability-weighted mortality experience, overall actual-to-expected ratios were 105% and 108% for males and females, respectively.

	Male	Female
Actual Deaths ($100,000 Annuities)	$911	$1,058
Expected Deaths based on Current Assumptions	$864	$979
A/E Ratio	105.4%	108.0%

The data from the last three fiscal years was clearly impacted by the pandemic, with much higher rates of mortality than the first six years. No one knows for sure how future mortality patterns will be impacted. As such, we have been careful to not add any more risk into the current assumption than currently exists, meaning if the data suggests life expectancies could be shortened based on the data, we will instead hold the same multipliers on the mortality assumptions and wait for more data before making adjustments. Thus, we are recommending no change to the Base Mortality assumption.

Recommended Mortality Improvement Assumption

We use a fully generational approach to this assumption. Because of this strategy of building in continuous improvement, life expectancies for today's younger active members are expected to be materially longer than those of today's retirees, and this provides substantial stability and dependability on costs and liabilities. We currently use a 1% improvement assumption per year across most ages.

There is an annual report published by the Retirement Plans Experience Committee of the Society of Actuaries to provide commentary on national trends in mortality experience and provide updated projection scales. The initial report was in 2014, with annual updates every year since. In every update, rates of improvement were materially decreased, meaning the original MP-2014 table was found to be too conservative. In addition, the amount of change from year to year has been significant. The amount of volatility produced by changing annually to each "most recent" table has been on the same order as the actual investment performance. Thus, we find the use of the full version of these tables to produce an overly complex, volatile pattern of results that has actually had minimal, if any, predictive power.

After approximately 15 years, all of the versions prior to the 2020 version of the MP tables reflected the same improvement rate at each future calendar year (the ultimate mortality improvement rates) at the 1% per year across most ages we currently use. In order to balance the two objectives of reflecting the most recent data available, while maintaining stability of results from year to year, we currently use the ultimate

mortality improvement rates in the MP tables for all years, which is again approximately 1% per year improvement across most ages.

In the 2020 report, the ultimate mortality improvement rates were modified to be higher at some ages and more precise across different age groups based on historical trends. Specifically, the pattern is 1.35% of the rate for ages 62 and younger, decreasing linearly to 1.10% at age 80, further decreasing linearly to 0.40% at age 95, and then decreasing linearly to 0.00% at age 115 (and thereafter). In general, the net change in overall liabilities if a retirement system was using the ultimate rates of the MP-2019 table to the ultimate rates of the MP-2020 version is minimal. Basically, the rates at individual ages were changed but the overall pattern over a lifetime is not much different.

We find it would be reasonable to use either set of improvement scales, but give preference to the more recently published report all else being equal. Given the material increase in healthcare costs required over the last few decades to allow for the rates of improvement that have existed, and the general worsening in morbidity factors in the United States, we find it reasonable to assume the future improvement would be approximate to or less than it has been historically across most ages. The 2020 report provides several pages of rationale and disclosure of the process used to generate the new long-term rates, including comparing to historical trends, and we find the analysis thorough and reasonable. Thus, we are recommending use of the ultimate rates in the MP-2020 scales, applied for all years.

The following is a table with the life expectancy for a retired member who attains age 65 based on the proposed assumption set, by calendar year. As shown, the life expectancy is expected to increase into the future.

Proposed Mortality Assumption - Life Expectancy for an Age 65 Retiree in Years					
Group	**Year of Retirement**				
	2023	2028	2033	2038	2043
Male	21.2	21.6	22.0	22.3	22.7
Female	23.9	24.2	24.6	24.9	25.3

The following exhibits provide more detail in the analysis.

POST-RETIREMENT MORTALITY - HEALTHY MALE
Weighted by Liability in $ in Millions

Age	Actual Deaths	Total Benefits	Actual Rate	Assumed Rate		Expected Benefits		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55-59	$ 22	$ 2,352	0.0096	0.0038	0.0039	$ 9	$ 9	241%	239%
60-64	58	6,307	0.0091	0.0058	0.0058	39	39	150%	148%
65-69	132	10,456	0.0126	0.0104	0.0104	111	112	118%	118%
70-74	174	9,611	0.0181	0.0187	0.0188	180	181	97%	96%
75-79	188	5,791	0.0324	0.0338	0.0339	192	193	98%	97%
80-84	167	2,742	0.0608	0.0609	0.0609	163	163	103%	103%
85-89	108	1,018	0.1060	0.1100	0.1096	108	108	100%	100%
90-94	52	273	0.1918	0.1989	0.1974	51	51	103%	104%
95-99	10	36	0.2948	0.3601	0.3572	12	11	91%	92%
Totals	$ 911	$ 38,586	0.0236	0.0224	0.0224	$ 864	$ 865	105%	105%
65-74	$ 305	$ 20,067	0.0152	0.0145	0.0146	$ 291	$ 292	105%	104%
75-84	$ 354	$ 8,533	0.0415	0.0416	0.0416	$ 355	$ 355	100%	100%
85-94	$ 160	$ 1,291	0.1241	0.1230	0.1224	$ 159	$ 158	101%	101%

POST-RETIREMENT MORTALITY - HEALTHY FEMALE
Weighted by Liability in $ in Millions

Age	Actual Benefits	Total Benefits	Actual Rate	Assumed Rate		Expected Benefits		Actual/Expected	
				Current	Proposed	Current (3) * (5)	Proposed (3) * (6)	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
55-59	$ 21	$ 5,014	0.0042	0.0022	0.0023	$ 12	$ 12	183%	182%
60-64	76	14,163	0.0054	0.0033	0.0033	50	51	150%	149%
65-69	161	22,272	0.0072	0.0063	0.0063	143	144	113%	112%
70-74	209	17,411	0.0120	0.0119	0.0120	206	207	102%	101%
75-79	192	8,822	0.0218	0.0226	0.0227	195	195	99%	98%
80-84	172	3,814	0.0450	0.0429	0.0429	159	159	108%	108%
85-89	129	1,504	0.0860	0.0815	0.0812	118	118	109%	110%
90-94	74	474	0.1559	0.1550	0.1539	70	69	106%	107%
95-99	24	98	0.2439	0.2951	0.2927	27	27	89%	90%
Totals	$ 1,058	$ 73,571	0.0144	0.0133	0.0133	$ 979	$ 981	108%	108%
65-74	$ 370	$ 39,683	0.0093	0.0088	0.0088	$ 349	$ 350	106%	106%
75-84	$ 364	$ 12,635	0.0288	0.0280	0.0281	$ 354	$ 354	103%	103%
85-94	$ 203	$ 1,977	0.1027	0.0950	0.0945	$ 188	$ 187	108%	109%

Disabled Mortality Rates

Because the rate of disability incidence is so low for OTRS and the disabled mortality rates apply to a very small subsection of plan participants, this is a minor assumption that has little impact on the liabilities of OTRS. We have historically used the healthy post-retirement tables, set forward three years for males and females, with a minimum mortality rate of 4.0% and 2.5%, for males and females, respectively. Additionally, we recommend applying future mortality improvements using the ultimate mortality improvement rates in the MP-2020 tables. This approach recognizes the underlying mortality patterns for OTRS while reflecting an adjustment (i.e., setting the age forward) to reflect the underlying impairment.

	Disabled Retiree Deaths		Actual/Expected	
	Males	Females	Males	Females
Actual Deaths	210	431	N/A	N/A
Actual Deaths (Weighted)	$22,939	$46,077	N/A	N/A
Current Assumption (Weighted)	$18,718	$36,564	123%	126%
Recommended Assumption (Weighted)	$18,716	$36,561	123%	126%

Active Mortality Rates

Active mortality is also a minor assumption. Incidence of active deaths is very low in comparison to terminations and retirements. For active mortality rates, we recommend continuing to use the Pub-2010 Teacher Employee mortality tables, with future mortality improvements modeled using the ultimate mortality improvement rates in the MP-2020 tables.

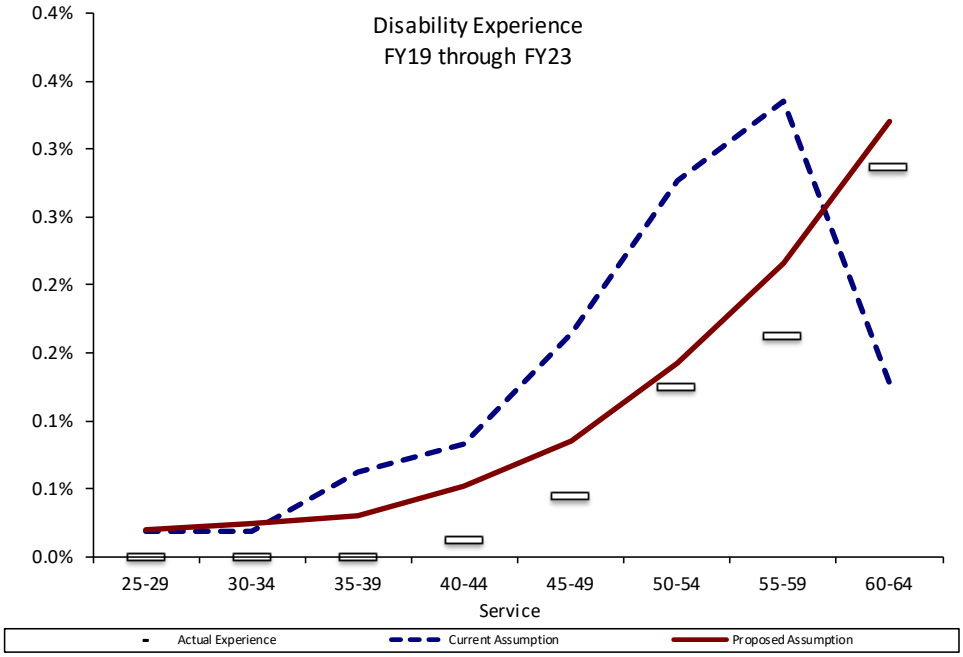
Disability Probabilities

The current disability probabilities are sex distinct. In order to simplify the assumption, our first recommendation is to use a unisex table. The analysis and new proposed probabilities are all based on unisex rates.

Disability is a low-incidence, low impact assumption. We performed additional analysis on these reconciliations to capture members who appeared to have gone from active to terminated in one valuation, but then terminated to disabled in the next valuation, and this appears to be due to a processing delay. However, the actual numbers of disabilities have been far less than currently expected. Based on recent experience, the A/E ratio was only 59%. We have proposed a new assumption which has a better fit by age and moved the overall A/E ratio half-way to the recent experience.

DISABILITY EXPERIENCE

				Assumed Rate		Expected Disabilities		Actual/Expected	
Age	Actual Disabilities	Total Count	Actual Rate	Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
25-29	-	34	0.0000	0.0002	0.0002	0	-	N/A	N/A
30-34	-	3,975	0.0000	0.0002	0.0003	1	1	N/A	N/A
35-39	-	16,222	0.0000	0.0006	0.0003	10	5	N/A	N/A
40-44	3	23,142	0.0001	0.0008	0.0005	19	12	16%	25%
45-49	13	29,272	0.0004	0.0016	0.0009	48	25	27%	52%
50-54	43	34,304	0.0013	0.0028	0.0014	95	49	45%	88%
55-59	52	31,954	0.0016	0.0034	0.0022	107	69	49%	75%
60-64	76	26,555	0.0029	0.0013	0.0032	34	85	224%	89%
Totals	187	165,458	0.0011	0.0019	0.0015	314	246	59%	76%



Retirement Probabilities

We currently use retirement rates that vary by age, sex, whether the member reaches an age based or Rule of based condition first, and the retirement eligibility "Group", as follows:

Group 1 members were hired before June 30, 1992 and are eligible to retire and receive a Normal Retirement benefit if (i) the member is at least age 62 and has credit for five or more years of service, or (ii) the sum of the member's age and service is at least 80 (Rule of 80).

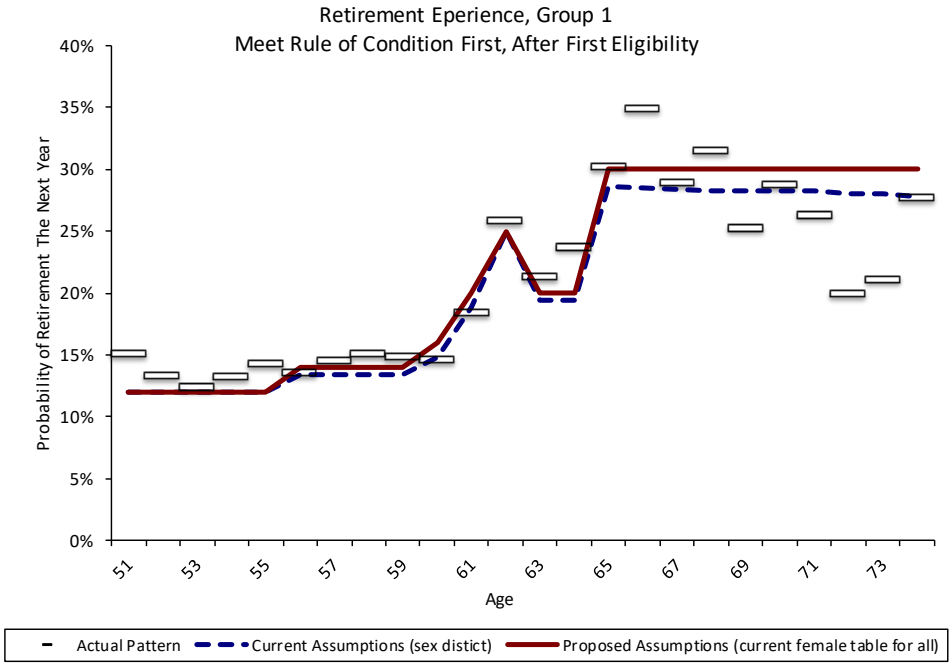
Group 2 members were hired after June 30, 1992 but before October 31, 2011 and must meet a "Rule of 90" instead of the "Rule of 80".

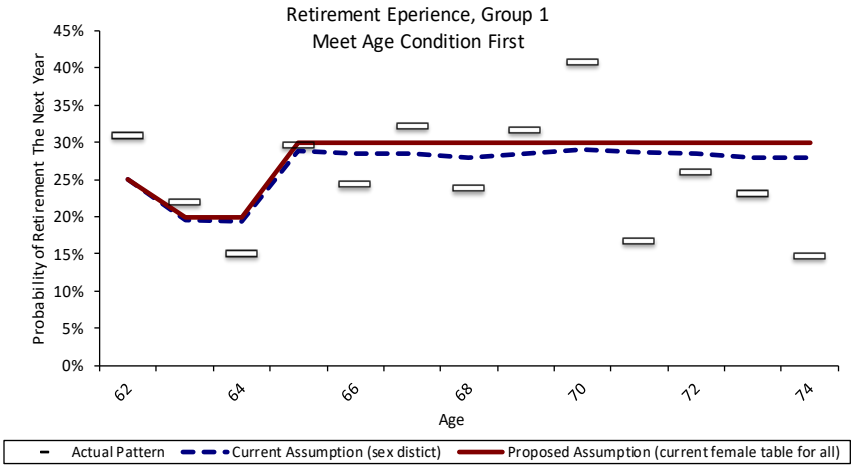
Group 3 members were hired after October 31, 2011 but before October 31, 2017 and are eligible if (i) the member is at least age 65 and has credit for five or more years of service or (ii) the member is at least age 60 and meets the "Rule of 90".

Group 4 members were hired after October 31, 2017 and must have credit for seven or more years of service.

Much of the experience for the Rule of conditions are still based on Group 1 members and thus the Rule of Base table is developed on that experience, with the assumptions for the other Groups adjusted for differences in the amount of service, etc. a member at a given age will have amongst the various groups.

The current assumption varies by sex, and given the liability weighted approach, the differences are not enough to warrant separate assumptions, thus the proposed probabilities are based on a unisex approach. In fact, the current female-based tables for both the Rule of and Age based tables for Group 1 are a good fit for the unisex assumption and we recommend that they be the Base Rule of and Base Age tables. For Group 1 members, this produces an A/E ratio of 103% for Rule of and 96% for Age based.





While Group 1 members make up most of the recent experience, Group 2 is most of the liability impacted by assumed future retirement patterns. Because the assumptions for Group 2 had to be based on estimates from Group 1 behavior, the current assumptions expect any member that would have been assumed to retire under Group 1 conditions, but are now not eligible to retire until 5 years later, to retire when first eligible. This gives a very large retirement probability at first eligibility, with more than 50% of members expected to retire when first eligible. This is a very common approach when experience for the group does not exist and professional judgement is needed.

However, there are now some Group 2 members reaching first eligibility and the current assumptions appear to overstate their retirement behavior. The A/E ratio for Group 2 members reaching first eligibility on a Rule of basis is 49%, so there are about half as many members actually retiring than expected right at first eligibility. This pattern has been seen across many of our clients with similar "tiered" retirement eligibilities, as members appear to be accepting the longer retirement eligibilities and likely need to work longer to prepare economically for retirement, given the rising healthcare costs and lack of COLAs in the program. Comparing Group 1 experience with Group 2 experience at first eligibility and after, we are recommending to lower the load at first eligibility to 5%. This approach produces an A/E ratio of 87% when compared to the actual experience, so there is still some conservatism. This is in addition to the 4% load discussed below.

RETIREMENT EXPERIENCE - GROUP 2
MEETS RULE OF CONDITION FIRST, AT FIRST ELIGIBILITY
Weighted by Liability in $millions

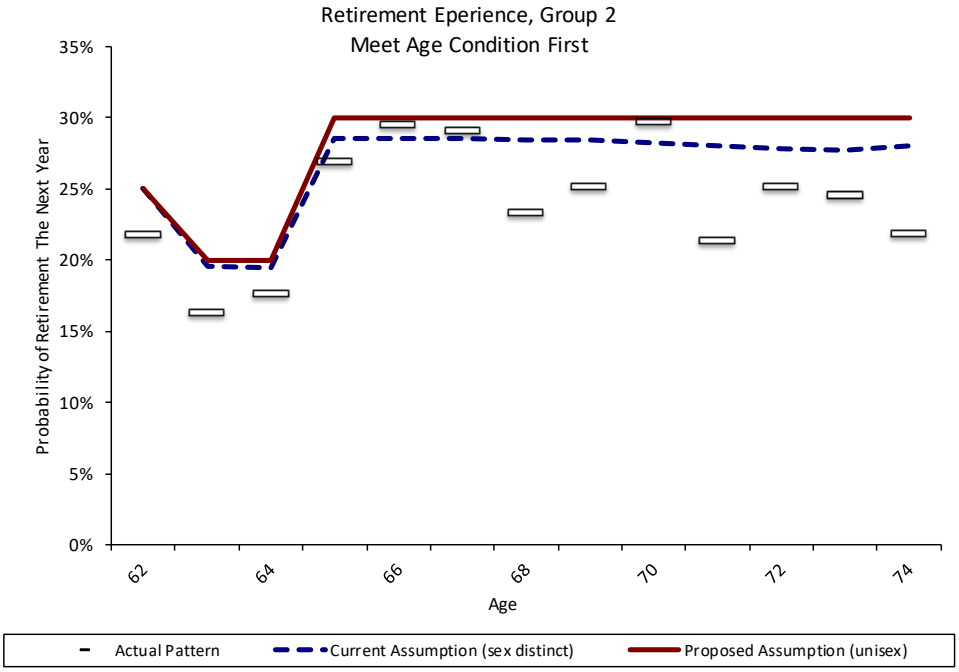
				Assumed Rate		Expected Retirement		Actual/Expected	
Age	Actual Retirement	Total Eligible	Actual Rate	Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
51	$ -	$ -	N/A	0.120	0.210	$ -	$ -	N/A	N/A
52	1	-	N/A	0.226	0.210	-	-	N/A	N/A
53	1	-	N/A	0.319	0.210	-	-	N/A	N/A
54	2	-	N/A	0.400	0.210	-	-	N/A	N/A
55	-	-	N/A	0.472	0.210	-	-	N/A	N/A
56	1	3	0.333	0.524	0.230	2	1	64%	100%
57	1	9	0.111	0.509	0.230	5	2	22%	50%
58	3	28	0.107	0.505	0.230	14	6	21%	50%
59	25	110	0.227	0.496	0.230	55	25	46%	100%
60	41	167	0.246	0.481	0.250	80	42	51%	98%
61	62	279	0.222	0.451	0.290	126	81	49%	77%
Total	$ 137	$ 596	0.230	0.471	0.263	$ 281	$ 157	49%	87%

For Group 2 members after first eligibility that meet the Rule of condition first, a member at a given age will on average have more service than the Group 1 member will have because they had to work five more years to be eligible. For all Groups based on the Rule of 90 retirement condition, we have added 4% to the Rule of Base table developed for Group 1. This produces an A/E ratio of 104% for recent Group 2 members, although there is a limited amount of data for this category of experience.

RETIREMENT EXPERIENCE - GROUP 2
MEETS RULE OF CONDITION FIRST, AFTER FIRST ELIGIBILITY
Weighted by Liability in $millions

				Assumed Rate		Expected Retirement		Actual/Expected	
Age	Actual Retirement	Total Eligible	Actual Rate	Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
57	-	1	0.000	0.120	0.180	0	-	0%	N/A
58	3	5	0.600	0.132	0.180	1	1	455%	300%
59	1	9	0.111	0.129	0.180	1	2	86%	50%
60	12	49	0.245	0.145	0.200	7	10	169%	120%
61	24	87	0.276	0.186	0.240	16	21	149%	114%
62	56	190	0.295	0.250	0.290	48	55	118%	102%
63	13	64	0.203	0.194	0.240	12	15	105%	87%
64	4	20	0.200	0.196	0.240	4	5	102%	80%
65	1	2	0.500	0.275	0.340	1	1	182%	100%
Total	$ 114	$ 427	0.267			$ 90	$ 110	127%	104%

Group 2 members have the same Age based eligibility conditions as Group 1, and the experience shows a good fit with an A/E ratio of 88%.



Members in Group 3 have to wait until age 60 to retire under the Rule of condition and age 65 for the Age based. We don't think this is different enough to warrant a separate assumption than Group 2 for the Rule of and thus are using the same approach to the assumption. For the age based, we are adding the 5% load at NAR at age 65 for the deferral from age 62 to age 65.

Thus, the full assumption for unreduced retirement is as follows:

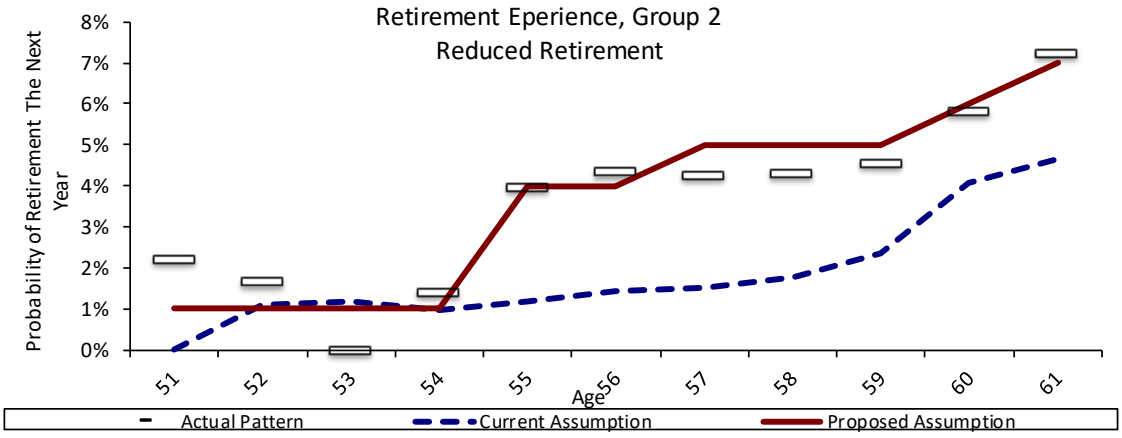
- One unisex pattern for members that reach the age-based condition before Rule of
- One unisex pattern for members that reach the Rule of based condition before Age
- For any member in Group 2, 3, or 4, 4% is added to the base Rule of table
- For any member whose retirement eligibility is later than it would have been under Group 1, a 5% load is added at first eligibility

Reduced Retirement

A member is eligible to retire early if the member is at least age 55 and has credit for five or more years of service, or at any age after 30 years of service. For members joining after October 31, 2011, a member is eligible to retire early if the member is at least age 60 and has credit for five or more years of service. It is likely that the reason there hasn't been a large increase in retirements at first eligibility for Group 2 is because they are opting to retire with reduced benefits. The A/E ratio for reduced retirement behavior was 205%, meaning almost twice as many members were retiring each year than assumed. We have recommended a new pattern based on recent experience which results in an A/E ratio of 96%.

REDUCED RETIREMENT EXPERIENCE - GROUP 2
Weighted by Liability in $millions

				Assumed Rate		Expected Retirement		Actual/Expected	
Age	Actual Retirement	Total Eligible	Actual Rate	Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
51	$ 1	$ 45	0.022	0.000	0.010	$ -	$ -	N/A	N/A
52	3	180	0.017	0.011	0.010	2	2	150%	150%
53	-	255	0.000	0.012	0.010	3	3	0%	0%
54	3	211	0.014	0.009	0.010	2	2	150%	150%
55	193	4,878	0.040	0.012	0.040	58	195	333%	99%
56	205	4,728	0.043	0.014	0.040	68	189	301%	108%
57	199	4,669	0.043	0.015	0.050	70	233	284%	85%
58	201	4,683	0.043	0.018	0.050	82	234	245%	86%
59	209	4,600	0.045	0.024	0.050	109	230	192%	91%
60	258	4,433	0.058	0.041	0.060	181	266	143%	97%
61	292	4,030	0.072	0.047	0.070	188	282	155%	104%
Total	$ 1,564	$ 32,712	0.048	0.023	0.050	$ 763	$ 1,636	205%	96%

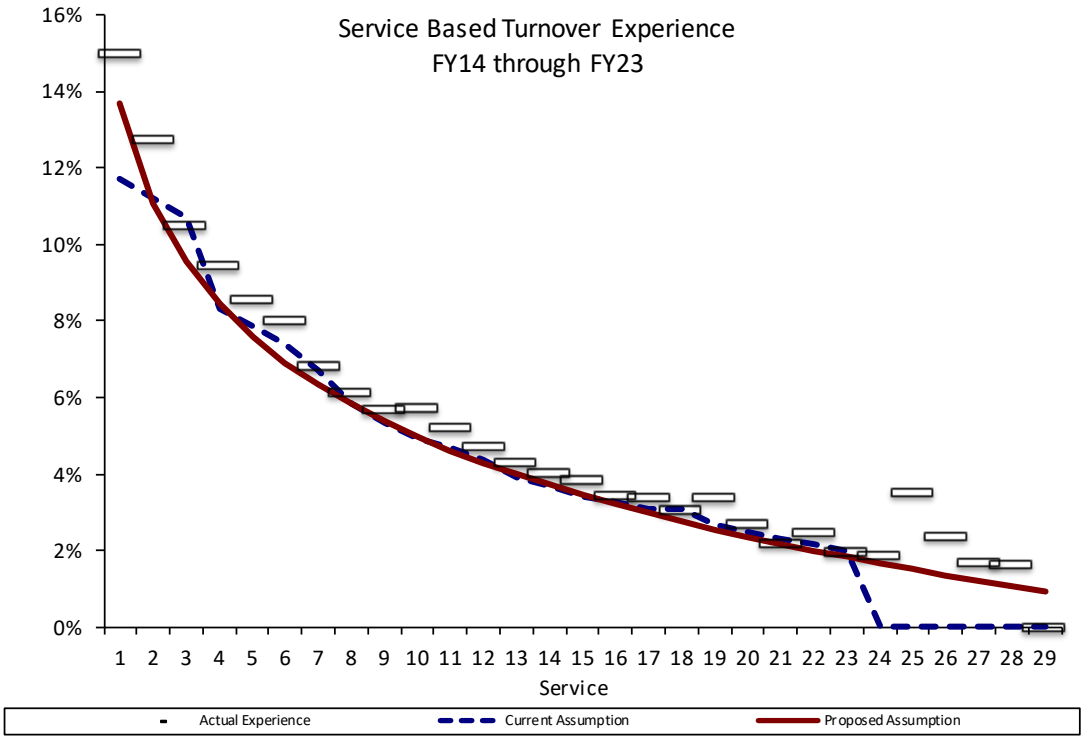


Turnover Patterns

Termination patterns reflect members who leave for any reason other than death, disability, or service retirement. They apply whether the termination is voluntary or involuntary, and whether the member takes a refund or keeps their account balance on deposit. The current turnover probabilities reflect the member's gender and service. This assumption is more significant than the disability assumption since the counts are so much higher, but less significant than the retirement assumption since these members leave at younger ages with smaller benefits and less liability.

As with several other assumptions, once the experience is liability weighted there is less need for different assumptions based on sex. We have simplified this assumption to be based on service only as our research has shown that service-based, liability weighted approaches produce the smallest bias in year to year gain loss analysis.

Generally, the overall pattern produces results very close to the previous assumption with an A/E ratio of 112% over the full ten years. We typically would have increased the probabilities to move the A/E closed to 105%, but the last 4 years of the period turnover was lower and we would rather wait and see what the experience is for the next four years before making a significant change.



SERVICE BASED TURNOVER EXPERIENCE

Weighted by Liability in $millions

				Assumed Rate		Expected Turnover		Actual/Expected	
Service	Actual Withdrawal	Total Exposed	Actual Rate	Current	Proposed	Current	Proposed	Current (2) / (7)	Proposed (2) / (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	$ 484	$ 3,232	0.1497	0.1170	0.1369	$ 378	$ 442	128%	109%
2	374	2,939	0.1273	0.1120	0.1107	329	325	114%	115%
3	313	2,980	0.1049	0.1070	0.0954	319	284	98%	110%
4	261	2,758	0.0946	0.0834	0.0845	230	233	113%	112%
5	232	2,711	0.0857	0.0786	0.0761	213	206	109%	113%
6	221	2,751	0.0804	0.0738	0.0692	203	190	109%	116%
7	196	2,868	0.0685	0.0673	0.0633	193	182	102%	108%
8	178	2,901	0.0615	0.0586	0.0583	170	169	105%	106%
9	167	2,934	0.0570	0.0535	0.0538	157	158	106%	106%
10	165	2,866	0.0574	0.0492	0.0499	141	143	117%	115%
11	146	2,794	0.0523	0.0469	0.0462	131	129	112%	113%
12	132	2,796	0.0473	0.0436	0.0430	122	120	108%	110%
13	126	2,916	0.0433	0.0391	0.0399	114	116	111%	109%
14	121	2,995	0.0406	0.0367	0.0371	110	111	110%	109%
15	117	3,023	0.0387	0.0341	0.0345	103	104	114%	112%
16	103	3,000	0.0343	0.0327	0.0321	98	96	105%	107%
17	99	2,924	0.0339	0.0308	0.0298	90	87	110%	114%
18	86	2,804	0.0307	0.0310	0.0276	87	77	99%	112%
19	91	2,684	0.0340	0.0268	0.0256	72	69	127%	132%
20	70	2,617	0.0269	0.0248	0.0237	65	62	108%	114%
21	58	2,614	0.0222	0.0233	0.0218	61	57	95%	102%
22	64	2,575	0.0249	0.0217	0.0200	56	52	114%	123%
23	50	2,517	0.0199	0.0199	0.0184	50	46	100%	109%
24	42	2,264	0.0186	0.0000	0.0168	0	38	0%	111%
25	33	940	0.0351	0.0000	0.0152	0	14	0%	236%
26	20	850	0.0237	0.0000	0.0137	0	12	0%	168%
27	12	693	0.0168	0.0000	0.0123	0	9	0%	129%
28	9	525	0.0164	0.0000	0.0109	0	6	0%	144%
29	0	60	0.0000	0.0000	0.0096	3	1	0%	0%
Totals	$ 3,972	$ 70,532	0.0563	0.0496	0.0502	$ 3,495	$ 3,538	114%	112%

Supplemental Medical Insurance

We currently assume that 50% of eligible member who are active or due a deferred vested benefit are assumed to elect the supplemental medical insurance benefit. Due to lagging, we also assume that for annuitants who began receiving a benefit in the year preceding the valuation date, 50% of those not already receiving the benefit are assumed to elect it.

We looked at the percentage of members as of June 30, 2023 who were eligible and have elected the insurance benefit, based on their year of retirement from 2018 to 2022. 2023 was ignored due to the lagging previously mentioned. As shown in the chart below, about 30% of eligible members who retired during that time period have elected the benefit as of June 30, 2023. In order to reflect this recent experience, while also giving credibility to the prior assumption of 50%, we are recommending this assumption be updated from a 50% assumption to a 40% assumption.

Year of Retirement	Percent Elected
2018	25.9%
2019	24.3%
2020	27.8%
2021	30.1%
2022	32.6%
2018 - 2022	28.4%

Other Assumptions

There are other assumptions made in the course of a valuation, such as the percentage of members who are married, the age difference between husbands and wives (both of which only impact the death benefit liability), the likelihood that a terminating employee will take a refund, etc, all of which have a minor impact on liabilities. We reviewed these, and believe these are generally realistic or conservative, so we decided to recommend no changes to these other assumptions.

Actuarial Methods

Actuarial Cost Method

We recommend continuing to use the Individual Entry Age Normal (IEAN) actuarial cost method. IEAN will generally produce level contribution amounts for each member as a percentage of salary from year to year, and allocates costs among various generations of taxpayers in a reasonable manner. It is by far the most commonly used actuarial cost method for large public retirement systems and the method used for accounting disclosures under GASB Statement No. 67.

For a plan that receives contributions primarily as a fixed percentage of payroll, the IEAN method does, however, eliminate the ability to perform a simple and algebraic calculation of the funding period and contribution requirements. Thus, we will continue to include a funding period determined based on an open group projection. The open group projection incorporates the fact that the normal cost rate will trend down over time. Otherwise, the projection is built to assume no gains or losses on the actuarial accrued liability.

Asset Valuation (Smoothing) Method

The purpose of asset smoothing is to reduce short-term volatility in actuarial valuation results which are intended for long-term decision making and funding. Periods of poor returns are often followed by some amount of recovery or vice versa, and a market value (unsmoothed) approach, may result in overreaction to short-term market volatility.

We believe the method used to determine the actuarial value of assets (AVA) is appropriate, since it does a good job of smoothing asset gains and losses, and reduces fluctuations in the funding period. The current method smooths the differences between the expected returns (based on the annual investment return assumption) and actual returns, net of expenses, over a five-year period. This method of determining the actuarial value of assets is very common and does not have a bias relative to market. In other words, we expect the ratio of the AVA to MVA to average about 100% over the long term. However, we are recommending a small adjustment to allow years with gains or losses to offset each other immediately instead of amortizing each through its own period. This keeps all of the benefits and attributes above, but reduces volatility another 20-30% and eliminates artificial volatility that can occur as recognition bases fall off at the end of the smoothing process.

SECTION D

SUMMARY OF ASSUMPTIONS AND METHODS

Summary of Assumptions and Methods
Incorporating the Recommended Assumptions

The assumptions and methods applied in this actuarial valuation may be adopted by the Board of Trustees on May 22, 2024 based on the experience investigation that covered the period ending June 30, 2023.

I. Valuation Date

The valuation date is June 30 of each plan year. This is the date as of which the actuarial present value of future benefits and the actuarial value of assets are determined.

II. Actuarial Cost Method

Because the employer contribution rate is set by statute, the actuarial valuation is used to determine the number of years required to amortize the Unfunded Actuarial Accrued Liability (UAAL), or the funding period.

The Individual Entry Age Normal actuarial cost method assigns the plan's total unfunded liabilities (the actuarial present value of future benefits less the actuarial value of assets) to various periods. The unfunded actuarial accrued liability is assigned to years prior to the valuation, and the normal cost is assigned to the year following the valuation. The remaining costs are the normal costs that will be recognized in future years. The resulting actuarially determined contribution requirement is composed of (i) the applicable year's normal cost, plus (ii) a payment intended to reduce the unfunded actuarial accrued liability.

The normal contribution is determined using the Individual Entry Age Normal method. Under this method, a calculation is made to determine the rate of contribution which, if applied to the compensation of each individual member during the entire period of anticipated covered service, would be required to meet the cost of all benefits payable on his behalf. The salary-weighted average of these rates is the normal cost rate. This calculation reflects the plan provisions that apply to each individual member. The employer normal cost rate is equal to (i) the normal cost rate, plus (ii) the expected administrative expenses, minus (iii) the member contribution rate.

The actuarial accrued liability is the difference between the total present value of future benefits and the actuarial present value of future normal costs. The unfunded actuarial accrued liability is the excess of the actuarial accrued liability over the actuarial value of assets.

The funding period is calculated as the number of years required to fully amortize the UAAL, assuming that: (a) future market earnings, net of investment-related expenses, will equal 7.00% per year, (b) there will be no liability gains/losses or changes in assumptions, (c) the number of active members will remain unchanged, (d) active members who leave employment will be replaced by new entrants each year, and (e) employer contributions and dedicated State revenue will remain the same percentage of payroll as projected for the current fiscal year.

The Entry Age actuarial cost method is an “immediate gain” method (i.e., experience gains and losses are separately identified as part of the UAAL). However, they are amortized over the same period applied to all other components of the UAAL.

III. Actuarial Value of Assets

The actuarial value of assets is based on the market value of assets with a five-year phase-in of actual investment return in excess of (less than) expected investment income. Offsetting unrecognized gains and losses are immediately recognized, with the shortest remaining bases recognized first and the net remaining bases continue to be recognized on their original timeframe. Expected investment income is determined using the assumed investment return rate and the market value of assets (adjusted for receipts and disbursements during the year). Returns are measured net of all investment expenses.

IV. Actuarial Assumptions

A. Economic Assumptions

1. Investment return: 7.00% per year, net of investment-related expenses (composed of an assumed 2.50% inflation rate and a 4.50% real rate of return)

2. Administrative expenses: 0.12% of valuation payroll per year

3. Salary increase rate: Inflation rate of 2.50% plus productivity increase rate of 0.50% plus step-rate/promotional as shown

Years of Service	Annual Step-Rate/Promotional Component Rates of Increase	Total Annual Rate of Increase
1-9	1.50%	4.50%
10	1.40%	4.40%
11	1.30%	4.30%
12	1.20%	4.20%
13	1.10%	4.10%
14	1.00%	4.00%
15	0.90%	3.90%
16	0.80%	3.80%
17	0.70%	3.70%
18	0.60%	3.60%
19-22	0.50%	3.50%
23-25	0.25%	3.25%
26 or more	0.00%	3.00%

4. New entrant salary growth: 3.00% per year

5. Overall payroll growth: 2.50% per year

6. Future ad hoc cost-of-living increases: None

B. Demographic Assumptions

1. Mortality after termination or retirement -

   a. Healthy males – 2020 GRS Southwest Region Teacher Mortality Table for Males. Generational mortality improvements in accordance with the latest MP scales with immediate convergence.

   b. Healthy females – 2020 GRS Southwest Region Teacher Mortality Table for Females. Generational mortality improvements in accordance with the latest MP scales with immediate convergence.

      Sample healthy retiree mortality rates, including associated annuity value and life expectancy results:

   c. Disabled males – 2020 GRS Southwest Region Teacher Mortality Table for Males, set forward three years with minimum rates at all ages of 4.0%. Generational mortality improvements in accordance with the latest MP scales with immediate convergence.

   d. Disabled females – 2020 GRS Southwest Region Teacher Mortality Table for Females, set forward three years with minimum rates at all ages of 2.5%. Generational mortality improvements in accordance with the latest MP scales with immediate convergence.

2. Mortality rates of active members – Pub-2010 Teachers Active Employee Mortality table. Generational mortality improvements in accordance with the latest MP scales with immediate convergence.

3. Disability Incidence –As shown below for selected ages (rates are only applied to eligible members, which are members with at least 10 years of service)

Age	Probability of Disability in the Next Year
25	0.0002
30	0.0003
35	0.0004
40	0.0006
45	0.0009
50	0.0015
55	0.0025
60	0.0035
65	0.0058

4. Retirement rates - Separate male and female rates, based on age, developed from the 2024 Experience Study. Sample rates are shown below:

Expected Retirements per 100 Lives			
	Unreduced Retirement		
Age	Reach Age Condition First	Reach Rule of Condition First	Reduced Retirement
Under 50	0.0	0.0	0.0
50-54	12.0	12.0	1.0
55	12.0	12.0	4.0
56	12.0	14.0	4.0
57	12.0	14.0	5.0
58	12.0	14.0	5.0
59	12.0	14.0	5.0
60	12.0	16.0	6.0
61	16.0	20.0	7.0
62	25.0	25.0	10.0
63	20.0	20.0	10.0
64	20.0	20.0	10.0
65-74	30.0	30.0	
75 and over	100.0	100.0	

Members whose Rule of is Rule of 90 have an additional 4% added to the table above

Members whose retirement eligibilities are delayed in comparison to members hired before 1992 have an additional 5% added at their first year of eligibility

5. Termination Rates – Rates based on the member's service, developed from the 2024 Experience Study. Rates reflect terminations for causes other than death, disability or retirement. Sample rates are shown below:

Credited Service (Years)	Expected Terminations Per 100 Lives
1	13.69
2	11.07
3	9.54
4	8.54
5	7.61
6	6.92
7	6.33
8	5.83
9	5.38
10	4.99
11	4.62
12	4.30
13	3.99
14	3.71
15	3.45
16	3.21
17	2.98
18	2.76
19	2.56
20	2.37
21	2.18
22	2.00
23	1.84
24	1.68
25	1.52
26	1.37
27	1.23
28	1.09
29	0.96

C. Other Assumptions

1. Percent married: 80% of employees are assumed to be married.

2. Age difference: Males are assumed to be three years older than females.

3. Percent electing annuity on death (when eligible): All of the spouses of married participants who die after becoming eligible for a retirement benefit are assumed to elect an annuity, in lieu of the $18,000 lump sum and refund.

4. Election of deferred termination benefit: vested terminating members are assumed to elect a refund or a deferred benefit, whichever is more valuable at the time of termination.

5. Assumed age for commencement of deferred benefits: Members electing to receive a deferred benefit are assumed to commence receipt at age 62 (age 65 if hired on or after November 1, 2011).

6. Supplemental medical insurance: 40% of eligible members who are active or due a deferred vested benefit are assumed to elect the insurance benefit. For annuitants who began receiving a benefit in the year preceding the valuation date, 40% of those not already receiving the benefit are assumed to elect it. The liability for all other annuitants is based on the actual benefit being paid as shown in the data.

7. Members who retire with at least 24 years of credited service are assumed to have 120 days of unused sick leave for which they will receive one year of service credit. This assumption only applies to reduced and unreduced retirement.

8. No assumption was made that current active members employed by the comprehensive universities will elect to transfer out of OTRS.

9. Reemployment, purchase of service, transfers: No recognition is made of (i) future member reimbursements upon reemployment, (ii) future purchase of additional service, or (iii) special transfer provisions.

10. For EESIP eligible employees, if the refund amount to be paid exceeds the actuarial present value of the additional benefit, then we assume the member does not elect the enhanced benefit.

11. Decrement timing: Decrements of all types are assumed to occur mid-year.

12. Actuarial equivalence factors are calculated using valuation assumptions. Mortality tables are projected from 2020 to 2030 using the Ultimate MP scale and blended 30%/70% for males/females. Payments are assumed to be made at the end of each month.

V. Valuation Data

Participant data was supplied on an electronic file for (i) active members, (ii) inactive vested members who are entitled to a future deferred benefit, (iii) inactive nonvested members who are entitled to a refund of their employee contributions, and in some cases a portion of the accumulated interest, and (iv) members and beneficiaries receiving benefits.

The data for active and inactive, non retired members included date of birth, date of hire, gender, years of service, salary, employee contributions and accumulated interest on employee contributions. The data also included a code to indicate whether the employee had elected to make contributions on salary above $25,000, and a code indicating the type of employer (comprehensive university, other college or university, or other employer). For retired members and beneficiaries, the data included date of birth, gender, spouse's date of birth (where applicable), amount of monthly benefit, date of retirement, and a form of payment code.

Individual member contributions for the 12 months prior to the valuation date were used to determine the actual salary for plan members in the prior plan year. The valuation assumptions for salary increases were used to determine the projected salary for the current plan year. Additionally, contributing members were assumed to accrue one additional year of service between the end of the prior employment year and the valuation date.

Additional assumptions were made to correct for missing or inconsistent data. These had no material impact on the results presented.

Some inactive, non-vested employees who are entitled to a refund are not included in the data, but a liability for their refund is included instead in the Suspense Fund, which is included in the liability.

VI. Actuarial Model

This report was prepared using our proprietary valuation model and related software which in our professional judgment has the capability to provide results that are consistent with the purposes of the valuation. We performed tests to ensure that the model reasonably represents that which is intended to be modeled.