

Judges' Retirement
System of Illinois
2018 Actuarial Experience Study
July 1, 2015 — June 30, 2018



July 16, 2019

Board of Trustees
Judges' Retirement System
2101 South Veterans Parkway
Springfield, Illinois 62794-9255

Subject: 2018 Actuarial Experience Study

Dear Members of the Board:

We are pleased to present our report on the results of the 2018 Actuarial Experience Study for the Judges' Retirement System of Illinois ("JRS" or "System"). The purpose of the study is to evaluate the continued appropriateness of the actuarial assumptions used in the annual actuarial valuation by comparing actual experience to expected experience. Our study was based on census information for the period from July 1, 2015, to June 30, 2018, as provided by JRS staff. This report includes our recommended assumptions and methods effective for the June 30, 2019, actuarial valuation. It also provides the actuarial impact produced by these recommendations as though they had been effective for the June 30, 2018 actuarial valuation.

Pursuant to Public Act 99-0232, effective August 3, 2015, the five state systems shall conduct an actuarial experience study at least once every three years.

Our study includes a review of the experience associated with the following actuarial assumptions:

- Price inflation;
- Investment return;
- General wage inflation and payroll growth;
- Salary increases;
- Mortality;
- Inflation;
- Retirement; and
- Withdrawal (Turnover).

Actuarial assumptions are set by the Board of Trustees. With the Board's approval of the recommendations in this report, we believe the actuarial condition of the System 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 report should not be relied on for any purpose other than the purpose stated. This report may be provided to parties other than JRS only in its entirety and only with the permission of JRS. GRS is not responsible for unauthorized use of this report.

The results of the experience study and recommended assumptions set forth in this report are based on the data and actuarial techniques and methods described above, and upon the provisions of the System as of the most recent actuarial valuation date, June 30, 2018. To the best of our knowledge, the information contained in this report is accurate and fairly presents the experience of members participating in the System for the period July 1, 2015, to June 30, 2018. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board.

Alex Rivera, Heidi G. Barry, and Jeffrey T. Tebeau are Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

The signing actuaries are independent of the plan sponsor.

We believe that the proposed actuarial assumptions that are the result of this experience study represent a reasonable estimate of expected future experience of the Judges' Retirement System of Illinois.

Respectfully submitted,

Gabriel, Roeder, Smith & Company



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SECTION A

EXECUTIVE SUMMARY

Executive Summary

The results of the three-year experience review of the Judges' Retirement System of Illinois are presented in this report. Public Act 99-0232 requires an experience review once every three years.

The last comparable experience review was prepared for the period from July 1, 2012, to June 30, 2015. In this report, actual experience is compared to expected experience for the three year period from July 1, 2015, to June 30, 2018, in order to evaluate and update the actuarial assumptions used for the most recent actuarial valuation as of June 30, 2018. The cost impact of the updated assumptions was measured as of June 30, 2018. The updated actuarial assumptions are effective beginning with the actuarial valuation as of June 30, 2019.

Based on our review of the actuarial experience, we recommend the following updates to the actuarial valuation assumptions:

- Decrease the assumed investment return assumption from 6.75 percent to 6.50 percent.
- Reduce the price inflation assumption from 2.50 percent to 2.25 percent.
- Reduce the general payroll growth assumption from 2.75 percent to 2.50 percent.
- Reduce the salary increase assumption.
- Update the mortality table to the Pub-2010 Above-Median Income General Healthy Retiree and Employee Mortality Tables with adjustments for the System's credibility factors and future mortality improvements using the scale MP-2018.
- Update the normal and early retirement rates to better reflect observed experience.
- Update the current turnover rates to better reflect observed experience.

Executive Summary

Based on the preceding recommended assumptions, the actuarial liability as of June 30, 2018, and the fiscal year 2020 statutory contributions are expected to change as follows:

Actuarial Valuation as of June 30, 2018 (\$ in thousands)	Actuarial Liability as of June 30, 2018	Fiscal Year 2020 Statutory Contribution
Baseline	\$ 2,721,853	\$ 144,160
Impact due to:		
• Mortality Table Changes	(99,654) -3.7%	(2,215) -1.5%
• Other Demographic Assumption Changes	13,997 0.5%	357 0.2%
• Economic Assumption Changes	<u>71,228 2.6%</u>	<u>1,973 1.4%</u>
Total Impact	\$ (14,429) -0.6%	\$ 115 0.1%
After Recommended Changes	\$ 2,707,424	\$ 144,275

The funded ratio as of June 30, 2018, and the fiscal year 2020 Statutory Contribution as a percent of pay are expected to change as follows:

Actuarial Valuation as of June 30, 2018	Funded Ratio based on Market Value of Assets	Fiscal Year 2020 Statutory Contribution as a Percent of Pay
Baseline	37.2%	91.9%
Impact due to:		
• Mortality Table Changes	1.4%	-1.5%
• Other Demographic Assumption Changes	-0.2%	0.4%
• Economic Assumption Changes	<u>-1.0%</u>	<u>1.3%</u>
Total Impact	0.2%	0.2%
After Recommended Changes	37.4%	92.1%

As shown in the above tables, there is an increase in cost due to the change in economic and demographic assumptions that is partially offset by the change in the mortality assumption.

Executive Summary

The remainder of the report is an integral part of the Experience Study and includes:

- An introduction to key factors that were included in the study;
- An analysis of the experience and assumption recommendations;
- Cost impact of the proposed assumption changes; and
- Tables showing the recommended actuarial assumptions.

SECTION B

INTRODUCTION

Introduction

Background

For any pension plan, actuarial assumptions are selected that are intended to provide reasonable estimates of future expected events, such as investment returns, interest crediting, and patterns of retirement, turnover, and mortality. These assumptions, along with an actuarial cost method, an asset valuation method, the employee census data, and the System's provisions are used to determine the actuarial liabilities and overall actuarially determined funding requirements for the System. The true cost to the System over time will be the actual benefit payments and expenses required by the System's provisions for the participant group under the System. To the extent the actual experience deviates from the actuarial assumptions, experience gains and losses will occur. These gains (losses) then serve to reduce (increase) future actuarially determined contributions and increase (reduce) the funded ratio.

A periodic review and update of the actuarial assumptions is one of many important components of understanding and managing the financial aspects of the Judges' Retirement System of Illinois. 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 actuarial 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 actuarial valuation process needs to represent the best estimate of the future experience of the System and be at least as likely, if not more than likely, to overestimate the future liabilities versus underestimate them.

Using this strategic mindset, each assumption was analyzed compared to the actual experience of the System and general experience of other large public employee retirement funds. Changes in certain assumptions and methods are suggested based 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.

Actuarial Standards of Practice ("ASOPs")

The Actuarial Standards Board ("ASB") provides guidance on measuring the costs of financing a retirement program through the following Actuarial Standards of Practices ("ASOPs"):

- (1) ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*;
- (2) ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*;

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- (3) ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*; and
- (4) ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*.

The recommended assumptions provided in this report are consistent with the preceding actuarial standards of practice.

The ASB recently adopted Actuarial Standard of Practice (ASOP) No. 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*. ASOP No. 51 will be effective for any actuarial work product with a measurement date on or after November 1, 2018.

Summary of Process

In determining liabilities and contribution rates for retirement plans, actuaries must make assumptions about the future. The actuarial assumptions are usually divided into two categories:

- Economic assumptions, which include:
 - Assumed rate of price inflation (as measured by the change in the Consumer Price Index for all Urban consumers)
 - Underlies all other economic assumptions
 - Basis for cost-of-living increases for members hired on or after January 1, 2011
 - Assumed long-term rate of return on investments
 - Rate at which projected benefits are reduced to present value
 - Rate for reversionary annuity factors
 - General wage increases
 - Reflects inflationary forces on increases in pay for all members
 - Rate of payroll growth
 - Reflects expectation of growth in total payroll and affects level percent of pay statutory contribution
- Demographic assumptions, which include:
 - Mortality rates
 - Retirement rates
 - Withdrawal (Turnover) rates

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 System's assumptions periodically and determine whether these assumptions are consistent with both actual past experience and anticipated future experience.

The last such actuarial experience study was performed following the June 30, 2015, actuarial valuation and the recommendations were first effective with the June 30, 2016, actuarial valuation. For this experience study, we have reviewed the System's experience for the three-year period from July 1, 2015, through June 30, 2018.

Introduction

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 period 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 decline 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 dampen real changes that may be occurring, such as mortality improvement or a change in the ages at which members retire.

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, consider a rate of retirement of 5.00 percent 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 percent. 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 percent, 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.

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 while the recommended assumption set represents our best estimate, there are other reasonable assumptions sets that could be supported. Some other reasonable assumption sets would show higher or lower liabilities or costs.

Summary of Recommendations

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

Economic Assumptions

- **Price inflation:** We recommend decreasing the rate of price inflation from 2.50 percent to 2.25 percent.
- **Investment return:** We recommend decreasing the nominal investment return assumption from 6.75 percent to 6.50 percent. Based on blended capital market assumptions from independent sources and the System's current asset allocation, over the next 20 years the likelihood assets will earn at least 6.75 percent per year is 49.34 percent and the likelihood assets will earn at least 6.50 percent per year is 53.03 percent. Based on a shorter 10-year horizon, the likelihood assets will

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earn at least 6.50 percent is 45.96 percent and the likelihood assets will earn at least 6.75 percent is 43.29 percent.

- **Payroll growth assumption:** We recommend lowering the general payroll growth assumption from 2.75 percent to 2.50 percent, which reflects an underlying general price inflation assumption of 2.25 percent.
- **Salary increase:** We recommend reducing the salary increase assumption to reflect the change in the payroll growth assumption.

Mortality Assumptions

- We recommend updating post-retirement mortality tables to the recently published public sector tables, the Pub-2010 Above-Median Income General Healthy Retiree Mortality tables. We also recommend assuming mortality rates will improve in the future using a fully generational approach, with the recently published projection scale, MP-2018.
- We recommend updating pre-retirement mortality tables for active employees to the recently published public sector tables, the Pub-2010 Above-Median Income General Employee Mortality tables. We also recommend assuming mortality rates will improve in the future using a fully generational approach, with the most recently published projection scale, MP-2018.
- We recommend applying scaling factors to the base mortality tables; i.e., Pub-2010 Above-Median Income General Tables, to partially reflect observed mortality experience to the extent it is credible.

Other Demographic Assumptions

- **Normal retirement rates:** Overall, the actual rates of retirement were lower than expected. We recommend updating the overall rates to better reflect observed experience.
- **Turnover rates:** Overall, the observed experience showed that fewer members terminated employment than expected. We recommend updating the rates of termination.
- **Load for inactive members eligible for deferred vested pension benefits:** Based on recent experience, we recommend updating the assumption to 10 percent to account for participation in the reciprocal system.
- **Marriage assumption:** We recommend updating the current assumption of 75 percent of active and retired participants are married to 80 percent.

SECTION C

ANALYSIS OF EXPERIENCE AND RECOMMENDATIONS

Economic Assumptions

Economic assumptions reflect the effects of economic forces on the projections of retirement benefits payable from the System and in the discounting of those benefits to present value.

These assumptions are based, at their core, on the assumed level of price inflation. Each economic assumption is then developed from expected spreads over price inflation.

The key economic assumptions are:

- Assumed Rate of Inflation – The rate of price inflation (as measured by the Consumer Price Index for all Urban consumers) which underlies the remainder of the economic assumptions.
- Assumed Rate of Investment Return – The rate at which projected future benefits under the pension plan are reduced to present value.
- Rate of General Annual Pay Increases – This reflects inflationary forces on increases in pay for individual members.

Actuarial Standard of Practice No. 27

Actuarial Standard of Practice 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. ASOP No. 27 was revised and adopted by the Actuarial Standards Board (ASB) in September 2013 (applicable to actuarial valuation dates on or after September 30, 2014). The standard requires that the selected economic assumptions be consistent with each other. That is, the selection of the investment return assumption should be consistent with the selection of the wage inflation and price inflation assumptions.

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; and
5. 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 actuarial 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.

Economic Assumptions

Inflation Assumption

By “inflation,” we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies most of the other economic assumptions. It impacts investment return, salary increases, and overall payroll growth. The current annual inflation assumption is 2.50 percent.

Over the three-year period from June 2015 through June 2018, the CPI-U has increased at an average annual rate of 1.83 percent. **However, the assumed inflation rate is only weakly tied to past results.**

The following table shows the average inflation over various periods, ending June 2018.

Fiscal Year	Annual Increase in CPI-U
2013-14	2.07%
2014-15	0.12%
2015-16	1.00%
2016-17	1.63%
2017-18	2.87%
3-Year Average	1.83%
5-Year Average	1.54%
10-Year Average	1.42%
20-Year Average	2.20%
25-Year Average	2.25%
30-Year Average	2.56%
40-Year Average	3.44%
50-Year Average	4.04%

Future Inflation Expectations

Since price inflation is relatively volatile and is subject to a number of influences not based on recent history, economic assumptions are less reliably based on recent past experience than are the demographic assumptions. Therefore, it is important not to give undue weight to recent experience. We must also consider future expectations as well.

One 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 January 1, 2019, the difference for 20-year bonds implies that inflation over the next 20 years would average 1.82 percent. The difference in yield for 30-year bonds implies 1.85 percent inflation over the next 30 years.

Economic Assumptions

The following tables present a summary of inflation rate forecasts from the Federal Reserve.

Federal Reserve Bank of Cleveland	July 2015	July 2016	July 2017	July 2018	January 2019
30-Year Expectation	2.20%	2.04%	2.18%	2.32%	2.24%
20-Year Expectation	2.07%	1.87%	2.04%	2.23%	2.12%
10-Year Expectation	1.88%	1.63%	1.85%	2.10%	1.96%
5-Year Expectation	1.77%	1.51%	1.74%	2.03%	1.87%

Federal Reserve Bank of St. Louis	July 2015	July 2016	July 2017	July 2018	January 2019
30-Year Breakeven Inflation	1.96%	1.62%	1.87%	2.13%	1.85%
20-Year Breakeven Inflation	1.90%	1.40%	1.81%	2.10%	1.82%
10-Year Breakeven Inflation	1.89%	1.43%	1.73%	2.11%	1.71%

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 Treasury Inflation Protected Securities (TIPS).

Another point of reference is the Social Security Administration's (SSA) 2018 Trustees Report, in which the Office of the Chief Actuary is projecting a long-term average ultimate annual inflation rate of 2.60 percent under the intermediate cost assumption. The ultimate inflation assumption is 2.00 percent and 3.20 percent respectively in the low cost and high cost projection scenarios. The Social Security Trustees report uses the ultimate rates for their 75-year projections, much longer than the longest horizon we can discern from Treasuries and TIPS.

We also surveyed the inflation assumption used by various investment consulting firms. In our sample of these firms, the inflation assumption ranged from 1.95 percent to 2.75 percent, with an average of 2.20 percent in the short-term (10 years or less) and 2.42 percent in the long-term (20 to 30 years).

The following table provides inflation forecasts from various sources.

Economic Assumptions

Forward-looking Annual Inflation Forecasts (From Professional Experts in the Field of Forecasting Inflation)	
Federal Reserve Board's Federal Open Market Committee Current Long-run Price Inflation Objective (Since Jan 2012; Personal Consumer Expenditures)	2.00%
Congressional Budget Office: <i>The Budget and Economic Outlook</i> Overall Consumer Price Index (August 2018; Ultimate) Personal Consumer Expenditures (August 2018; Ultimate)	2.40% 2.00%
2018 Social Security Trustees Report CPI-W 15-Year Intermediate Assumption CPI-W 30-Year Intermediate Assumption GDP Deflator 15-Year Intermediate Assumption GDP Deflator 30-Year Intermediate Assumption	2.60% 2.60% 2.20% 2.20%
Quarterly Survey of Professional Forecasters 3Q2018 Federal Reserve Bank of Philadelphia 10-Year Forecast	2.21%
Federal Reserve Bank of Cleveland 30-Year Expectation on February 1, 2019 20-Year Expectation on February 1, 2019 10-Year Expectation on February 1, 2019	2.25% 2.13% 1.97%
Bond Investors (Excess Yield of Non-indexed Treasuries Over Indexed Treasuries) 30-Year Expectation on January 1, 2019 Median 30-year Expectation over 12/31/13 - 12/31/18 20-Year Expectation on January 1, 2019 Median 20-year Expectation over 12/31/13 - 12/31/18 10-Year Expectation on December 31, 2018 Median 10-year Expectation over 12/31/13 - 12/31/18	1.85% 1.97% 1.82% 1.91% 1.71% 1.86%
Investment Consultants and Forecasters 2018 GRS Survey major national investment forecasters and consultants Median expectation among 11 firms (averaging 9.9 years) Median expectation among 3 firms (averaging 26.7 years) 2018 HAS* Survey of 13 investment advisors: Median (10 years) 2018 HAS* Survey of 13 investment advisors: Median (20 years)	2.20% 2.42% 2.41% 2.47%

*Horizon Actuarial Service 2018 Survey of Capital Market Assumptions

Economic Assumptions

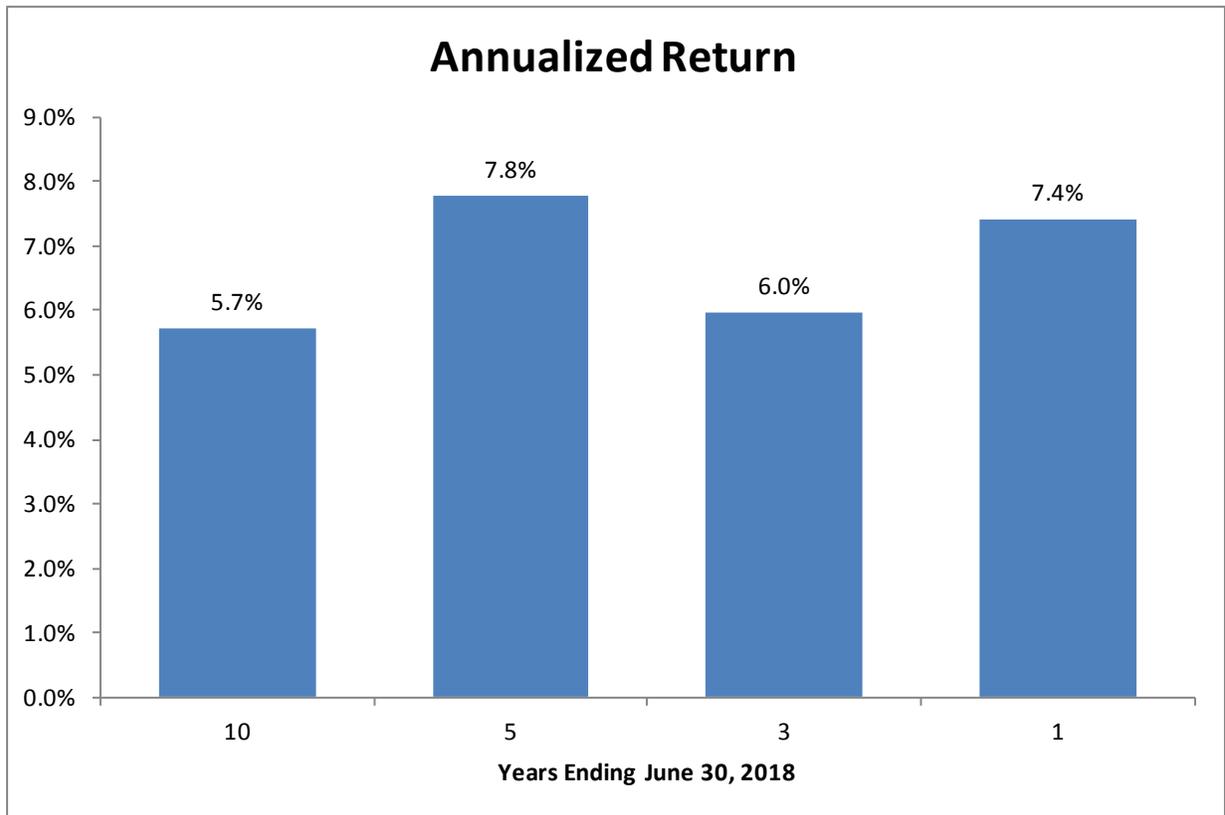
Recommendation

Based on this information, our opinion is that it would be reasonable to lower the current price inflation assumption of 2.50 percent. However, we caution against lowering the price inflation assumption too low (i.e., below 2.00 percent). We are recommending the inflation assumption be reduced from 2.50 percent to 2.25 percent. This reduction recognizes lower inflation expectations in both the near and longer term. The change will bring it closer to recent inflation levels and closer to levels expected in the financial markets. As you will see, this change also affects all other economic assumptions.

Investment Return Assumption

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 actuarial 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 6.75 percent per year, net of investment expenses.

The chart below shows the historical annualized history of the System's market returns through fiscal year end 2018.



Economic Assumptions

Real Return

The allocation of assets within the universe of investment options will have a significant impact on the overall performance. Therefore, it is meaningful to identify the range of expected returns based on the fund's targeted allocation of investments and an overall set of capital market assumptions.

Based on information provided by JRS and ISBI, following is a table with the System's current target asset allocation and capital market assumptions based on a 20-year horizon:

Asset Category	Current Target	Annualized Compounded Return	Annualized Average Return	Annualized Standard Deviation
U.S. Equity	23.00%	7.50%	9.10%	18.00%
Developed Foreign Equity	13.00%	7.30%	9.30%	20.00%
Emerging Market Equity	8.00%	9.80%	13.20%	26.00%
Private Equity	7.00%	9.60%	13.20%	27.00%
Intermediate Investment Grade Bonds	14.00%	3.50%	3.60%	4.00%
Long-term Government Bonds	4.00%	3.80%	4.60%	12.50%
TIPS	4.00%	3.50%	3.80%	7.50%
High Yield	2.50%	6.00%	6.80%	12.50%
Bank Loans	2.50%	5.50%	6.00%	10.00%
Opportunistic Debt - Direct Lending	2.00%	7.30%	8.60%	16.00%
Opportunistic Debt - Mezzanine Debt	2.00%	6.80%	8.80%	20.00%
Opportunistic Debt - Distressed Debt	2.00%	6.90%	9.80%	24.00%
Opportunistic Debt - Real Estate Debt	2.00%	6.90%	9.50%	23.00%
Emerging Market Debt	2.00%	5.90%	7.00%	14.50%
Core Real Estate	5.50%	5.70%	6.50%	12.50%
Non-core Real Estate - Value Add Real Estate	2.50%	7.20%	9.00%	19.00%
Non-core Real Estate - Opportunistic Real Estate	2.00%	8.90%	12.00%	25.00%
Infrastructure	2.00%	8.80%	11.40%	23.00%
Total	100.00%			

Based on page 54 of the ISBI Asset Allocation Review and Risk Analysis report issued by Meketa Investment Group on September 21, 2018.

We applied the System's target asset allocation, and performed an analysis using capital market assumptions from a sample of 11 nationally known investment consulting firms. Three of the investment consulting firms provided capital market expectations for longer time horizons (20 to 30 years). Eleven firms provided capital market expectations for shorter time horizons (10 years or less).

These investment consulting firms periodically issue reports that describe their capital market assumptions; that is, their estimates of expected returns, volatility and correlations among the different asset classes. The assumptions for most of the investment consultants are for 2018. While some of these assumptions may be based upon historical analysis, many of these firms also incorporate forward-looking adjustments to better reflect near-term and long-term expectations. The estimates for core investments (i.e., fixed income, equities and real estate) are generally based on anticipated returns produced by passive index funds.

The current nominal investment return assumption of 6.75 percent is based on an inflation assumption of 2.50 percent and a real return of 4.25 percent.

Given the System's current target asset allocation and the capital market assumptions from the investment consultants, the development of the average nominal return, net of investment expenses, is provided in the following tables.

Economic Assumptions

Short-term Investment Horizon (10 years or less) Assumptions – One Year Arithmetic Returns

Investment Consultant	Investment Consultant Expected Nominal Return Net of Expenses	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal One-year Arithmetic Return Net of Expenses (4)+(5)	Annualized Standard Deviation of Expected Return
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	6.30%	2.26%	4.04%	2.25%	6.29%	10.45%
2	6.07%	2.00%	4.07%	2.25%	6.32%	9.96%
3	6.62%	2.50%	4.12%	2.25%	6.37%	12.41%
4	6.77%	2.50%	4.27%	2.25%	6.52%	12.22%
5	6.40%	2.00%	4.40%	2.25%	6.65%	11.56%
6	6.64%	2.21%	4.43%	2.25%	6.68%	12.81%
7	6.83%	2.31%	4.53%	2.25%	6.78%	11.26%
8	6.80%	2.26%	4.54%	2.25%	6.79%	13.28%
9	6.67%	1.95%	4.72%	2.25%	6.97%	11.76%
10	7.02%	2.25%	4.77%	2.25%	7.02%	13.63%
11	7.69%	2.00%	5.69%	2.25%	7.94%	9.91%
Average	6.71%	2.20%	4.51%	2.25%	6.76%	11.75%

Long-term Investment Horizon (20 to 30 years) Assumptions – One Year Arithmetic Returns

Investment Consultant	Investment Consultant Expected Nominal Return Net of Expenses	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal One-year Arithmetic Return Net of Expenses (4)+(5)	Annualized Standard Deviation of Expected Return
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	7.16%	2.31%	4.85%	2.25%	7.10%	11.55%
2	8.08%	2.75%	5.33%	2.25%	7.58%	12.22%
3	7.46%	2.20%	5.26%	2.25%	7.51%	12.81%
Average	7.57%	2.42%	5.15%	2.25%	7.40%	12.19%

Based on each investment consulting firm’s assumptions, we estimated the expected real return of the System’s portfolio (col. (4)). Next, based on the actuary’s recommended inflation, we estimated the expected one-year arithmetic return net of expenses (col. (6)). The average one-year arithmetic return is 6.76 percent using short-term investment horizon assumptions, and 7.40 percent using long-term

Economic Assumptions

investment horizon assumptions. Based on the capital market assumptions for Meketa, the average one-year arithmetic return is 7.84 percent.

However, in addition to examining the expected one-year arithmetic return, it is important to review anticipated volatility of the investment portfolio and understand the range of long-term net returns that could be expected to be produced by the investment portfolio.

The following tables provide the 40th, 50th, and 60th percentiles of the geometric average (10-year for short-term investment horizon and 20-year for long-term investment horizon) of the expected nominal return, net of expenses based on the recommended inflation assumption of 2.25 percent. The tables also show the probability of exceeding the baseline 6.75 percent assumption and alternative lower assumptions.

Economic Assumptions

Short-term Investment Horizon (10 years or less) – Annualized 10-year Geometric Returns

Investment Consultant	Distribution of 10-Year Average Geometric Net Nominal Return			Probability of Exceeding 6.75%	Probability of Exceeding 6.50%	Probability of Exceeding 6.25%
	40 th	50 th	60 th	(5)	(6)	(6)
(1)	(2)	(3)	(4)	(5)	(6)	(6)
1	4.95%	5.78%	6.61%	38.39%	41.31%	44.28%
2	5.07%	5.86%	6.65%	38.82%	41.89%	45.02%
3	4.67%	5.65%	6.64%	38.90%	41.36%	43.87%
4	4.86%	5.83%	6.80%	40.52%	43.05%	45.62%
5	5.11%	6.02%	6.95%	42.09%	44.79%	47.51%
6	4.91%	5.92%	6.94%	41.79%	44.22%	46.69%
7	5.29%	6.19%	7.08%	43.68%	46.47%	49.28%
8	4.92%	5.97%	7.03%	42.57%	44.92%	47.31%
9	5.40%	6.33%	7.27%	45.48%	48.17%	50.87%
10	5.09%	6.16%	7.24%	44.51%	46.83%	49.17%
11	6.71%	7.49%	8.28%	59.45%	62.56%	65.59%
Average	5.18%	6.11%	7.05%	43.29%	45.96%	48.66%

Long-term Investment Horizon (20 to 30 years) – Annualized 20-year Geometric Returns

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of Exceeding 6.75%	Probability of Exceeding 6.50%	Probability of Exceeding 6.25%
	40 th	50 th	60 th	(5)	(6)	(6)
(1)	(2)	(3)	(4)	(5)	(6)	(6)
1	5.84%	6.49%	7.14%	45.90%	49.78%	53.68%
2	6.21%	6.89%	7.58%	52.09%	55.76%	59.40%
3	6.04%	6.75%	7.47%	50.02%	53.54%	57.04%
Average	6.03%	6.71%	7.40%	49.34%	53.03%	56.71%

Meketa (20 years)

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of Exceeding 6.75%	Probability of Exceeding 6.50%	Probability of Exceeding 6.25%
	40 th	50 th	60 th	(5)	(6)	(6)
(1)	(2)	(3)	(4)	(5)	(6)	(6)
Meketa	6.33%	7.06%	7.79%	54.26%	57.68%	61.05%

As these tables indicate, the average expected rate of return at the 50th percentile based on (1) the System's current target asset allocation, (2) the recommended inflation assumption of 2.25 percent and (3) the capital market assumptions from the investment consultants is 6.11 percent under the shorter-term investment horizon and 6.71 percent under the longer-term investment horizon. Based on the capital market assumptions from Meketa, the average expected rate of return at the 50th percentile is 7.06 percent.

Economic Assumptions

Additionally, the average results of the investment firms with shorter-term expectations indicate there is about a 43.29 percent chance that the System will produce an average return that exceeds 6.75 percent in the next 10 years, a 45.96 percent chance that the average return exceeds 6.50 percent, and a 48.66 percent chance that the average return exceeds 6.25 percent.

The average results of the investment firms with longer-term expectations indicate there is about a 49.34 percent chance that the System will produce an average return that exceeds 6.75 percent in the next 20 years, a 53.03 percent chance that the average return exceeds 6.50 percent, and a 56.71 percent chance that the average return exceeds 6.25 percent.

A key factor to consider when evaluating short-term or long-term investment projections is the relative level of assets available to pay benefits over the next 10 years to 25 years. Using current assumptions and liability measures as of June 30, 2018, assets equal about 50 percent of the present value of benefits expected to be paid over the next 10 years. Consequently, it is important to consider both short-term and long-term expectations when setting economic assumptions.

Recommendation

Based on our analysis of the expected investment return and the current target asset allocation, we recommend reducing the investment return assumption to 6.50 percent for the actuarial valuation as of June 30, 2019, reflecting an inflation assumption of 2.25 percent.

We recommend that the assumed investment return be monitored for continued appropriateness between experience reviews. Also, any significant changes in the target asset allocation of the System may warrant an additional review of the rate of return assumption.

We believe that this assumption can be supported by the Actuarial Standard of Practice No. 27. Under the Standard, all economic assumptions must be selected to be consistent with the purpose of the measurement. The purpose of the measurement is to determine the contribution rate which will lead to the accumulation of assets to pay benefits when due.

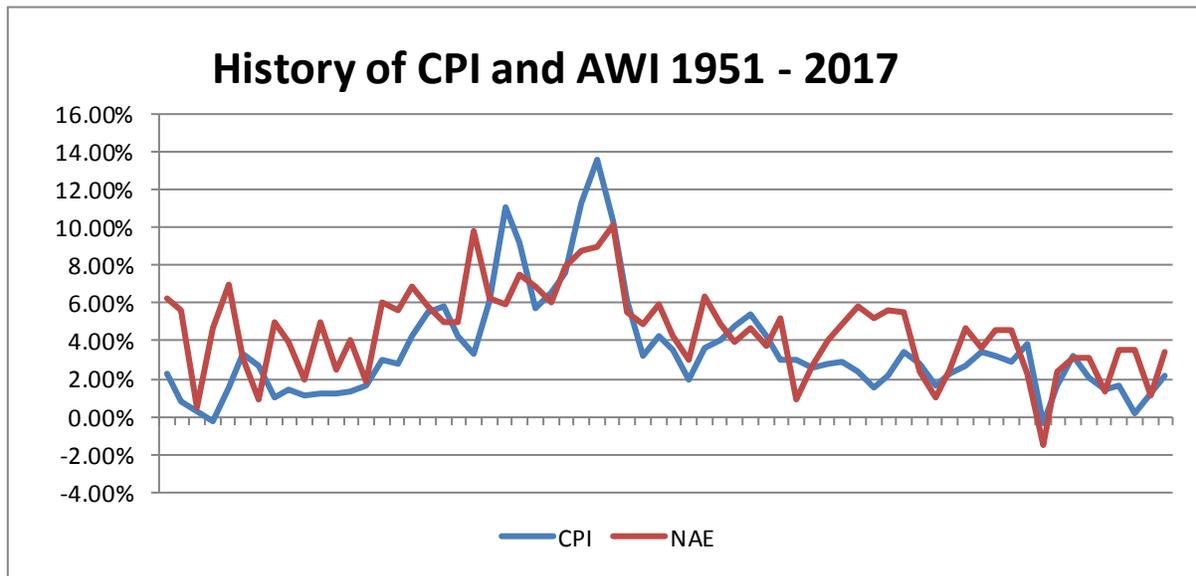
General Wage Inflation and Payroll Growth

A General Wage Inflation (“GWI”) assumption represents the real wage growth over time in the general economy. It 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 affected by population changes, etc. Wage inflation consists of two components, (1) a portion due to pure price inflation (i.e., increases due to changes in the CPI), and (2) increases in average salary levels in excess of pure price inflation (i.e., increases due to changes in productivity levels, supply and demand in the labor market and other macroeconomic factors).

The Average Wage Index (“AWI”), formerly named the National Average Earnings (“NAE”), series published in connection with the operation of the Social Security program is a useful proxy for measuring general changes in wage levels in the economy. Increases in AWI typically exceed increases in the Consumer Price Index (CPI), although there are periods where the patterns are reversed. The economic argument for wages exceeding prices in the long run is that CPI is based on the prices of a fixed basket of goods whereas wages reflect innovations, real productivity growth, labor supply and demand, and other factors in addition to pure price inflation.

Economic Assumptions

The following graph compares CPI and AWI over the past 66 years.



Economic Assumptions

The following table shows the average inflation and increase in the AWI through 2017.

Years	Annual Increases in		
	Prices (CPI-U)	Wages (AWI)	Difference
1958-1967	1.60%	3.65%	2.06%
1968-1977	6.15%	6.49%	0.34%
1978-1987	6.48%	6.54%	0.06%
1988-1997	2.98%	4.06%	1.07%
1998-2007	2.59%	3.95%	1.36%
2008-2017	1.69%	2.22%	0.53%
3-Year Average	1.83%	2.68%	0.85%
5-Year Average	1.54%	2.57%	1.04%
10-Year Average	1.42%	2.22%	0.80%
20-Year Average	2.20%	3.08%	0.88%
25-Year Average	2.25%	3.19%	0.94%
30-Year Average	2.56%	3.41%	0.84%
40-Year Average	3.44%	4.18%	0.74%
50-Year Average	4.04%	4.64%	0.59%
60-Year Average	3.68%	4.47%	0.80%
65-Year Average	3.48%	4.45%	0.97%

Since 1951, for the national economy as a whole, wage inflation has been about 1.00 percent higher than price inflation each year. For the last 10 years, for the national economy as a whole, wage inflation has been 2.22 percent, outpacing price inflation by about 0.80 percent. However, that spread will likely be viewed as overstated due to the historically low inflation during the past decade.

As with the investment return assumption, past experience does not necessarily dictate future expectations. Current expectations are mixed on whether price and wage inflation will remain low in the short term, particularly due to the after effects of recent federal government spending. For a long-term view, the 2018 Annual Report from the Trustees of the Social Security Administration (SSA) assumes an intermediate average ultimate CPI of 2.60 percent over the next 75 years and an ultimate intermediate growth assumption for average wages in covered employment of 3.80 percent. The SSA report provides alternate “High-cost” assumptions of 2.00 percent CPI/2.60 percent wages and “Low-cost” assumptions of 3.20 percent CPI/5.00 percent wages.

Economic Assumptions

Recommendation

With the ongoing pressure on the ability of states to sustain across the board increases in wages is consistent with historical norms, we do not believe there is justification to increase the assumption for productivity increases; in other words, to increase the assumed gap between price increases and wage growth. In fact, we recommend maintaining the assumption for productivity increases of 0.25 percent. Combining this recommendation with our recommendation for price inflation of 2.25 percent implies a wage inflation assumption of 2.50 percent. These assumptions are summarized below:

	JRS Wage Inflation and Payroll Growth Assumption	
	Current Assumption	Recommended Assumption
Price Inflation	2.50%	2.25%
Productivity Increases	0.25%	0.25%
Total Wage Inflation	2.75%	2.50%

Economic Assumptions

Salary Increase

Most actuaries recommend salary increase assumptions that include elements which depend on the member's age or service. Generally, younger or shorter service employees receive higher merit and promotion salary increases. As the employee's age or service increases, these salary increases tend to decrease.

Total salary increases include components for wage inflation and other increases. Over the experience study period, actual salary increases for plan members averaged 2.00 percent compared to expected total increases of 2.75 percent. Expected real salary increases were 2.75 percent less 2.50 percent, or 0.25 percent, and actual real salary increases were 2.00 percent less 1.83 percent, or 0.17 percent. During the same period, actual general inflation averaged 1.83 percent compared to the current assumption of 2.50 percent. We recommend adjusting the current assumed real rates of salary increase to partially recognize actual experience. The graph on page C-16 shows the real salary increase plus price inflation.

This assumption was developed using both Tier One and Tier Two data and is applicable to both Tier One and Tier Two members.

Table I and Graph I compare the salary experience, current assumptions, and recommended assumptions by age for each of the following:

- Table I – Salary Experience by Age
- Graph I – Salary Experience by Age

Economic Assumptions

Table I

Age at Beginning of Year	Number	Actual		Actual Real Increase ¹	Actual Total Increase	Expected Real Increase ²	Expected Total Increase	Proposed Real Increase ³	Proposed Total Increase
		Prior Year	Current Year						
30-34	2	375,221	382,376	0.08%	1.91%	0.25%	2.75%	0.25%	2.50%
35-39	23	4,317,942	4,402,464	0.13%	1.96%	0.25%	2.75%	0.25%	2.50%
40-44	93	17,186,632	17,528,136	0.16%	1.99%	0.25%	2.75%	0.25%	2.50%
45-49	277	51,882,271	52,959,730	0.25%	2.08%	0.25%	2.75%	0.25%	2.50%
50-54	488	91,141,789	92,982,800	0.19%	2.02%	0.25%	2.75%	0.25%	2.50%
55-59	608	113,355,452	115,605,108	0.15%	1.98%	0.25%	2.75%	0.25%	2.50%
60-64	547	102,982,477	105,002,431	0.13%	1.96%	0.25%	2.75%	0.25%	2.50%
65-69	389	73,575,788	75,089,093	0.23%	2.06%	0.25%	2.75%	0.25%	2.50%
70-74	186	35,620,780	36,307,071	0.10%	1.93%	0.25%	2.75%	0.25%	2.50%
75-79	52	10,082,405	10,278,120	0.11%	1.94%	0.25%	2.75%	0.25%	2.50%
80+	17	3,313,741	3,378,939	0.14%	1.97%	0.25%	2.75%	0.25%	2.50%
Total	2,682	503,834,498	513,916,268	0.17%	2.00%	0.25%	2.75%	0.25%	2.50%

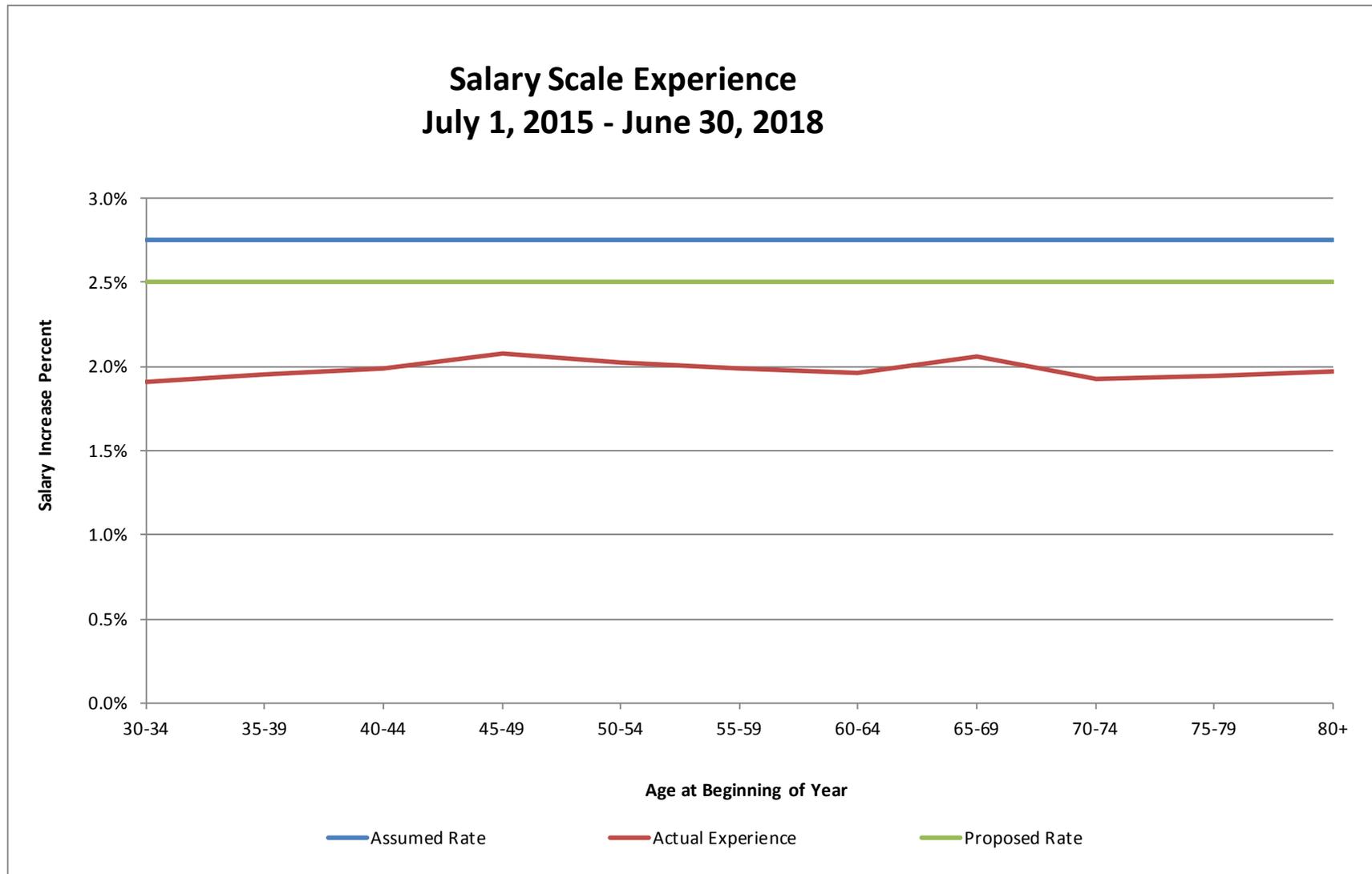
¹Total increase less average inflation of 1.83 percent.

²Total increase less assumed inflation of 2.50 percent.

³Total increase less proposed inflation of 2.25 percent.

Economic Assumptions

Graph I



Demographic Assumptions

The following pages present the analysis of the demographic assumptions. These assumptions include assumed rates of mortality among active and retired members, retirement patterns, turnover patterns, and disability patterns. These patterns generally take the form of tables of rates of incidence based on age and/or years of service.

Absent any significant changes in benefit provisions, these assumptions generally exhibit reasonable consistency over periods of time. As a result, each demographic assumption is normally reviewed by relating actual experience to that assumed over the recent past.

Actuarial Standard of Practice No. 35 – Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations

ASOP No. 35 applies to actuaries when they are selecting demographic and all other assumptions not covered by ASOP No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, to measure obligations under any defined benefit pension plan that is not a social insurance program as described in Section 1.2, Scope, of ASOP No. 32, Social Insurance.

The actuary should identify the types of demographic assumptions to use for a specific measurement. In doing so, the actuary should determine the following:

- (a) The purpose and nature of the measurement;
- (b) The plan provisions or benefits and factors that will affect the timing and value of any potential benefit payments;
- (c) The characteristics of the obligation to be measured (such as measurement period, pattern of plan payments over time, open or closed group, and volatility);
- (d) The contingencies that give rise to benefits or result in loss of benefits;
- (e) The significance of each assumption; and
- (f) The characteristics of the covered group.

Not every contingency requires a separate assumption. For example, for a plan that is expected to provide benefits of equal value to employees who voluntarily terminate employment or become disabled, retire, or die, the actuary may use an assumption that reflects some or all of the above contingencies in combination rather than selecting a separate assumption for each.

Analysis Approach

The analysis of demographic experience is conducted for each assumption using a measure known as the “Actual to Expected (A/E) Ratio.” The A/E Ratio is simply the ratio of the actual number of occurrences of the event to which the assumption applies (e.g., deaths or retirements) to the number expected to occur in accordance with the assumption. An A/E Ratio of 1.00 indicates that the assumption precisely predicted the number of occurrences. An A/E Ratio exceeding 1.00 indicates that the assumption underestimated actual experience. Conversely, an A/E Ratio lower than 1.00 indicates that the assumption overestimated actual experience.

Demographic Assumptions

These are statistical analyses. As a result, there are several considerations we must keep in mind as we analyze these ratios:

1. An actuarial assumption is designed to reflect average experience over long periods of time (30 - 50 years). As a result:
 - (a) A deviation between actual experience and that expected from our assumptions for one or two years does not necessarily mean that the assumption should be changed.
 - (b) A change in actuarial assumption should result if the experience indicates a consistent pattern which is different from that assumed over a period of years.
2. The larger the amount of data available, the more reliable the statistics used in the analysis. As a result:
 - (a) Events that occur with great frequency (e.g., general employment turnover) are more credibly predictable than those occurring less frequently (e.g., active member death).
 - (b) In all cases, data covering the entire study period produces more credible results than data for a single year.
 - (c) Year by year experience is helpful only in identifying trends and determining whether the three-year data is truly reflective of the entire period.

This analysis is based on the actuarial valuation data for the three-year period from July 1, 2015, to June 30, 2018.

Mortality Assumption

Mortality

Post-retirement mortality is an important component in cost calculations and should be updated from time to time to reflect current and expected future longevity improvements. Pre-retirement mortality is a relatively minor component in cost calculations. The frequency of pre-retirement deaths is so low that mortality assumptions based on actual experience can only be produced for very large retirement systems.

Actuarial Standards of Practice

Actuarial Standards of Practice (ASOP) No. 35 Disclosure Section 4.1.1 states, “The disclosure of the mortality assumption should contain sufficient detail to permit another qualified actuary to understand the provision made for future mortality improvement. If the actuary assumes zero mortality improvement after the measurement date, the actuary should state that no provision was made for future mortality improvement.” The current mortality rates used in the actuarial valuation include a provision for future mortality improvement.

The Pub-2010 Mortality Tables

The Society of Actuaries (SOA) and Retirement Plans Experience Committee (RPEC) initiated a study in January 2015 with the primary focus of a comprehensive review of recent mortality experience of public retirement plans in the United States. The previous study for the RP-2014 Mortality Tables only included data from private pension plans. The main objectives of the study were to develop mortality tables based exclusively on public sector pension plan experience, and provide new insights into the composition of gender-specific pension mortality by factors such as job category (e.g., Teachers, Public Safety, General), salary/benefit amount, health status (i.e., healthy or disabled), geographic region and duration since event. Additional information on the background, data, and process is available in the *Pub-2010 Public Retirement Plans Mortality Tables Report* published by the SOA and RPEC.

Mortality Assumption

Findings

The mortality experience was reviewed on a liability weighted basis for retired members in pay status and on a headcount basis for active members. The observed experience was compared to the current mortality tables and updated baseline tables:

- Current mortality tables: RP-2014 White Collar Healthy Annuitant Mortality Tables, with one year set forward for males and one year setback for females
- Proposed baseline mortality tables: Pub-2010 Above-Median Income General Healthy Retiree Mortality Tables

The following table, applicable to retired member mortality experience, compares the actual liability weighted deaths to the expected liability weighted deaths using the current tables and the proposed baseline tables:

Retiree Experience	Liability Weighted Deaths (\$ in 10,000)		
	Expected Using Current Mortality Table	Actual	Expected Using Proposed Mortality Table Pub-2010 Above-Median General Healthy Retiree
Male Retirees	\$8,591	\$9,359	\$8,555
Female Retirees	\$635	\$342	\$695

Although the experience has limited credibility, when compared to the current mortality tables the experience on a liability weighted basis shows that actual experience is above expectation for males and below expectation for females.

When compared to the current mortality tables, the proposed mortality tables are expected to produce slightly higher liability weighted deaths overall.

We applied credibility and “best-fit” factors to the baseline mortality table to recognize a portion of the observed mortality experience. The credibility factor applies more weight to the observed mortality experience as the sample size of the group and number of deaths increases. The “best-fit” factor compares actual deaths during the experience period to expected deaths during the period using a base mortality table. The following table shows the development of the scaling factor that is applied to the recommended base mortality table (Pub-2010 Above-Median Income General Healthy Retiree Mortality) for retirees:

Mortality Assumption

Retiree Experience	Liability Weighted Deaths (\$ in 10,000)			Credibility Factor (d)=(b/a) ^{1/2}	Best Fit Factor (e)=(b)/(c)	Scaling Factor Applied to Baseline Table (d) x (e) + [1-(d)] x 100%
	Fully Credible Target Deaths Using Baseline Table ¹ (a)	Observed Deaths (b)	Expected Deaths Using Baseline Table (c)			
Male Retirees	\$184,347	\$9,359	\$8,555	23%	109%	102%
Female Retirees	\$229,579	\$342	\$695	4%	49%	98%

¹Minimum number of expected liability weighted deaths needed for plan experience to be fully credible.

The experience for active members is even less credible.

During the experience period, the actual number of active member deaths of 6 was lower than the expected number of deaths of 11 using the current mortality tables and 7 using the proposed tables. The following table shows the development of scaling factors applied to active member baseline mortality; i.e., the Pub-2010 Above-Median Income General Employee Tables.

Active Member Experience	Headcount Weighted Deaths			Credibility Factor (d)=(b/a) ^{1/2}	Best Fit Factor (e)=(b)/(c)	Scaling Factor Applied to Baseline Table (d) x (e) + [1-(d)] x 100%
	Fully Credible Target Deaths Using Baseline Table (a)	Observed Deaths (b)	Expected Deaths Using Baseline Table (c)			
Male Employees	1,082	5	6	7%	80%	99%
Female Employees	1,082	1	1	3%	68%	99%

Recommendation

We reviewed the mortality experience separately for active members and retirees during the three-year study period. The results are shown on the following pages.

Following is a summary of the current mortality assumptions:

Applicable Group	Base Table with 2014 Base Year	Male Set Back	Female Set Back	Male Multiplier	Female Multiplier
Pre-retirement	RP-2014 White Collar Employee, sex distinct	0 years	0 years	100%	100%
Post-retirement	RP-2014 White Collar Healthy Annuitant, sex distinct	-1 year	1 year	100%	100%

Mortality Assumption

Following is a summary of the recommended mortality assumptions:

Applicable Group	Base Mortality Table	Male Scaling Factor	Female Scaling Factor
Pre-retirement	Pub-2010 Above-Median General Employee, sex distinct	99%	99%
Post-retirement	Pub-2010 Above-Median General Healthy Retiree, sex distinct	102%	98%

Future mortality improvements are reflected by projecting the base mortality tables forward from the year 2010 using the MP-2018 projection scale.

A Note about Mortality Rates

The recommended mortality assumptions include generational mortality improvements, which means that the probability of a 60-year-old retired male dying in any particular year is lower for a 60-year old born in 1994 than a 60-year-old born in 1954.

The use of generational mortality tables is based on the assumption that life expectancy increases from generation to generation. Simply put, this means that the life expectancy of someone born in 1994 is greater than that of someone born in 1954.

The following tables contain the mortality experience for the experience study period:

- Table II(a) and Graph II(a) – Post-Retirement Mortality Experience
- Table II(b) – Pre-Retirement Mortality Experience

Mortality Assumption

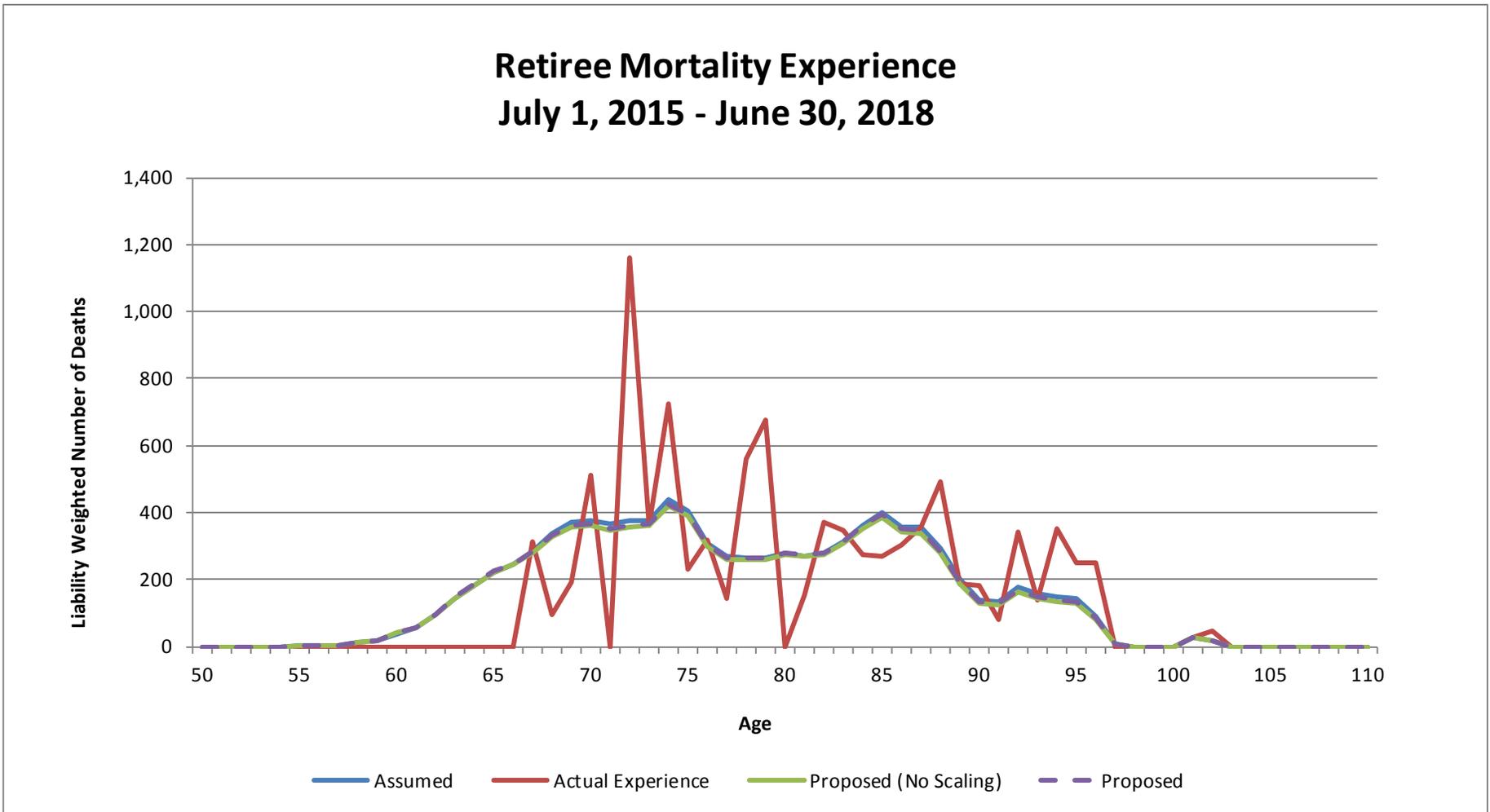
Table II(a)

Male Retiree Mortality Experience									
Age	Actual Experience			Current Assumptions			Proposed Assumptions		
	Liability Weighted (\$ in 10,000)		Actual Rate	Expected Deaths	Assumed Rate	Actual / Expected	Expected Deaths	Proposed Rate	Actual / Expected
	Exposures	Deaths							
Under 54	\$0	\$0		\$0			\$0		
55-59	3,366	0	0.000%	17	0.498%	0.00	18	0.527%	0.00
60-64	57,765	0	0.000%	390	0.675%	0.00	413	0.715%	0.00
65-69	121,712	595	0.489%	1,223	1.005%	0.49	1,243	1.021%	0.48
70-74	104,316	2,496	2.393%	1,715	1.644%	1.46	1,718	1.647%	1.45
75-79	49,132	1,925	3.918%	1,339	2.725%	1.44	1,382	2.814%	1.39
80-84	26,883	1,151	4.280%	1,391	5.174%	0.83	1,440	5.358%	0.80
85-89	16,970	1,603	9.447%	1,527	8.997%	1.05	1,556	9.171%	1.03
90-94	4,257	1,016	23.875%	716	16.829%	1.42	690	16.203%	1.47
95-99	996	501	50.273%	231	23.188%	2.17	223	22.381%	2.25
100+	120	72	59.992%	43	35.563%	1.69	42	34.807%	1.72
Totals:	\$385,517	\$9,359	2.428%	\$8,591	2.229%	1.09	\$8,726	2.263%	1.07
Female Retiree Mortality Experience									
Under 54	\$0	\$0		\$0			\$0		
55-59	5,533	0	0.000%	17	0.305%	0.00	18	0.323%	0.00
60-64	24,385	0	0.000%	106	0.434%	0.00	112	0.458%	0.00
65-69	28,612	0	0.000%	196	0.684%	0.00	202	0.705%	0.00
70-74	12,924	260	2.009%	145	1.120%	1.79	154	1.192%	1.69
75-79	5,354	0	0.000%	95	1.782%	0.00	106	1.988%	0.00
80-84	1,828	0	0.000%	54	2.964%	0.00	63	3.467%	0.00
85-89	86	0	0.000%	7	7.949%	0.00	8	9.214%	0.00
90-94	166	82	49.333%	15	9.273%	5.32	18	10.980%	4.49
95-99	0	0		0			0		
100+	0	0		0			0		
Totals:	\$78,889	\$342	0.433%	\$635	0.805%	0.54	\$681	0.864%	0.50
Grand Totals:	\$464,406	\$9,701	2.089%	\$9,227	1.987%	1.05	\$9,407	2.026%	1.03

Expected deaths under the current and proposed assumptions are on a liability weighted basis.

Mortality Assumption

Graph II(a)



Mortality Assumption

Table II(b)

Male Active Mortality Experience									
Age	Actual Experience			Current Assumptions			Proposed Assumptions		
	Population Weighted			Expected Deaths	Assumed Rate	Actual / Expected	Expected Deaths	Proposed Rate	Actual / Expected
	Exposures	Deaths	Actual Rate						
Under 30	0	0		0			0		
30-39	18	0	0.000%	0	0.038%	0.00	0	0.054%	0.00
40-49	208	0	0.000%	0	0.078%	0.00	0	0.090%	0.00
50-59	730	1	0.137%	1	0.198%	0.69	1	0.190%	0.72
60-69	763	3	0.393%	4	0.543%	0.72	3	0.387%	1.01
70-79	219	1	0.457%	3	1.422%	0.32	2	0.743%	0.61
Totals:	1,938	5	0.258%	9	0.458%	0.56	6	0.318%	0.81
Less than 60:	956	1	0.105%	2	0.169%	0.62	2	0.166%	0.63
Female Active Mortality Experience									
Age	Population Weighted			Expected Deaths	Assumed Rate	Actual / Expected	Expected Deaths	Proposed Rate	Actual / Expected
	Exposures	Deaths	Actual Rate						
	Under 30	0	0		0			0	
30-39	7	0	0.000%	0	0.027%	0.00	0	0.030%	0.00
40-49	169	1	0.592%	0	0.059%	10.03	0	0.051%	11.54
50-59	395	0	0.000%	1	0.139%	0.00	0	0.111%	0.00
60-69	285	0	0.000%	1	0.277%	0.00	1	0.241%	0.00
70-79	48	0	0.000%	0	0.672%	0.00	0	0.520%	0.00
Totals:	904	1	0.111%	2	0.195%	0.57	1	0.111%	1.00
Less than 60:	571	1	0.175%	1	0.114%	1.54	0	0.011%	16.07
Grand Totals:	2,842	6	0.211%	11	0.374%	0.56	7	0.252%	0.84
Less than 60:	1,527	2	0.131%	2	0.148%	0.88	2	0.108%	1.21

Expected deaths under the current and proposed assumptions are on a population weighted basis.

Retirement Assumption

Retirement

The System plan provisions establish the minimum eligibility requirements for retirement as follows:

Upon termination of State service, a Tier One judge who has at least 10 years of service may retire with an unreduced retirement annuity upon attainment of age 60. A Tier One judge with at least six years of service may retire with an unreduced retirement annuity upon attainment of age 62. A Tier Two judge is eligible to retire with unreduced benefits after attainment of age 67 with at least eight years of service credit.

The retirement annuity is determined according to the following formula based upon the member's final rate of salary:

- 3.5% for each of the first 10 years of service; plus
- 5.0% for each year of service in excess of 10.

The maximum retirement annuity is 85% of the final rate of salary.

Retirement cost, however, is determined not by the minimum eligibility requirements but by the ages at which members actually retire. The actuarial valuation does not assume that everyone retires at earliest eligibility. The assumption about timing of retirement once eligibility has been established is a major component in cost calculations. Note that higher rates of retirement at earlier retirement ages or years of service upon attaining retirement eligibility generally result in higher actuarially determined contributions, and vice versa.

Experience during the last three years was considered in the analysis shown on the following pages. The "Exposures" column shows the number of employees eligible to retire at various years of service or ages throughout the experience period. An individual could potentially be counted up to three times if eligible each year in the period. By tabulating employees in this fashion we are able to answer the question "For all employees eligible at condition X, how many retired?"

Current and past experience has shown that normal retirement rates under this System are correlated with age. Currently, the System uses age-based rates with higher rates at key ages, with 100 percent retirement at age 80. We recommend a slight increase in overall rates to reflect the actual experience of the System. Early retirement experience for male members was generally lower than the current early retirement rates, and female members was generally higher than the current rates.

Applying the proposed rates to historical data generates the following number of retirements by age at retirement:

Retirement Assumption

Age	Number of Early and Normal Retirements		
	Actual	Current Assumption	Proposed Assumption
55-59	20	20	20
60	6	13	8
61-65	63	49	54
66-70	43	37	41
71-74	12	17	18
75-79	3	8	8
80+	2	19	19
Total	149	163	168
Less than 80:	147	144	149

The table and graph on the following pages show early and normal retirement experience for plan members.

- Table III(a) and Graph III(a) – Normal Retirement Experience
- Table III(b) – Early Retirement Experience

Tier One Retirement Rates		
Age	Current	Proposed
60	15.00%	9.00%
61-64	10.00%	11.00%
65	10.00%	12.00%
66-69	11.00%	12.00%
70-71	11.00%	13.00%
72	12.00%	13.00%
73	13.00%	13.00%
74	14.00%	13.00%
75-79	15.00%	14.00%
80+	100.00%	100.00%

Tier One Early Retirement Rates				
Age	Current		Proposed	
	Male	Female	Male	Female
55	6.50%	7.50%	5.50%	8.50%
56	6.50%	7.50%	5.50%	8.50%
57	6.50%	7.50%	5.50%	8.50%
58	6.50%	7.50%	5.50%	8.50%
59	6.50%	7.50%	5.50%	8.50%

Retirement Assumption

Currently, there are no Tier Two members eligible for retirement. Therefore, the retirement assumptions can only be developed based upon our future expectation of the group's behavior.

We are recommending reducing the retirement rates for Tier Two members eligible for early and normal retirement benefits based on experience with Tier One members.

Retirement Rates for Tier Two Members		
Age	Current	Proposed
67	30.00%	30.00%
68-69	13.00%	12.00%
70	13.00%	13.00%
71	11.00%	10.00%
72	12.00%	11.00%
73	13.00%	12.00%
74	14.00%	13.00%
75-79	15.00%	14.00%
80	100.00%	100.00%
Early Retirement Rates for Tier Two Members		
Age	Current	Proposed
62	11.00%	11.00%
63	12.00%	12.00%
64	13.00%	13.00%
65	14.00%	14.00%
66	15.00%	14.00%

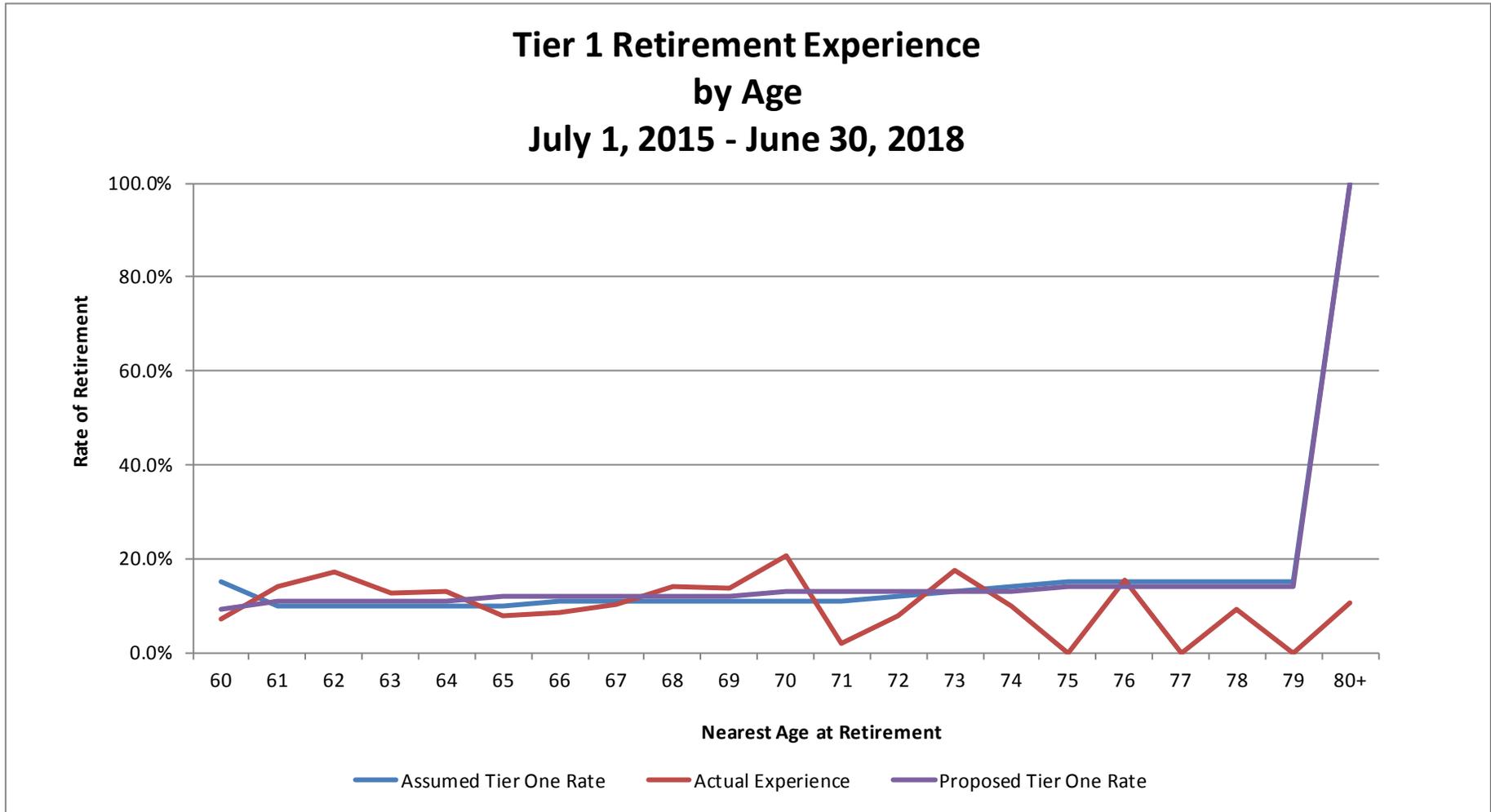
Retirement Assumption

Table III(a)

Tier 1 Normal Retirement Experience by Age									
Nearest Age @ Retirement	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Retirements	Actual Rate	Expected Retirements	Assumed Rate	Actual / Expected	Expected Retirements	Proposed Rate	Actual / Expected
60	86	6	7.0%	13	15.0%	0.5	8	9.0%	0.8
61	93	13	14.0%	9	10.0%	1.4	10	11.0%	1.3
62	100	17	17.0%	10	10.0%	1.7	11	11.0%	1.5
63	96	12	12.5%	10	10.0%	1.3	11	11.0%	1.1
64	108	14	13.0%	11	10.0%	1.3	12	11.0%	1.2
65	89	7	7.9%	9	10.0%	0.8	11	12.0%	0.7
66	82	7	8.5%	9	11.0%	0.8	10	12.0%	0.7
67	69	7	10.1%	8	11.0%	0.9	8	12.0%	0.8
68	71	10	14.1%	8	11.0%	1.3	9	12.0%	1.2
69	59	8	13.6%	6	11.0%	1.2	7	12.0%	1.1
70	53	11	20.8%	6	11.0%	1.9	7	13.0%	1.6
71	49	1	2.0%	5	11.0%	0.2	6	13.0%	0.2
72	38	3	7.9%	5	12.0%	0.7	5	13.0%	0.6
73	34	6	17.6%	4	13.0%	1.4	4	13.0%	1.4
74	20	2	10.0%	3	14.0%	0.7	3	13.0%	0.8
75	15	0	0.0%	2	15.0%	0.0	2	14.0%	0.0
76	13	2	15.4%	2	15.0%	1.0	2	14.0%	1.1
77	10	0	0.0%	2	15.0%	0.0	1	14.0%	0.0
78	11	1	9.1%	2	15.0%	0.6	2	14.0%	0.6
79	6	0	0.0%	1	15.0%	0.0	1	14.0%	0.0
80+	19	2	10.5%	19	100.0%	0.1	19	100.0%	0.1
Totals:	1,121	129	11.5%	143	12.7%	0.9	148	13.2%	0.9
Less than 80:	1,102	127	11.5%	124	11.2%	1.0	129	11.7%	1.0
Average Retirement Age:			66.0			68.1			68.2
Average Retirement Age (Less than 80):			65.7			66.3			66.5

Retirement Assumption

Graph III(a)



Retirement Assumption

Table III(b)

Tier 1 Male Early Retirement Experience									
Nearest Age @ ER Retirement	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Retirements	Actual Rate	Expected Retirements	Assumed Rate	Actual / Expected	Expected Retirements	Proposed Rate	Actual / Expected
55	24	0	0.0%	2	6.5%	0.0	1	5.5%	0.0
56	29	0	0.0%	2	6.5%	0.0	2	5.5%	0.0
57	30	1	3.3%	2	6.5%	0.5	2	5.5%	0.6
58	38	2	5.3%	2	6.5%	0.8	2	5.5%	1.0
59	51	4	7.8%	3	6.5%	1.2	3	5.5%	1.4
Totals:	172	7	4.1%	11	6.5%	0.6	9	5.5%	0.7
Tier 1 Female Early Retirement Experience									
Nearest Age @ ER Retirement	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Retirements	Actual Rate	Expected Retirements	Assumed Rate	Actual / Expected	Expected Retirements	Proposed Rate	Actual / Expected
55	19	1	5.3%	1	7.5%	0.7	2	8.5%	0.6
56	23	3	13.0%	2	7.5%	1.7	2	8.5%	1.5
57	22	2	9.1%	2	7.5%	1.2	2	8.5%	1.1
58	27	3	11.1%	2	7.5%	1.5	2	8.5%	1.3
59	28	4	14.3%	2	7.5%	1.9	2	8.5%	1.7
Totals:	119	13	10.9%	9	7.5%	1.5	10	8.5%	1.3
Grand Totals:	291	20	6.9%	20	6.9%	1.0	20	6.7%	1.0

Turnover Assumption

Turnover

Currently, turnover rates are based on age, sex-distinct. The experience supports maintaining this structure.

Turnover experience during the last three years was considered in the analysis shown on the following pages. The “Exposures” column shows the number of employees at various years of service throughout the experience period.

The “Turnover” column shows the number of employees at various ages who have gone from active status for reasons other than retirement and death. This includes members moving to inactive status and members terminating and receiving a refund of contributions, and disabled members.

This assumption was analyzed for both Tier One and Tier Two members.

There were less terminations than expected under the current assumptions. Based on our analysis, we recommend decreasing the rates for Tier One members and Tier Two members.

The tables and graphs on the following pages show termination experience by age.

- Table IV(a) and Graph IV(a) – Termination Experience by Age – Tier One
- Table IV(b) and Graph IV(b) – Termination Experience by Age – Tier Two

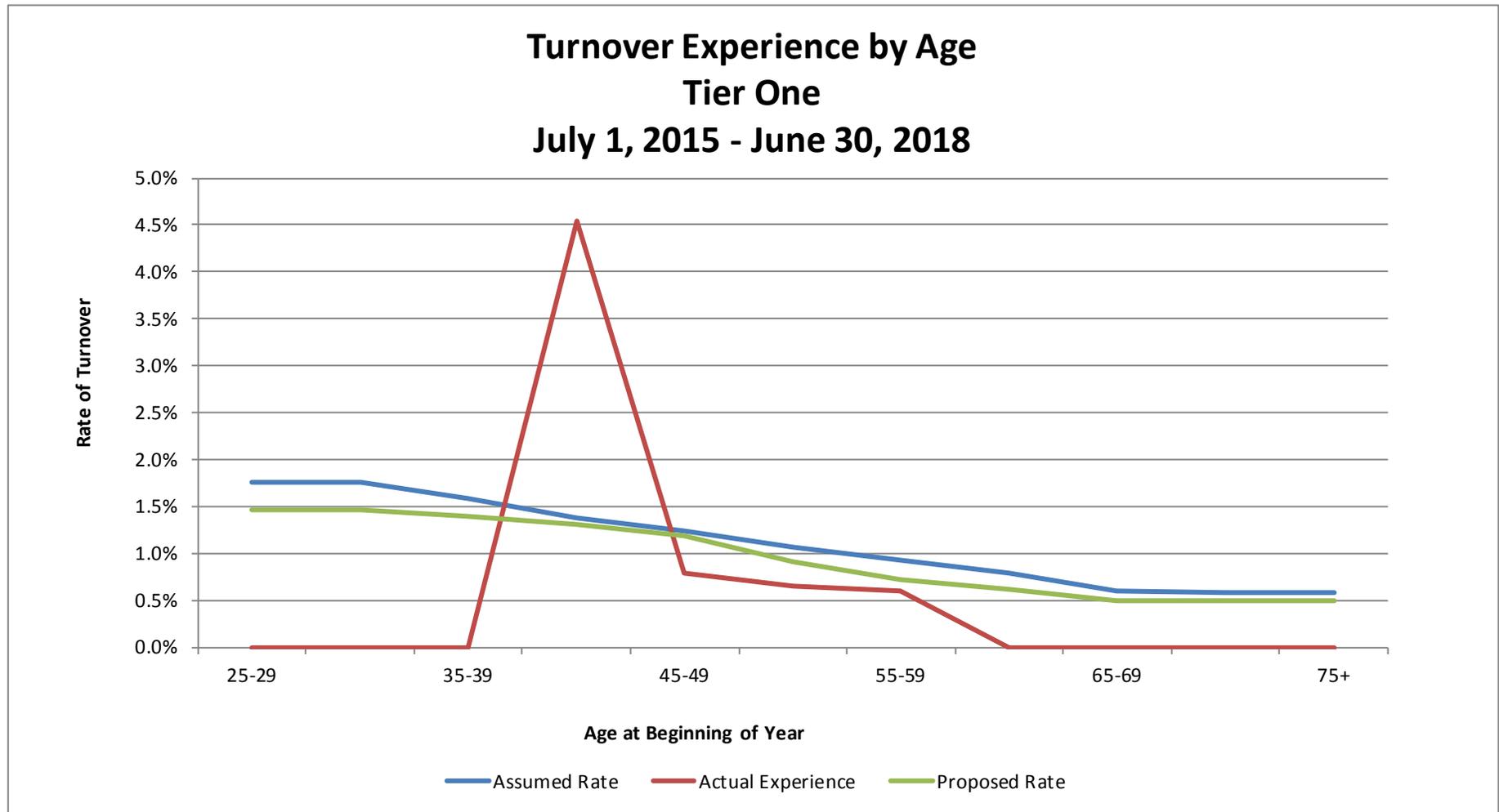
Analysis of Experience and Recommendations

Table IV(a)

Tier 1 Male Termination Experience									
Age	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Turnover	Actual Rate	Expected Turnover	Assumed Rate	Actual / Expected	Expected Turnover	Proposed Rate	Actual / Expected
25-29	0	0		0.00	1.75%		0.00	1.29%	
30-34	0	0		0.00	1.75%		0.00	1.29%	
35-39	0	0		0.00	1.64%		0.00	1.17%	
40-44	11	0	0.00%	0.16	1.46%	0.0	0.11	1.02%	0.0
45-49	77	0	0.00%	0.99	1.29%	0.0	0.69	0.90%	0.0
50-54	185	1	0.54%	2.05	1.12%	0.5	1.44	0.78%	0.7
55-59	120	1	0.83%	1.13	0.95%	0.9	0.79	0.66%	1.3
60-64	41	0	0.00%	0.33	0.77%	0.0	0.23	0.54%	0.0
65-69	5	0	0.00%	0.03	0.64%	0.0	0.02	0.47%	0.0
70-74	1	0	0.00%	0.01	0.63%		0.00	0.47%	0.0
75+	0	0		0.00	0.63%		0.00	0.47%	
Total	440	2	0.45%	4.70	1.07%	0.4	3.29	0.75%	0.6
Tier 1 Female Termination Experience									
Age	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Turnover	Actual Rate	Expected Turnover	Assumed Rate	Actual / Expected	Expected Turnover	Proposed Rate	Actual / Expected
25-29	0	0		0.00	1.75%		0.00	1.62%	
30-34	0	0		0.00	1.75%		0.00	1.62%	
35-39	0	0		0.00	1.54%		0.00	1.62%	
40-44	11	1	9.09%	0.14	1.36%	7.0	0.18	1.62%	5.6
45-49	49	1	2.04%	0.58	1.19%	1.7	0.79	1.62%	1.3
50-54	120	1	0.83%	1.22	1.02%	0.8	1.33	1.12%	0.8
55-59	47	0	0.00%	0.41	0.85%	0.0	0.41	0.85%	0.0
60-64	18	0	0.00%	0.13	0.67%	0.0	0.13	0.67%	0.0
65-69	3	0	0.00%	0.02	0.54%	0.0	0.02	0.54%	0.0
70-74	1	0	0.00%	0.01	0.53%	0.0	0.01	0.53%	0.0
75+	0	0		0.00	0.53%		0.00	0.53%	
Total	249	3	1.20%	2.49	1.00%	1.2	2.86	1.15%	1.0
Grand Total	689	5	0.73%	7.19	1.04%	0.7	6.15	0.89%	0.8

Analysis of Experience and Recommendations

Graph IV(a)



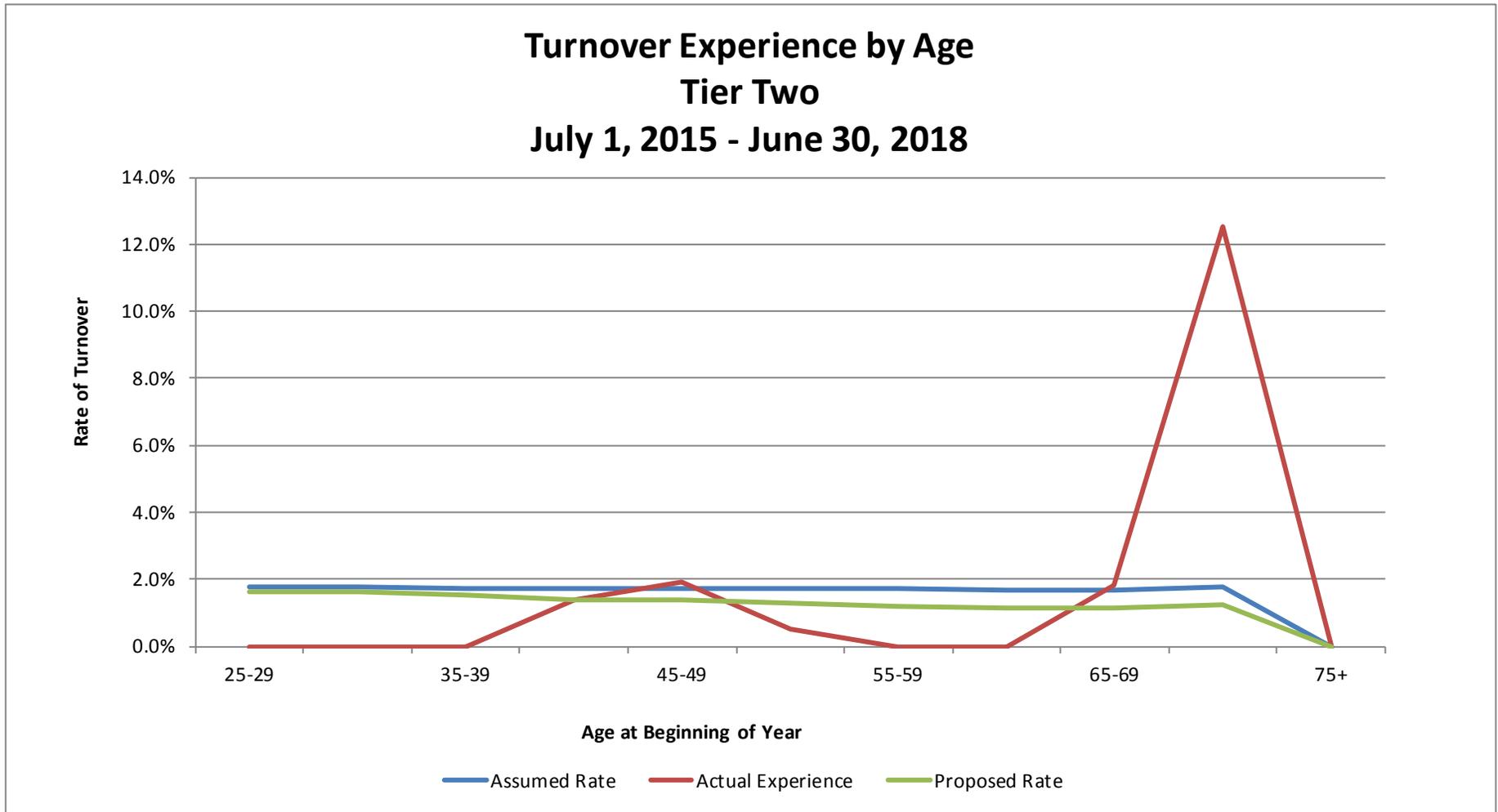
Analysis of Experience and Recommendations

Table IV(b)

Tier 2 Male Termination Experience									
Age	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Turnover	Actual Rate	Expected Turnover	Assumed Rate	Actual / Expected	Expected Turnover	Proposed Rate	Actual / Expected
25-29	0	0		0.00	1.75%		0.00	1.75%	
30-34	1	0	0.00%	0.02	1.75%	0.0	0.02	1.75%	0.0
35-39	17	0	0.00%	0.30	1.75%	0.0	0.28	1.66%	0.0
40-44	33	1	3.03%	0.57	1.74%	1.7	0.51	1.53%	2.0
45-49	87	3	3.45%	1.51	1.74%	2.0	1.24	1.43%	2.4
50-54	133	0	0.00%	2.28	1.72%	0.0	1.78	1.33%	0.0
55-59	120	0	0.00%	2.05	1.71%	0.0	1.49	1.24%	0.0
60-64	56	0	0.00%	0.93	1.66%	0.0	0.69	1.24%	0.0
65-69	46	1	2.17%	0.79	1.73%	1.3	0.57	1.24%	1.8
70-74	16	2	12.50%	0.28	1.75%	7.1	0.20	1.24%	10.1
75+	0	0		0.00	0.00%		0.00	0.00%	
Total	509	7	1.38%	8.74	1.72%	0.8	6.77	1.33%	1.0
Tier 2 Female Termination Experience									
Age	Actual Experience			Current Assumptions			Proposed Assumptions		
	Exposures	Turnover	Actual Rate	Expected Turnover	Assumed Rate	Actual / Expected	Expected Turnover	Proposed Rate	Actual / Expected
25-29	0	0		0.00	1.75%		0.00	1.50%	
30-34	1	0	0.00%	0.02	1.75%	0.0	0.02	1.50%	0.0
35-39	6	0	0.00%	0.11	1.73%	0.0	0.08	1.39%	0.0
40-44	40	0	0.00%	0.70	1.74%	0.0	0.52	1.29%	0.0
45-49	69	0	0.00%	1.20	1.73%	0.0	0.89	1.29%	0.0
50-54	55	1	1.82%	0.95	1.72%	1.1	0.67	1.23%	1.5
55-59	54	0	0.00%	0.92	1.70%	0.0	0.58	1.06%	0.0
60-64	17	0	0.00%	0.30	1.75%	0.0	0.15	0.88%	0.0
65-69	9	0	0.00%	0.13	1.51%	0.0	0.07	0.75%	0.0
70-74	0	0		0.00	0.63%		0.00	0.74%	
75+	0	0		0.00	0.00%		0.00	0.00%	
Total	251	1	0.40%	4.31	1.72%	0.2	2.97	1.18%	0.3
Grand Total	760	8	1.05%	13.05	1.72%	0.6	9.75	1.28%	0.8

Analysis of Experience and Recommendations

Graph IV(b)



Analysis of Experience and Recommendations

Marriage Assumption

Currently, 75% of active and retired participants are assumed to be married. Over the past five years, the average number of active members denoted as “Married” was 73% (79% if we include 73% of records marked as “Unknown”). The average number of retired members over the past five years denoted as “Married” was 86%. We recommend increasing the current assumption to 80%.

Load for Inactive Members Eligible for Deferred Vested Pension Benefits

Currently, deferred vested liability is not increased to account for increases in final average salary due primarily to participation in a reciprocal system.

For inactive members who retired from July 1, 2012, to June 30, 2018, the ratio of actual retirement benefits to estimated retirement benefits was approximately 17.5 percent. However, we recommend an assumption of 10 percent since the data is not credible. The following table shows the experience data.

Impact of Reciprocal Salary Increases of Inactive Members

	Number of Inactive Members at the Beginning of the Plan Year	Number of Inactive Members who Retired during the Plan Year	Estimated Benefits of Inactive Members who Retired During Year	Actual Benefits of Inactive Members who Retired during Year	Increase in Benefits
6/30/2013	15	2	\$ 106,586	\$ 109,524	2.8%
6/30/2016	24	2	28,504	37,724	32.3%
6/30/2018	23	3	99,466	128,464	29.2%
Total	62	7	\$ 234,556	\$ 275,712	
Average					17.5%

SECTION D

COST IMPACT

Cost Impact

The impact of adopting the recommended assumptions is summarized in the tables below. The results are based on the June 30, 2018, actuarial valuation.

	Valuation Baseline	Experience Study	
		6.75% Discount Rate Changing Mortality Tables	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions
1	Number of Members		
	a. Active	936	936
	b. Inactive:		
	i. Eligible for deferred vested pension benefits	9	9
	ii. Eligible for return of contributions only	12	12
	c. Current Benefit Recipients:		
	i. Retirement annuities	871	871
	ii. Disability annuities	-	322
	iii. Reversionary annuities	322	-
	d. Total	2,150	2,150
2	Covered Uncapped Payroll	\$ 182,776,153	\$ 182,776,153
3	Annualized Benefit Payments Currently Being Made		
	a. Retirement	\$ 124,417,314	\$ 124,417,314
	b. Disability	-	-
	c. Survivor	25,510,905	25,510,905
	d. Total	\$ 149,928,219	\$ 149,928,219
4	Actuarial Liability—Annuitants		
	a. Current Benefit Recipients:		
	i. Retirement annuities	\$ 1,721,028,246	\$ 1,664,064,353
	ii. Disability annuities	-	-
	iii. Survivor annuities	257,259,265	237,723,730
	b. Total	\$ 1,978,287,511	\$ 1,901,788,083

Cost Impact

	Valuation Baseline	Experience Study		
		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions
5 Actuarial Liability—Inactive Members	\$ 8,530,162	\$ 8,302,978	\$ 9,094,528	\$ 9,473,742
6 Active Members				
a. Pension Benefits	\$ 534,312,313	\$ 527,647,202	\$ 525,132,092	\$ 542,372,401
b. Cost-of-Living Adjustments	181,231,154	170,198,699	169,733,642	177,800,612
c. Death Benefits	16,133,462	10,959,758	11,214,966	11,544,113
d. Disability	-	-	-	-
e. Withdrawal	3,358,245	3,302,306	3,459,857	3,635,567
f. Expenses	-	-	-	-
g. Total	\$ 735,035,174	\$ 712,107,965	\$ 709,540,557	\$ 735,352,693
7 Total Actuarial Liability (4 + 5 + 6)	\$ 2,721,852,847	\$ 2,622,199,026	\$ 2,636,196,465	\$ 2,707,424,862
8 Market Value of Assets (MVA)	\$ 1,012,484,801	\$ 1,012,484,801	\$ 1,012,484,801	\$ 1,012,484,801
9 Unfunded Actuarial Liability Based on MVA (7 – 8)	\$ 1,709,368,046	\$ 1,609,714,225	\$ 1,623,711,664	\$ 1,694,940,061
10 Funded Percentage Based on MVA (8 ÷ 7)	37.20%	38.61%	38.41%	37.40%
11 Actuarial Value of Assets (AVA)	\$ 1,012,757,312	\$ 1,012,757,312	\$ 1,012,757,312	\$ 1,012,757,312
12 Unfunded Actuarial Liability Based on AVA (7 – 11)	\$ 1,709,095,535	\$ 1,609,441,714	\$ 1,623,439,153	\$ 1,694,667,550
13 Funded Percentage Based on AVA (11 ÷ 7) ^a	37.21%	38.62%	38.42%	37.41%
14 Total Normal Cost	51,659,393	50,232,373	49,773,911	51,483,370
15 Employee Contributions	\$ 13,648,568	\$ 13,658,969	\$13,685,664	\$13,685,664
16 Annual Employer Normal Cost (% uncapped payroll)	\$ 38,010,825 20.80%	\$ 36,573,404 20.01%	\$ 36,088,247 19.74%	\$ 37,797,706 20.68%

^a The funded status measure is appropriate for assessing the need for future contributions. The funded status is not appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations.

Cost Impact

Actuarial Valuation Date: June 30, 2018			6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions
Fiscal Year Ending: June 30, 2020	Valuation Baseline	6.75% Discount Rate Changing Mortality Tables		
Estimated Statutory Contributions:				
· Annual Amount	\$ 144,160,000	\$ 141,945,000	\$ 142,302,000	\$ 144,275,000
· Percentage of Projected Capped Payroll for Fiscal Year	91.851%	90.399%	90.731%	92.059%
Actuarially Determined Contribution^a (ADC):				
· Annual Amount	\$ 173,704,375	\$ 164,336,170	\$ 165,085,822	\$ 172,312,576
· Percentage of Projected Capped Payroll for Fiscal Year	110.675%	104.659%	105.257%	109.949%
Membership				
· Number of				
- Active Members	936	936	936	936
- Members Receiving Payments	1,193	1,193	1,193	1,193
- Inactive Members	21	21	21	21
- Total	2,150	2,150	2,150	2,150
· Covered Uncapped Payroll Provided by System	\$ 182,776,153	\$ 182,776,153	\$ 182,776,153	\$ 182,776,153
· Projected Capped Payroll For Fiscal Year	\$ 156,950,432	\$ 157,020,248	\$ 156,840,174	\$ 156,719,869
· Annualized Benefit Payments	\$ 149,928,218	\$ 149,928,218	\$ 149,928,218	\$ 149,928,218
Assets				
· Market Value of Assets (MVA)	\$ 1,012,484,801	\$ 1,012,484,801	\$ 1,012,484,801	\$ 1,012,484,801
· Actuarial Value of Assets (AVA)	\$ 1,012,757,312	\$ 1,012,757,312	\$ 1,012,757,312	\$ 1,012,757,312
· Return on MVA	7.42%	7.42%	7.42%	7.42%
· Return on AVA	7.32%	7.32%	7.32%	7.32%
· Ratio – AVA to MVA	100.03%	100.03%	100.03%	100.03%
Actuarial Information				
· Employer Normal Cost Amount	\$ 38,010,825	\$ 36,573,404	\$ 36,088,248	\$ 37,797,706
· Actuarial Accrued Liability (AAL)	\$ 2,721,852,847	\$ 2,622,199,026	\$ 2,636,196,465	\$ 2,707,424,862
· Unfunded Actuarial Accrued Liability (UAAL)	\$ 1,709,095,535	\$ 1,609,441,714	\$ 1,623,439,153	\$ 1,694,667,550
· Funded Ratio based on AVA	37.21%	38.62%	38.42%	37.41%
· UAAL as % of Covered Payroll	935.08%	880.55%	888.21%	927.18%
· Funded Ratio based on MVA	37.20%	38.61%	38.41%	37.40%

^a For contributions in fiscal years ending on and after June 30, 2017, the Board adopted a recommended policy used to develop the Actuarially Determined Contribution (ADC) as defined in GASB Statements Nos. 67 and 68. The policy adopted by the Board calculates the ADC as the Normal Cost plus a 25-year level percent of capped payroll closed-period amortization of the Unfunded Accrued Liability. As of June 30, 2018, the remaining amortization period is 22 years. The ADC is used for financial reporting purposes only.

Cost Impact

Actuarial Accrued Liability and Actuarial Value of Assets Determined as of June 30, 2018 (\$ in millions)

Year	Actuarial Accrued Liability				Actuarial Value of Assets			
	Valuation Baseline	Experience Study			Valuation Baseline	Experience Study		
		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions
2019	\$ 2,792.96	\$ 2,685.39	\$ 2,699.82	\$ 2,771.01	\$1,066.94	\$ 1,067.23	\$ 1,067.22	\$ 1,064.72
2020	2,858.76	2,743.22	2,758.16	2,829.00	1,124.49	1,123.21	1,123.47	1,120.19
2021	2,918.01	2,794.48	2,810.51	2,880.69	1,194.26	1,189.74	1,190.61	1,187.49
2022	2,971.45	2,839.90	2,856.74	2,925.91	1,254.96	1,245.42	1,247.07	1,245.05
2023	3,017.97	2,878.38	2,895.93	2,963.76	1,309.27	1,292.81	1,295.17	1,295.16
2028	3,145.69	2,966.22	2,983.94	3,040.01	1,519.01	1,456.50	1,459.50	1,471.19
2033	3,108.49	2,892.07	2,906.52	2,942.63	1,646.29	1,534.90	1,534.91	1,547.30
2038	2,948.88	2,704.77	2,715.08	2,723.79	1,814.30	1,653.42	1,652.13	1,656.63
2043	2,735.53	2,481.57	2,487.74	2,462.52	2,159.17	1,951.18	1,952.62	1,932.51
2045	2,652.74	2,401.13	2,405.93	2,365.49	2,387.57	2,161.08	2,165.31	2,128.87

Normal cost rate includes administrative expenses.

State contribution based on the requirements of Public Act 88-0593, as amended by Public Act 90-0065, Public Act 94-0004, Public Act 96-0043 and Public Act 100-0023.

Total expenses include benefit payments, refunds and administrative expenses.

Actuarial accrued liability and assets are measured at Plan Year End.

Total payroll is capped for members hired after December 31, 2010, as defined in Public Act 96-0889.

Cost Impact

Required State Contribution Determined as of June 30, 2018 (\$ in millions)

Year	Contribution Dollar					Contribution Percent			
	Valuation Baseline	Experience Study				Valuation Baseline	Experience Study		
		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions
2019	\$ 140.47	\$ 140.47	\$ 140.47	\$ 140.47	\$ 140.47	88.13%	88.13%	88.13%	88.13%
2020	144.16	141.95	142.30	144.28		91.85%	90.40%	90.73%	92.06%
2021	147.75	143.60	144.13	147.22		94.30%	91.57%	92.11%	94.25%
2022	151.07	144.99	145.89	150.04		96.50%	92.51%	93.25%	96.19%
2023	150.62	142.57	143.56	148.65		96.05%	90.79%	91.72%	95.40%
2028	153.51	143.31	143.91	148.21		95.81%	89.30%	90.37%	94.49%
2033	159.87	149.02	149.83	151.96		94.42%	87.90%	88.98%	92.89%
2038	177.23	165.31	166.71	167.47		96.16%	89.64%	90.76%	95.22%
2043	196.93	183.62	185.59	183.86		96.16%	89.64%	90.76%	95.22%
2045	206.13	192.18	194.36	191.53		96.16%	89.64%	90.76%	95.22%
Total Cont. Through 2045 Present Value of Total Cont.	\$ 4,483.89	\$ 4,211.53	\$ 4,240.70	\$ 4,296.25					
	\$ 2,004.82	\$ 1,895.96	\$ 1,906.93	\$ 1,990.23					

Normal cost rate includes administrative expenses.

State contribution based on the requirements of Public Act 88-0593, as amended by Public Act 90-0065, Public Act 94-0004, Public Act 96-0043 and Public Act 100-0023.

Total expenses include benefit payments, refunds and administrative expenses.

Actuarial accrued liability and assets are measured at Plan Year End.

Total payroll is capped for members hired after December 31, 2010, as defined in Public Act 96-0889.

Cost Impact

Unfunded Accrued Liability and Funded Ratio Determined as of June 30, 2018 (\$ in millions)

Year	Unfunded Accrued Liability				Funded Ratio			
	Valuation Baseline	Experience Study			Valuation Baseline	Experience Study		
		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions		6.75% Discount Rate Changing Mortality Tables	6.75% Discount Rate Changing Mortality Tables and all Demographic Assumptions	6.50% Discount Rate Changing Mortality Tables and all Demographic Assumptions
2019	\$ 1,726.02	\$ 1,618.16	\$ 1,632.60	\$ 1,706.29	38.20%	39.74%	39.53%	38.42%
2020	1,734.27	1,620.01	1,634.69	1,708.81	39.33%	40.94%	40.73%	39.60%
2021	1,723.75	1,604.74	1,619.90	1,693.20	40.93%	42.57%	42.36%	41.22%
2022	1,716.49	1,594.48	1,609.67	1,680.86	42.23%	43.85%	43.65%	42.55%
2023	1,708.70	1,585.57	1,600.76	1,668.60	43.38%	44.91%	44.72%	43.70%
2028	1,626.68	1,509.72	1,524.44	1,568.82	48.29%	49.10%	48.91%	48.39%
2033	1,462.20	1,357.17	1,371.61	1,395.33	52.96%	53.07%	52.81%	52.58%
2038	1,134.58	1,051.35	1,062.95	1,067.16	61.53%	61.13%	60.85%	60.82%
2043	576.36	530.39	535.12	530.01	78.93%	78.63%	78.49%	78.48%
2045	265.17	240.05	240.62	236.62	90.00%	90.00%	90.00%	90.00%

Normal cost rate includes administrative expenses.

State contribution based on the requirements of Public Act 88-0593, as amended by Public Act 90-0065, Public Act 94-0004, Public Act 96-0043 and Public Act 100-0023.

Total expenses include benefit payments, refunds and administrative expenses.

Actuarial accrued liability and assets are measured at Plan Year End.

Total payroll is capped for members hired after December 31, 2010, as defined in Public Act 96-0889.

SECTION E

RECOMMENDED ACTUARIAL ASSUMPTIONS

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Actuarial Cost Method as Mandated by 40 ILCS 5/2-124, Adopted June 30, 1989

The projected unit credit normal cost method is used. Under this method, the projected pension at retirement age is first calculated and the present value at the individual member's current or attained age is determined. The normal cost for the member for the current year is equal to actuarial present value divided by the member's projected service at retirement. The normal cost for the plan for the year is the sum of the individual normal costs.

The actuarial liability at any point in time is the present value of the projected pensions at that time less the value of future normal costs.

For ancillary benefits for active members, in particular death and survivor benefits, termination benefits, and the postretirement increases, the same procedure as outlined above is followed.

Estimated annual administrative expenses are added to the normal cost.

For actuarial valuation purposes, as well as projection purposes, an actuarial value of assets is used.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Proposed Actuarial Assumptions to be Adopted for the June 30, 2019, Actuarial Valuation

Mortality

Post-Retirement Mortality

Pub-2010 Above-Median Income General Healthy Retiree Mortality table, sex distinct, with scaling factors of 102 percent for males and 98 percent for females, and the MP-2018 two-dimensional generational mortality improvement scale. This assumption provides a margin for future mortality improvements.

Pre-Retirement Mortality, including terminated vested members prior to attaining age 50

Pub-2010 Above-Median Income General Employee Mortality table, sex distinct, with scaling factors of 99 percent for males and females, and the MP-2018 two-dimensional generational mortality improvement scale. This assumption provides a margin for future mortality improvements.

Future mortality improvements are reflected by projecting the base mortality tables forward from the year 2010 using the MP-2018 projection scale.

We use what is termed “the limited fluctuation credibility procedure” to determine the appropriate scaling factor of the base mortality tables for each gender and each member classification. We used a liability weighted basis for postretirement mortality and a headcount basis for preretirement and disabled mortality. In each case, the partial credibility factor (or “Z-factor”) is computed based on the experience of the specific group being studied. This Z-factor is a measure of the credibility of the pertinent group.

The Best Fit is the ratio of actual to expected deaths using the base table. The final scale is then determined as the weighted average of the Best Fit and 100 percent based on the Z-factor. For example, the Z-factor for male retirees is 23 percent, suggesting that the data for this group is 23 percent credible (there were not enough deaths among members to be completely credible). The Best Fit for this group would be to scale the base tables by 109 percent. The final scale of 102 percent is the credibility-weighted average ($102\% = 23\% \times 109\% + 77\% \times 100\%$). Factors for other groups are determined similarly.

**Projection Methodology and Appropriation Requirements under
P.A. 93-0002, P.A. 94-0004, P.A. 96-0043,
and P.A. 100-0023**

Applicable Group	Base Mortality Table	Male Scaling Factor	Female Scaling Factor
Pre-retirement	Pub-2010 Above-Median General Employee, sex distinct	99%	99%
Post-retirement	Pub-2010 Above-Median General Healthy Retiree, sex distinct	102%	98%

Age	Future Life Expectancy (years) in 2018		Future Life Expectancy (years) in 2033	
	Postretirement		Postretirement	
	Male	Female	Male	Female
35	51.88	54.83	53.30	56.14
40	46.57	49.47	47.97	50.78
45	41.28	44.14	42.66	45.44
50	36.11	38.91	37.47	40.20
55	31.16	33.91	32.49	35.17
60	26.41	29.04	27.67	30.23
65	21.87	24.28	23.03	25.40
70	17.56	19.69	18.60	20.74
75	13.55	15.39	14.48	16.36

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Interest

6.50 percent per annum, compounded annually.

General Inflation

2.25 percent per annum, compounded annually.

This assumption serves as the basis for the determination of Tier 2 pay cap growth and annual increases that are equal to the lesser of 3.0 percent or the annual change in the Consumer Price Index-U during the preceding 12-month calendar year.

Marriage Assumption

80.0 percent of active and retired participants are assumed to be married.

Termination

Illustrative rates of withdrawal from the plan are as follows:

Age Based Withdrawal - Tier 1		
Age	Male	Female
30	0.0129	0.0162
35	0.0124	0.0162
40	0.0108	0.0162
45	0.0095	0.0162
50	0.0083	0.0158
55	0.0071	0.0092
60	0.0059	0.0074
65	0.0047	0.0057

It is assumed that terminated employees will not be rehired. The rates apply only to employees who have not fulfilled the service requirement necessary for retirement at any given age.

Salary Increases

A salary increase assumption of 2.50 percent per year, compounded annually, was used. This 2.50 percent salary increase assumption includes an inflation component of 2.25 percent per year, and a productivity/merit/promotion component of 0.25 percent.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Load for Inactive Members Eligible for Deferred Vested Pension Benefits

Deferred vested liability is increased by 10 percent to account for increases in final average salary due to participation in a reciprocal system.

Disability

No assumption for disability was assumed.

Employee Contribution Election

For purposes of the actuarial valuation, it is assumed that all judges elect to contribute only on increases in salary when they become eligible for this provision.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Population Projection

For purposes of determining annual appropriation as a percent of total covered payroll, the size of the active group is assumed to remain level at the number of actives as of the actuarial valuation date. New entrants are assumed to enter with an average age and average pay as disclosed below. The new entrant profile is based on the averages for all current active members. The average increase in uncapped payroll for the projection period is 2.50 percent per year. The average increase in capped payroll for the projection period is 2.25 percent per year.

New Entrant Profile			
Age Group	No.	Uncapped Salary	Capped Salary
Under 20			
20-24			
25-29	1	\$ 198,075	\$ 119,792
30-34	29	5,925,100	3,473,962
35-39	103	20,335,519	12,338,554
40-44	204	39,729,543	24,437,525
45-49	211	41,231,482	25,276,068
50-54	171	33,194,626	20,484,396
55-59	118	22,926,939	14,135,431
60-64	50	9,737,178	5,989,590
65-69	3	584,321	359,375
70 & Over			
Total	890	\$ 173,862,783	\$ 106,614,693
Avg. Salary		\$ 195,351	\$ 119,792
Avg. Age			47.35
Percent Male			67.87%

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Retirement

Employees are assumed to retire in accordance with the rates shown below. The rates apply only to employees who have fulfilled the service requirement necessary for retirement at any given age.

Retirement Rates	
Age	Males & Females
60	9.00%
61-64	11.00%
65-69	12.00%
70-74	13.00%
75-79	14.00%
80+	100.00%

Early Retirement Rates		
Age	Male	Female
55	5.50%	8.50%
56	5.50%	8.50%
57	5.50%	8.50%
58	5.50%	8.50%
59	5.50%	8.50%

Assets

Assets available for benefits are determined as described on pages 41 to 42 of the June 30, 2018, actuarial valuation report. The asset valuation method is prescribed by statute, and does not appear to allow a corridor; therefore, a corridor has not been established.

Expenses

As estimated and advised by JRS staff, based on current expenses and expected to increase in relation to the projected capped payroll. Expenses are included in the service cost.

Spouse's Age

The female spouse is assumed to be four years younger than the male spouse.

Decrement Timing

All decrements are assumed to occur beginning of year.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Decrement Relativity

Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects.

Decrement Operation

Turnover decrements do not operate after member reaches retirement eligibility.

Eligibility Testing

Eligibility for benefits is determined based upon the age nearest birthday and service on the date the decrement is assumed to occur.

415(b) and 401(a)(17) Limits

No explicit assumption is made with respect to these items.

Assumptions as a Result of Public Act 96-0889 – Tier 2 Assumptions

Members hired after December 31, 2010, are assumed to make contributions on salary up to the final average compensation cap in a given year until this plan provision or administrative procedure is clarified. State contributions, expressed as a percentage of pay, are calculated based upon capped pay.

Retirement rates for tier two members to account for the change in retirement age are shown in the table below.

Retirement Rates for Tier Two Members	
Age	Male & Female
67	30.00%
68-69	12.00%
70	13.00%
71	10.00%
72	11.00%
73	12.00%
74	13.00%
75-79	14.00%
80	100.00%

Early Retirement Rates for Tier Two Members	
Age	Males and Females
62	11.00%
63	12.00%
64	13.00%
65	14.00%
66	14.00%

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Illustrative rates of withdrawal from the plan for Tier 2 members are as follows:

Age Based Withdrawal		
Age	Male	Female
30	0.0175	0.0150
35	0.0172	0.0145
40	0.0157	0.0129
45	0.0148	0.0129
50	0.0139	0.0129
55	0.0124	0.0113
60	0.0124	0.0095
65	0.0124	0.0078

State Contributions under P.A. 93-0002

In general, for each year during the life of the GOB program, the state contributions to the System are to be calculated as follows:

1. Calculation of the contribution maximum
 - a. A projection of contributions will be made from the valuation date to June 30, 2045. Such projection will be based on hypothetical asset values determined using the following assumptions:
 - i) That the System had received no portion of the general obligation bond proceeds in excess of the scheduled contributions for the remainder of fiscal 2003 and for the entirety of 2004,
 - ii) That hypothetical state contributions had been made each fiscal year from 2005 through the valuation date, based on the funding process in place prior to P.A. 93-0002 (without regard to prior state minimum requirements),
 - iii) That the actual amounts of member contributions and the actual cash outflows (benefit payments, refunds and administrative expenses) for each year prior to the valuation date were realized, and
 - iv) That the hypothetical fund earned returns in each prior fiscal year equal to the rate of total return actually earned by the retirement fund in that year.
 - b. The hypothetical asset values developed in a., above, will not exceed the actual assets of the fund.
 - c. A projection of maximum contributions for each year of the GOB program will be performed each year, by reducing the contributions produced in a., above, by the respective amount of debt service allocated to the System for each year.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

2. Calculation of the contribution with GOB proceeds
 - a. The basic projection of State contributions from the valuation date through June 30, 2045, will be made, taking into account all assets of the System, including the GOB proceeds.
 - b. State contribution rates (expressed as a percentage of covered pay), in the pattern required by the funding sections of the statutes, are calculated.
 - c. In those projections, the dollars of state contributions which are added to assets each year during the GOB program are limited by the contribution maximum. Because the bonds are to be liquidated by the end of fiscal 2033, there is no contribution maximum thereafter.

State Contributions under P.A. 94-0004

The following is an excerpt from the Illinois Compiled statutes 40 ILCS 5/18-131:

(c) Notwithstanding any other provision of this Article, the total required State contribution for fiscal year 2006 is \$29,189,400.

Notwithstanding any other provision of this Article, the total required State contribution for fiscal year 2007 is \$35,236,800.

For each State fiscal year 2008 through 2010, the State contribution to the System, as a percentage of the applicable employee payroll, shall be increased in equal annual increments from the required State contribution for State fiscal year 2007, so that by State fiscal year 2011, the State is contributing at a rate otherwise required under this Section.

State Contributions under P.A. 96-0043

The following is an excerpt from the Illinois Compiled statutes 40 ILCS 5/2-124:

(d) For purposes of determining the required State contribution to the System, the value of the System's assets shall be equal to the actuarial value of the System's assets, which shall be calculated as follows:

As of June 30, 2008, the actuarial value of the System's assets shall be equal to the market value of the assets as of that date. In determining the actuarial value of the System's assets for fiscal years after June 30, 2008, any actuarial gains or losses from investment return incurred in a fiscal year shall be recognized in equal annual amounts over the five-year period following that fiscal year.

(e) For purposes of determining the required State contribution to the system for a particular year, the actuarial value of assets shall be assumed to earn a rate of return equal to the system's actuarially assumed rate of return.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

State Contributions under P.A. 100-0023

Public Act (“P.A.”) 100-0023, effective July 6, 2017, modified the State’s funding policy to include smoothing State contribution rate increases or decreases due to changes in actuarial assumptions, including investment return assumptions, over a five-year period in equal annual amounts beginning in fiscal year 2018. In addition, changes in actuarial or investment assumptions that increased or decreased the State contribution rate in fiscal years 2014 through 2017 are to be smoothed over a five-year period in equal annual amounts, applying only to the portion of the five-year phase-in that is applicable to fiscal years on and after 2018.

Projection Methodology and Appropriation Requirements under P.A. 93-0002, P.A. 94-0004, P.A. 96-0043, and P.A. 100-0023

Phase-in of the Financial Impact of Assumption Changes

Following is a table with the recognition schedule for the phase-in of actuarial assumption changes required under Public Act 100-0023. The following actuarial assumption changes were made:

1. Beginning with the June 30, 2013, actuarial valuation, there were changes to the economic and demographic assumptions.
2. Beginning with the June 30, 2016, actuarial valuation, there were changes to the economic and demographic assumptions.
3. Beginning with the June 30, 2018, actuarial valuation, there were changes to the economic assumptions.
4. Beginning with the June 30, 2018, actuarial valuation, there were changes to the demographic and economic assumptions due to an experience review. ^a

Valuation Year Ending June 30,	2013	2014	2015	2016	2017	2018	2018 ^a	2019	2020	2021	2022
Applicable Fiscal Year Ending June 30,	2015	2016	2017	2018	2019	2020	2020	2021	2022	2023	2024
\$ in Millions After Impact of GOB Proceeds											
Contribution Before Assumption Change											
(1) Contribution Dollar	\$ 127.624	\$ -	\$ -	\$ 132.782	\$ -	\$ 143.976	\$ 145.223				
(2) Contribution Rate	76.115%	0.000%	0.000%	82.414%	0.000%	91.511%	92.528%				
Contribution After Assumption Change											
(3) Contribution Dollar	\$ 133.982	\$ -	\$ -	\$ 146.767	\$ -	\$ 145.223	\$ 142.818				
(4) Contribution Rate	79.961%	0.000%	0.000%	91.395%	0.000%	92.528%	91.130%				
(5) Assumption Change Impact as a Percentage of Capped Payroll [(4) - (2)]	3.846%	0.000%	0.000%	8.981%	0.000%	1.017%	-1.398%				
(6) Assumption Change Impact Recognized											
This Year (5-year Recognition)											
(6a) From This Year	0.769%	0.000%	0.000%	1.796%	0.000%		-0.076%				
(6b) From One Year Ago	0.000%	0.769%	0.000%	0.000%	1.796%		0.000%	-0.076%			
(6c) From Two Years Ago	0.000%	0.000%	0.769%	0.000%	0.000%		1.796%	0.000%	-0.076%		
(6d) From Three Years Ago	0.000%	0.000%	0.000%	0.769%	0.000%		0.000%	1.796%	0.000%	-0.076%	
(6e) From Four Years Ago	0.000%	0.000%	0.000%	0.000%	0.770%		0.000%	0.000%	1.797%	0.000%	-0.077%
(6f) Total Recognized Assumption Change Impact	0.769%	0.769%	0.769%	2.565%	2.566%		1.720%	1.720%	1.721%	-0.076%	-0.077%

^a The June 30, 2018, phase-in adjustments for the change in assumptions due to the experience review study will be re-measured as of June 30, 2019, and will become effective beginning with the June 30, 2019, actuarial valuation.