



Cavanaugh Macdonald
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**State of Mississippi Retirement Systems
Experience Investigation for the
Four-Year Period
Ending June 30, 2018**





Cavanaugh Macdonald

CONSULTING, LLC

The experience and dedication you deserve

April 2, 2019

The Board of Trustees
Public Employees' Retirement System of Mississippi
429 Mississippi Street
Jackson, MS 39201

Members of the Board:

We are pleased to submit the results of an investigation of the economic and demographic experience for the Public Employees' Retirement System (PERS), the Highway Safety Patrol Retirement System (HSPRS), the Supplemental Legislative Retirement Plan (SLRP) and the Municipal Retirement Systems (MRS) for the four-year period from July 1, 2014 to June 30, 2018. The study was based on the data submitted by PERS for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation was to assess the reasonability of the current PERS economic assumptions and demographic actuarial assumptions for each Retirement System. As a result of the investigation, it is recommended that revised economic assumptions and demographic tables be adopted by the Board for future use.

All recommended rates of separation, mortality and salary increase at each age for each division are shown in the attached tables in Appendix D of this report. In the actuary's judgment, the rates recommended are suitable for use until further experience indicates that modifications are desirable.

We hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the principles prescribed by the Actuarial Standards Board (ASB) and the Code of Professional Conduct and Qualification Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries.

We further certify that, in our opinion, the assumptions developed in this report satisfy Actuarial Standards of Practice, in particular, No. 27 (Selection of Economic Assumptions for Measuring Pension Obligations) and No. 35 (Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations).



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The experience investigation was performed by, and under the supervision of, independent actuaries who are members of the American Academy of Actuaries with experience in performing valuations for public retirement systems. The undersigned meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

A handwritten signature in blue ink that reads 'Edward J. Koebel'.

Edward J. Koebel, EA, FCA, MAAA
Principal and Consulting Actuary

A handwritten signature in blue ink that reads 'Jonathan T. Craven'.

Jonathan T. Craven, ASA, EA, FCA, MAAA
Consulting Actuary



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Section I - Executive Summary

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. Actuarial valuations of the Mississippi Public Employees' Retirement System (PERS), the Mississippi Highway Safety Patrol Retirement System (HSPRS), the Mississippi Supplemental Legislative Retirement Plan (SLRP) and the Mississippi Municipal Retirement System (MRS) are prepared annually to determine the actuarial contribution rate required to fund them on an actuarial reserve basis, (i.e. the current assets plus future contributions, along with investment earnings will be sufficient to provide the benefits promised by the system). The valuation requires the use of certain assumptions with respect to the occurrence of future events, such as rates of death, termination of employment, retirement age, and salary changes to estimate the obligations of the system.

The basic purpose of an experience study is to determine whether the actuarial assumptions currently in use have adequately anticipated the actual emerging experience. This information, along with the professional judgment of system personnel and advisors, is used to evaluate the appropriateness of continued use of the current actuarial assumptions. When analyzing experience and assumptions, it is important to recognize that actual experience is reported in the short term while assumptions are intended to be long-term estimates of experience. Therefore, actual experience is expected to vary from study period to study period, without necessarily indicating a change in assumptions is needed.

Cavanaugh Macdonald Consulting, LLC (CMC) has performed a study of the experience of each of the Plans under the PERS' Board of Trustees purview for the four-year period ending June 30, 2018. This report presents the results, analysis, and resulting recommendations of our study. It is anticipated that the changes, if approved, will first be reflected in the June 30, 2019 actuarial valuations.

These assumptions have been developed in accordance with generally recognized and accepted actuarial principles and practices that are consistent with the applicable Actuarial Standards of Practice adopted by the Actuarial Standards Board (ASB). While the recommended assumptions represent our best estimate of future experience, there are other reasonable assumption sets that could be supported by the results of this experience study. Those other sets of reasonable assumptions could produce liabilities and costs that are either higher or lower.

Our Philosophy

Similar to an actuarial valuation, the calculation of actual and expected experience is a fairly mechanical process, and differences between actuaries in this area are generally minor. However, the setting of assumptions differs, as it is more art than science. In this report, we have recommended changes to certain assumptions. To explain our thought process, we offer a brief summary of our philosophy:



Section I - Executive Summary

- **Do Not Overreact:** When we see significant changes in experience, we generally do not adjust our rates to reflect the entire difference. We will typically recommend rates somewhere between the old rates and the new experience. If the experience during the next study period shows the same result, we will probably recognize the trend at that point in time or at least move further in the direction of the observed experience. On the other hand, if experience returns closer to its prior level, we will not have overreacted, possibly causing volatility in the actuarial contribution rates.
- **Anticipate Trends:** If there is an identified trend that is expected to continue, we believe that this should be recognized. An example is the retiree mortality assumption. It is an established trend that people are living longer. Therefore, we believe the best estimate of liabilities in the valuation should reflect the expected increase in life expectancy.
- **Simplify:** In general, we attempt to identify which factors are significant and eliminate or ignore the ones that do not materially improve the accuracy of the liability projections.

The following summarizes the findings and recommendations with regard to the assumptions utilized for PERS. Detailed explanations for the recommendations are found in the sections that follow.

Recommended Economic Assumption Changes

Economic assumptions are some of the most visible and significant assumptions used in the valuation process. The items in the broad economy modeled by these assumptions can be very volatile over short periods of time, as clearly seen in the economic downturn in 2008 followed by the rebound in many financial markets in the years following. Our goal is to try to find the emerging long-term trends in the midst of this volatility so that we can then apply reasonable assumptions.

Most of the economic assumptions used by actuaries are developed through a building-block approach. For example, the expected return on assets is based on the expectation for inflation plus the expected real return on assets. At the core of the economic assumptions is the inflation assumption. As we discuss later in the report, based on recent trends of inflation, the market pricing of inflation, and the Chief Actuary of the Social Security Administration's view of inflation, **we are recommending a decrease in the price inflation assumption from 3.00% to 2.75%.**



Section I - Executive Summary

We are also recommending a corresponding decrease in the long-term expected return on assets assumption from 7.75% to 7.50%, reflecting the 0.25% decrease in the inflation assumption. This will be discussed in detail later in this report, but a real rate of return of 4.75% is supported by the forecasting models developed using the Board’s investment consultant’s capital market assumptions and the Board’s target asset allocation. Further analysis of the 35 sets of capital market assumptions included in the Horizon Actuarial Services, LLC. Survey conducted in 2018 also support this recommendation.

Finally, we are recommending that the general wage inflation (payroll growth) assumption used as the underlying payroll growth for active member and used in the level percent of payroll amortization method be decreased from 3.25% to 3.00%, reflecting the 0.25% decrease in the inflation assumption.

The following table summarizes the current and proposed economic assumptions:

Item	Current	Proposed
Price Inflation	3.00%	2.75%
Investment Return*	7.75%	7.50%
Wage Inflation (Payroll Growth)	3.25%	3.00%

* Net of investment expenses only.

Although we have recommended a change in the set of economic assumptions, we recognize there may be other sets of economic assumptions that are also reasonable for purposes of funding PERS. For example, we have typically reflected conservatism to the degree we would classify as moderate. Actuarial Standards of Practice allow for this difference in approaches and perspective, as long, as the assumptions are reasonable and consistent.



Section I - Executive Summary

Recommended Demographic Assumption Changes

In the experience study, actual experience for the study period is compared to that expected based on the current actuarial assumption. The analysis is most commonly performed based on counts, i.e. each member is one exposure as to the probability of the event occurring and one occurrence if the event actually occurs. Comparing the actual incidence of the event to what was expected (called the Actual-to-Expected ratio, or A/E ratio) then provides the basis for our analysis.

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying in recent years. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date. There have been significant improvements in longevity in the past, although there are different opinions about future expectations. We believe it is prudent to anticipate that the trend will continue to some degree in the future. Therefore, we believe it is appropriate to reflect future mortality improvement as part of the mortality assumption.

There are two widely used approaches for reflecting future improvements in mortality:

- (1) Static table with “margin”
- (2) Generational mortality

The first approach to reflecting mortality improvements is through the use of a static mortality table with “margin.” Under this approach, the A/E ratio is intentionally targeted to be over 100% so that mortality can improve without creating actuarial losses. While there is no formal guidance for the amount of margin required (how far above 100% is appropriate for the A/E ratio), we typically prefer to have a margin of around 10 to 14% at the core retirement ages. The goal is still for the general shape of the curve to be a reasonable fit to the observed experience. Depending on the magnitude and duration of actual mortality improvements in the future, the margin may decrease and eventually become insufficient. If and when that occurs, the assumption would need to be updated.

Another approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% as future mortality improvements will be taken into account directly in the actuarial valuation process.



Section I - Executive Summary

The current post-retirement mortality assumption for healthy lives, which we changed in the 2016 experience study, is a static table, the RP-2014 Healthy Annuitant Blue Collar Table projected with Scale BB to 2022 with male rates set forward one year and adjusted by 106% for males at all ages and as follows for females: 90% for ages less than 76, 95% for age 76, 105% for age 78 and 110% for ages 79 and greater. The results of the experience analysis indicate that this table provides a very reasonable margin for future mortality improvements. In fact, the PERS plan experienced a very small gain due to post-retirement mortality for the 2018 valuation, meaning that there were slightly more deaths than expected. We have, however, decided to adopt a generational mortality approach and have selected the mortality assumption from the recently published Pub-2010 Public Mortality Plans Mortality Tables. These tables, released earlier this year, were developed using public pension plan mortality experience only. More information will be discussed in the demographic section of this report.

The following is a general list of the other recommended changes to the demographic assumptions for PERS.

- **Retirement: Increased rates of retirement slightly at younger ages for members with less than 25 years of service and for members with 25 years of service or more to better match experience.**
- **Disability: No changes recommended in the rates of disability retirement.**
- **Withdrawal: Increased rates of withdrawal slightly at younger ages and during select period (below 2 years of service).**
- **Merit Salary Scale: No change in merit salary scale.**

Section IV of this report will provide more detail to these recommended demographic changes. Sections V-VII provide a summary of the recommended changes for each of the other three Systems.

Actuarial Methods

The basic actuarial methodologies used in the valuation process include the:

- Actuarial Cost Method
- Asset Valuation Method
- Amortization Method

Based on our review, discussed in full detail in Section III of this report, we recommend no changes in these actuarial methods at this time.



Other Assumptions

Another assumption that is included in the valuations is the determination of administrative expense component that is added to the total normal cost each year. The current assumption is 0.23% of payroll. **After reviewing the total amount of administrative expenses for the past four years and the percentage of payroll, we are recommending a slight increase in this assumption from 0.23% to 0.25% of payroll.** The following table shows actual percentages over the past four years:

(\$ in Thousands)

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2015	13,523	5,904,827	0.23%
2016	15,166	6,022,533	0.25%
2017	17,056	6,038,229	0.28%
2018	16,264	5,999,231	0.27%

Financial Impact

Although the assumption changes, if approved, will first be reflected in the 2019 valuations, we have provided the following tables which highlight the impact of the recommended changes on the unfunded accrued liabilities (UAL), funding ratios, amortization period and projected funding ratios for each System on the 2018 valuation and projection results.

Change in 2018 Valuation Unfunded Accrued Liability

(\$ in Thousands)

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	16,940,459	17,295,161	18,415,764
HSPRS	175,013	178,549	192,427
SLRP	4,374	4,451	4,938



Change in 2018 Valuation Funding Ratio

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	61.8%	61.4%	59.9%
HSPRS	66.8%	66.4%	64.7%
SLRP	80.4%	80.1%	78.4%

Change in 2018 Valuation UAL Amortization Period*

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	30.9	33.8	41.5
HSPRS	18.3	20.0	24.2
SLRP	20.1	22.4	28.8

* Fixed contribution rates kept constant.

Change in Projected Funding Ratio in 2047 for PERS and 2042 for HSPRS and SLRP*

System	Before All Changes	After Demographic Changes Only	After All Changes
PERS	95.8%	86.5%	70.6%
HSPRS	103.5%	97.5%	86.8%
SLRP	97.5%	91.3%	80.8%

* Fixed contribution rates kept constant.



Section II – Economic Assumptions

There are four economic assumptions used in the actuarial valuations performed for PERS. They are:

- Price Inflation
- Investment Return
- Wage Inflation
- Payroll Growth for Amortization Method

Note that future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return and wage inflation. However, it is not directly used in the valuation process.

Actuarial Standard of Practice (ASOP) No. 27, “*Selection of Economic Assumptions for Measuring Pension Obligations*” provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. ASOP No. 27 was revised in September, 2013 and no longer includes the concept of a “best estimate range”. Instead, the revised standard now requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary’s professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary’s estimate of future experience, the actuary’s observation of the estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period.

In our opinion, the economic assumptions recommended in this report have been developed in accordance with ASOP No. 27. The following table shows our recommendations followed by detailed discussions of each assumption.



Item	Current	Proposed
Price Inflation	3.00%	2.75%
Real Rate of Return*	<u>4.75</u>	<u>4.75</u>
Investment Return	7.75%	7.50%
Price Inflation	3.00%	2.75%
Real Wage Growth	<u>0.25</u>	<u>0.25</u>
Wage Inflation	3.25%	3.00%
Payroll Growth	3.25%	3.00%

* net of investment expenses.



Section II – Economic Assumptions

Price Inflation

Background

As can be seen from the table on the previous page, assumed price inflation is used as the basis for both the investment return assumption and the wage inflation assumption. These latter two assumptions will be discussed in detail in the following sections.

It is important that the price inflation assumption be consistently applied throughout the economic assumptions utilized in an actuarial valuation. This is called for in ASOP No. 27 and is also required to meet the parameters for determining pension liabilities and expense under Governmental Accounting Standards Board (GASB) Statements No. 67 and 68.

The long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that the investor demands a more or less level “real return” – the excess of actual investment return over price inflation. If inflation rates are expected to be high, investment return rates are also expected to be high, while low inflation rates are expected to result in lower expected investment returns, at least in the long run.

The current price inflation assumption is 3.00% per year.

Past Experience

The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The table below provides historical annualized rates and annual standard deviation of the CPI-U over periods ending June 30th.

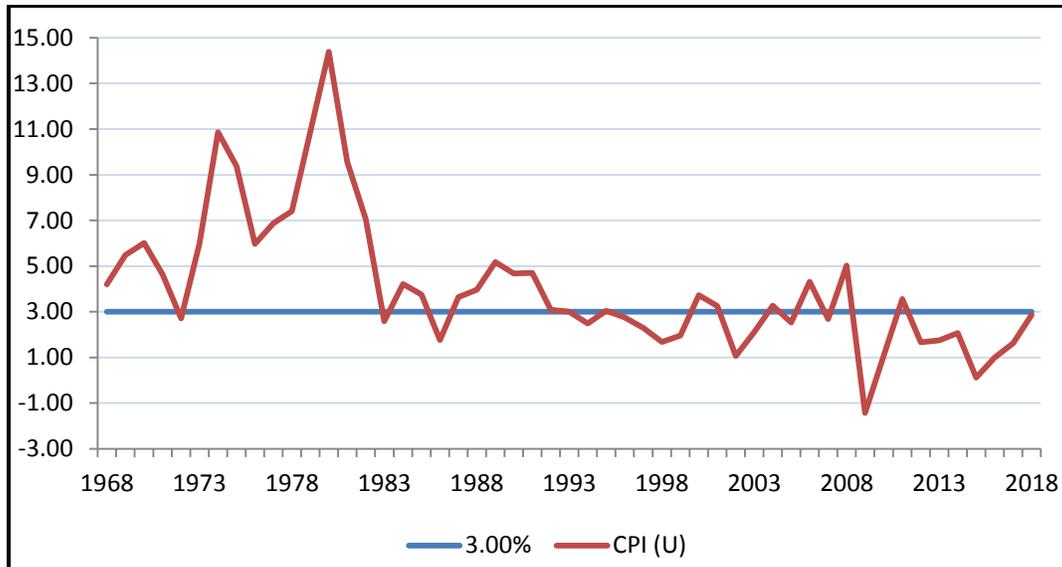
Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2018	92	2.91%	4.08%
1958 – 2018	60	3.68	2.88
1968 – 2018	50	4.04	2.99
1978 – 2018	40	3.44	2.84
1988 – 2018	30	2.56	1.46
1998 – 2018	20	2.20	1.49
2008 - 2018	10	1.42	1.39



Section II – Economic Assumptions

The following graph illustrates the historical levels of price inflation measured as of June 30th of each of the last 50 years and compared to the current 3.00% annual rate currently assumed.

Annual Rate of CPI (U) Increases



Over the last 50 years, the average annual rate of increase in the CPI-U has been below 4.00%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. The volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Federal Reserve since the early 1980's to stabilize price inflation.

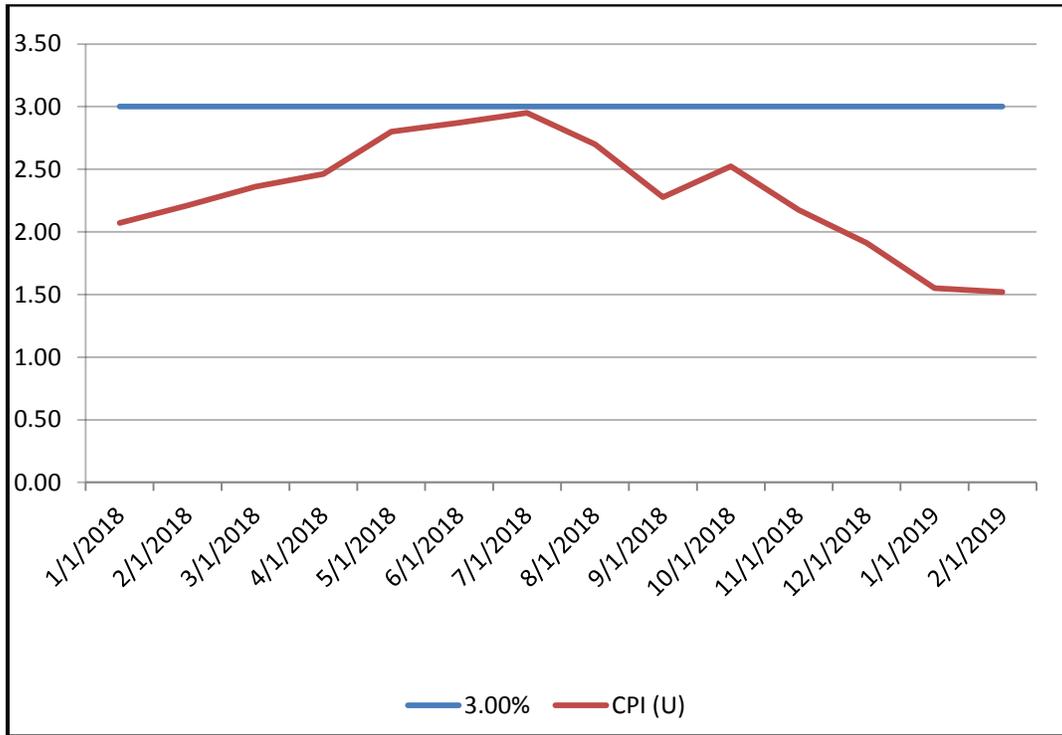
Forecasts

Based upon information contained in the "Survey of Professional Forecasters" for the fourth quarter of 2018 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.21%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for rates of inflation lower than our current assumption of 3.00% for the near term future.

Interestingly, the most recent inflation data, in the graph on the following page, shows an acceleration in the rate which is approaching the current assumption of 3.00%. This recent surge in the inflation rate supports the Federal Reserve forecast of multiple increases in the federal funds this year.



Month over Month Annual Inflation Rate
January 2018 through February 2019



Social Security Administration

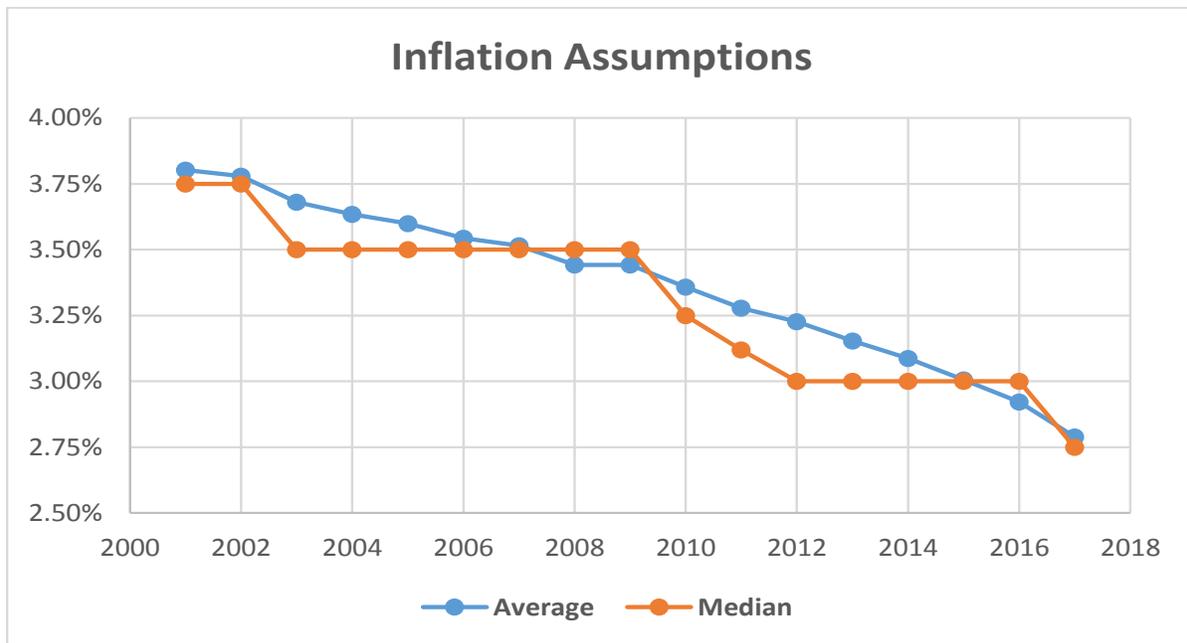
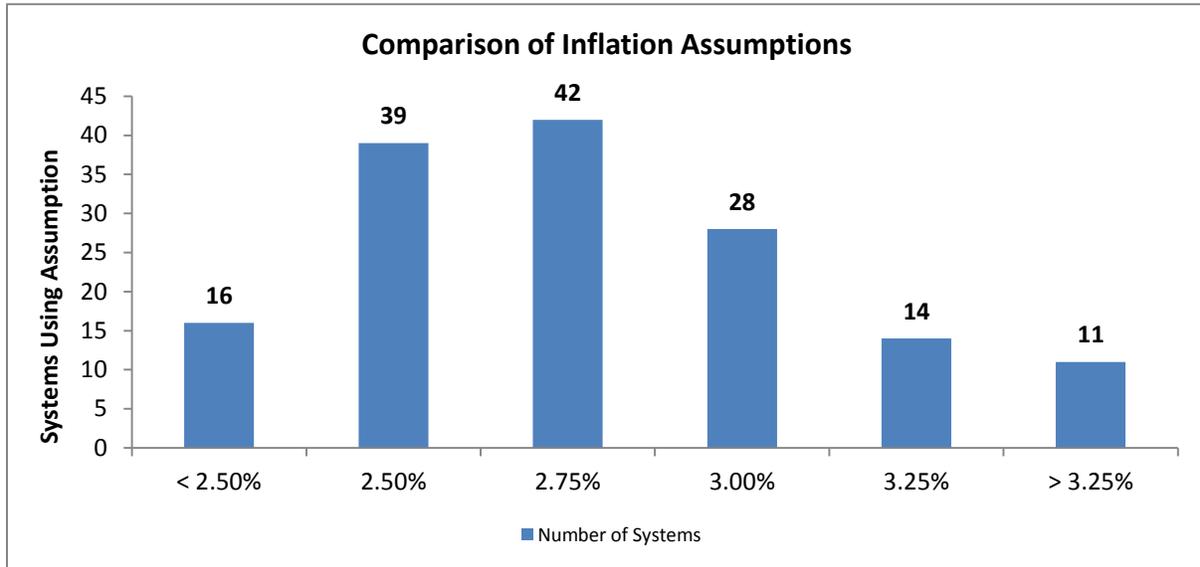
Although many economists forecast lower inflation than the assumption used by most retirement plans, they are generally looking at a shorter time horizon than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the 2018 annual report, the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.60%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 2.00% to 3.20%.



Section II – Economic Assumptions

Peer Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. The following chart and graph shows the inflation rate assumptions of 150 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from actuarial valuation reported in FYE 2017.





Section II – Economic Assumptions

Recommendation

It is difficult to predict inflation accurately. Inflation's short-term volatility is illustrated by comparing its average rate over the last 10 and 50 years. Although the 10-year average of 1.42% is lower than the System's assumed rate of 3.00%, the longer 50-year averages of 4.04% is somewhat higher than PERS' current rate. The reasonableness of PERS' assumption is, therefore, dependent upon the emphasis one assigns to the short and long-terms.

Current economic forecasts suggest lower inflation but are generally looking at a shorter time period than appropriate for our purposes. We consider the range included in the Social Security Administration of 2.00% to 3.20% to be reasonable and recommend lowering the inflation assumption for PERS from 3.00% to 2.75%.

Price Inflation Assumption	
Current	3.00%
Recommended	2.75%



Section II – Economic Assumptions

Investment Return

Background

The assumed investment return is one of the most significant assumptions in the annual actuarial valuation process as it is used to discount the expected benefit payments for all active, inactive and retired members. Minor changes in this assumption can have a major impact on valuation results. The investment return assumption should reflect the asset allocation target for the funds set by the Board of Trustees.

The current assumption is 7.75%, consisting of a price inflation assumption of 3.00% and a real rate of return assumption of 4.75%.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider very long periods of time. For example, a newly-hired employee who is 25 years old may work for 35 years, to age 60, and live another 30 years, to age 90 (or longer). The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 30 years. During the entire 65-year period, the system is investing assets related to the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received after the employee retires. In addition, in an open, ongoing system like PERS, the stream of benefit payments is continually increasing as new hires replace current members who leave covered employment due to death, termination of employment, and retirement. This difference in the time horizon used by actuaries and investment consultants is frequently a source of debate and confusion when setting economic assumptions.

Past Experience

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, the asset allocation can also impact the investment returns so comparing results over long periods when different asset allocations were in place may not be meaningful.



Section II – Economic Assumptions

The assets for PERS are valued using a widely accepted asset-smoothing methodology that fully recognizes the expected investment income and also recognizes 20% of each year’s investment gain or loss (the difference between actual and expected investment income). The recent experience over the last five years is shown in the table below.

Year Ending 6/30	Actuarial Value	Market Value
2014	13.88	18.31
2015	11.86	3.38
2016	7.10	0.53
2017	8.91	14.51
2018	8.74	9.17
Average	10.10%	9.18%

While important to review and analyze, historical returns over such a short time period are not credible for the purpose of setting the long-term assumed future rate of return.

Future Expectation Analysis

ASOP 27 provides that the actuary may rely on outside experts in setting economic assumptions. PERS utilizes the services of Callan to assist them in developing investment strategies and providing capital market assumptions for the PERS portfolio. As part of their duties, Callan periodically performs asset-liability studies, along with comprehensive reviews of the expected return of the various asset classes in which the PERS portfolio is invested. We believe it is appropriate to consider the results of Callan’s work as one factor in assessing expected future returns.

We also recognize that there can be differences of opinion among investment professionals regarding future return expectations. Horizon Actuarial Services prepares an annual study in which they survey various investment advisors (35 were included in the 2018 study with a 10-year horizon) and provide ranges of results as well as averages. This information provides an additional perspective on what a broad group of investment experts anticipate for future investment returns.

Our forward-looking analysis used the real rates of return in Callan’s capital market assumptions for 2019-2028 and PERS’ target asset allocation. Using statistical projections that assume investment returns approximately follow a lognormal distribution with no correlation between years, produces an expected range of real rates of return over a 50 year time horizon. Looking at one year’s results produces a mean real return of 5.67%, but also has a high standard deviation or



Section II – Economic Assumptions

measurement of volatility. By expanding the time horizon, the real return does not change, but the volatility declines significantly. The table below provides a summary of results.

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	5.67%	14.71%	-16.67%	-4.68%	4.66%	14.91%	31.45%
5	4.86%	6.50%	-5.48%	0.38%	4.66%	9.13%	15.89%
10	4.76%	4.59%	-2.62%	1.61%	4.66%	7.80%	12.48%
20	4.71%	3.24%	-0.54%	2.50%	4.66%	6.87%	10.13%
30	4.69%	2.65%	0.40%	2.89%	4.66%	6.46%	9.11%
40	4.69%	2.29%	0.96%	3.13%	4.66%	6.22%	8.50%
50	4.68%	2.05%	1.34%	3.29%	4.66%	6.05%	8.09%

The percentile results are the percentages of random returns over the time span shown that are expected to be less than the amount indicated. For example, for the 10 year time span, 5% of the resulting real rates of return will be below -2.62% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50 year time span, the results indicate there will be a 25% chance that real returns will be below 3.29% and a 25% chance they will be above 6.05%. In other words, there is a 50% chance the real returns will be between 3.29% and 6.05%.

The results of our real return forward looking analysis are very similar to the real rate of return analysis as developed by Callan in their first quarter of 2019 analysis, where they developed a real return expectation of 4.75% over a 10-year horizon.

For a broader view of expected returns, we also reviewed the 2018 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions. The Horizon survey includes both 10-year horizon and 20-year horizon capital market assumptions. We applied the same statistical analysis to these survey results as we did the capital market assumption of PERS investment advisor with the following real return results for the 20-year horizon:

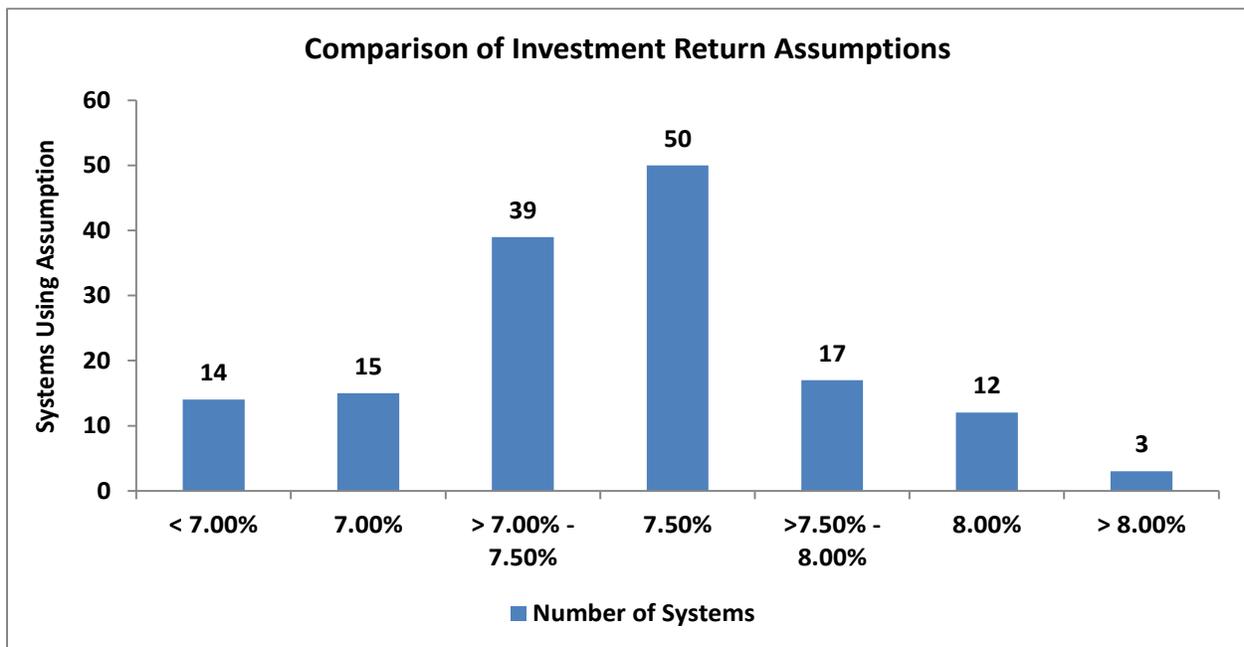


Section II – Economic Assumptions

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	5.91%	13.52%	-14.77%	-3.58%	5.06%	14.46%	29.50%
5	5.23%	5.99%	-4.32%	1.10%	5.06%	9.17%	15.36%
10	5.14%	4.23%	-1.67%	2.25%	5.06%	7.95%	12.24%
20	5.10%	2.99%	0.26%	3.06%	5.06%	7.09%	10.09%
30	5.09%	2.44%	1.12%	3.43%	5.06%	6.72%	9.15%
40	5.08%	2.11%	1.64%	3.64%	5.06%	6.49%	8.59%
50	5.07%	1.89%	2.00%	3.79%	5.06%	6.34%	8.21%

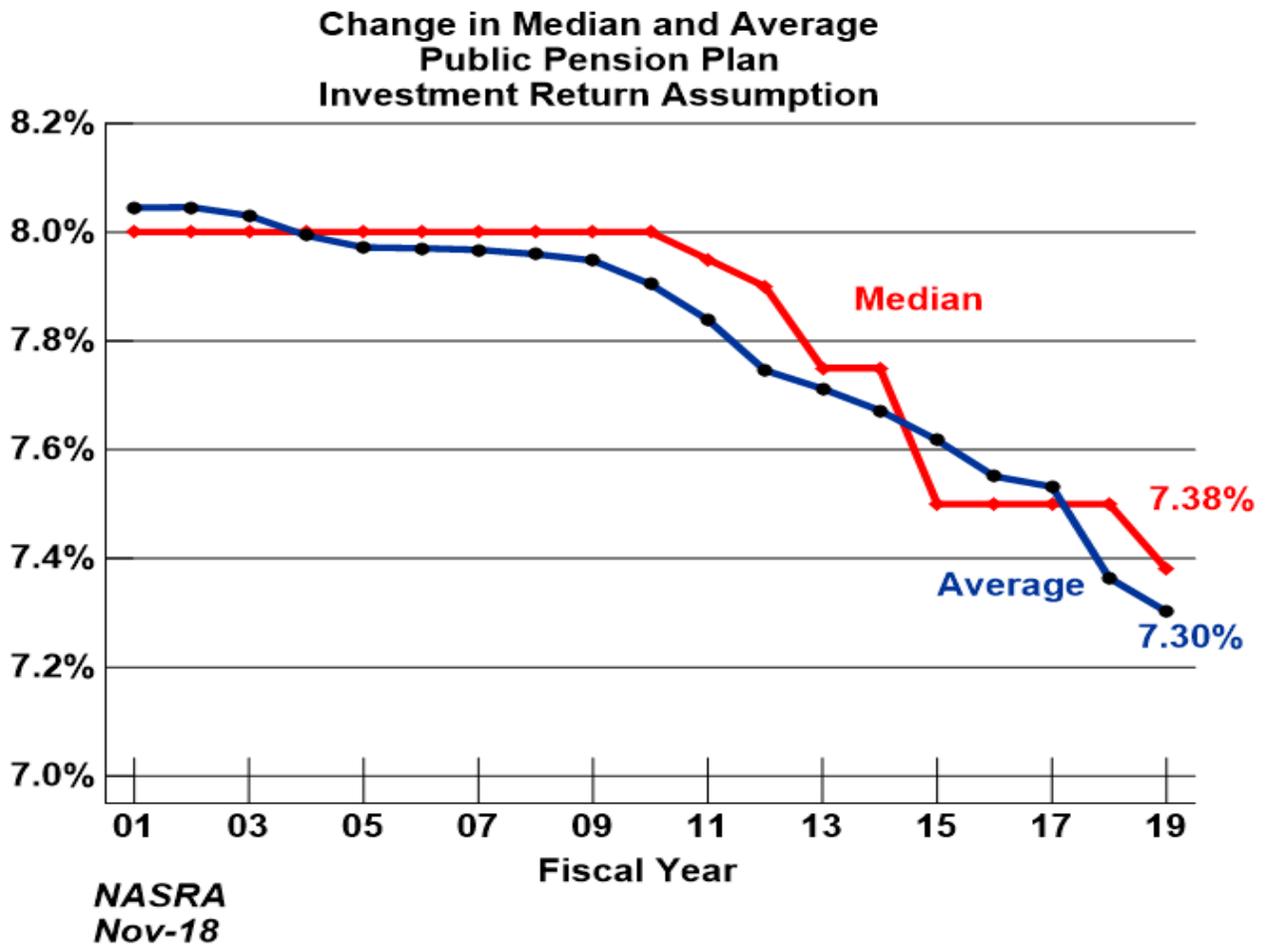
Peer Comparison

The following chart shows the nominal investment return assumptions of 150 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from FYE 2017 reporting.





The following chart shows the changes in expected investment return assumption from the NASRA public plan survey over the last 19 years from 2001.





Section II – Economic Assumptions

Recommendation

By actuarial standards, we are required to maintain a long-term perspective in setting all assumptions, including the investment return assumption. Therefore, we believe we must be careful not to let recent experience or the short-term expectations impact our judgment regarding the appropriateness of the current assumption over the long term.

Based on our analysis of Callan’s capital market assumptions and the Horizon Survey capital market assumptions, we are recommending no change to the real return assumption of 4.75%. Based on our recommended inflation assumption of 2.75%, we are recommending a 7.50% expected long term nominal rate of return assumption.

Investment Return Assumption		
	Current	Recommended
Real Rate of Return*	4.75%	4.75%
Inflation	<u>3.00</u>	<u>2.75</u>
Net Investment Return	7.75%	7.50%

* net of investment expenses.



Section II – Economic Assumptions

Wage Inflation

Background

The wage inflation assumption is composed of the price inflation assumption and an assumption for the real rate of wage increases. The salary increase assumption combines the wage inflation assumption with an assumption for promotion and longevity, often called merit increases. Merit assumptions are generally age and or service related, and will be dealt with in the demographic assumption section of the report. The excess of wage growth over price inflation is also considered the increase in productivity that labor provides.

The current wage inflation assumption is 3.25%, and is composed of a 3.00% rate of inflation assumption and a 0.25% real rate of wage inflation.

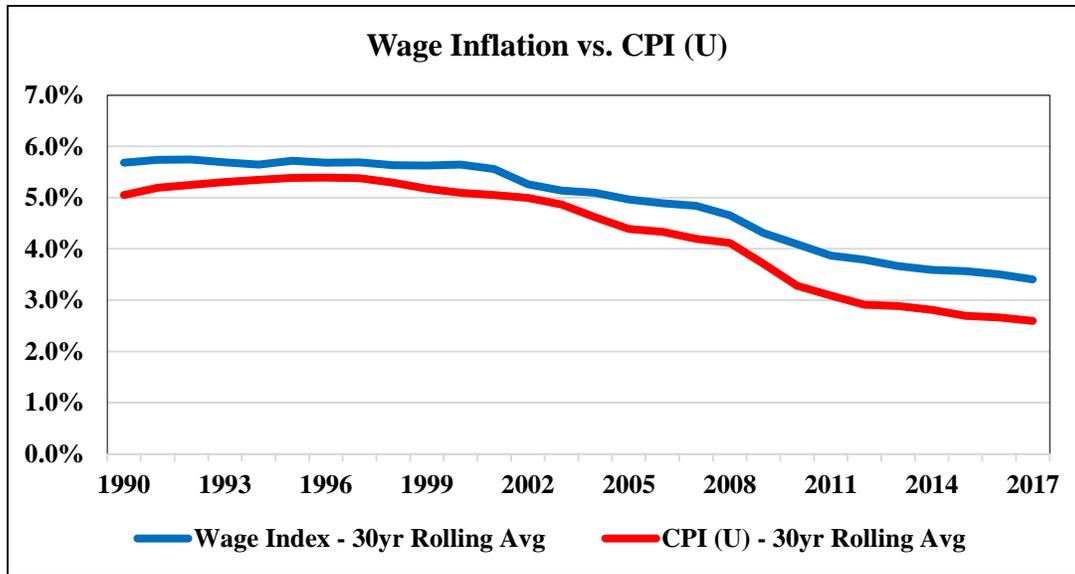
Past Experience

The Social Security Administration publishes data on wage growth in the United States (see Appendix C). While this is the most comprehensive data available, it is based on all wage earners in the country so it can be influenced by the mix of jobs as well as by changes in certain sectors of the workforce that may not be seen by all segments.

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Currently, this wage data is only available through calendar year 2017. We remove the rate of price inflation for each year from the data to result in the historical real rate of wage inflation.

Period	Wage Inflation	Price Inflation	Real Wage Growth
2007-2017	2.22%	1.63%	0.59%
1997-2017	3.08%	2.14%	0.94%
1987-2017	3.41%	2.60%	0.81%
1977-2017	4.18%	3.55%	0.63%
1967-2017	4.64%	4.07%	0.57%

Thus over the last 50 years, annual real wage growth has averaged 0.57%.



Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In June of 2018, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.8%, 1.2% higher than the Social Security intermediate inflation assumption of 2.6% per year. The range of the assumed real wage inflation in the 2018 Trustees report was 0.58% to 1.82% per year.

Recommendation

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. It is questionable whether public sector employees can match the productivity rates of the private sector. **Therefore, we recommend a 0.25% reduction in total wage inflation growth from 3.25% to 3.00%, in conjunction with the recommendation of lowering the price inflation assumption by 0.25%.**

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	3.00%	2.75%
Real Wage Growth	<u>0.25%</u>	<u>0.25%</u>
Wage Inflation	3.25%	3.00%



Section II – Economic Assumptions

Payroll Growth

Background

The assumed future rate of payroll growth increase in the total payroll of PERS’ active members is an assumption used in the level percentage of payroll amortization method that affects the calculation of the amortization period required to fully amortize the unfunded actuarial accrued liability and the actuarially determined employer contribution. The total payroll growth is impacted by individual member’s increases and population growth. The current assumption is 3.25% per year which is comprised of the inflation assumption of 3.00% and real wage growth of 0.25%.

Past Experience

The following table shows the actual PERS’ payroll growth experienced over different time periods.

Period	Number of Years	Annual Payroll Growth	Annual Active Membership Growth	Net Payroll Growth
1998 – 2018	20	2.80%	0.18%	2.62%
2003 – 2018	15	2.04%	-0.18%	2.22%
2008 – 2018	10	0.79%	-0.95%	1.76%
2013 – 2018	5	0.60%	-1.41%	2.04%

Recommendation

The table above shows annual payroll growth has been much lower than assumed and the active membership growth has declined fairly significantly since the financial crisis of 2008/2009. The net growth has been averaging less than the current assumption of 3.25%. **Therefore, we are recommending a payroll growth assumption reduction from 3.25% to 3.00%, which is equal to the recommended wage inflation assumption.**



ACTUARIAL COST METHOD

There are various actuarial cost methods, each of which has different characteristics, advantages and disadvantages. However, Governmental Accounting Standard Board (GASB) Statement Numbers 67 and 68 require that the Entry Age Normal cost method be used for financial reporting. Most systems do not want to use a different actuarial cost method for funding and financial reporting. In addition, the Entry Age Normal method has been the most common funding method for public systems for many years. This is the cost method currently used by PERS.

The rationale of the Entry Age Normal (EAN) cost method is that the cost of each member's benefit is determined to be a level percentage of his salary from date of hire to the end of his employment with the employer. This level percentage multiplied by the member's annual salary is referred to as the normal cost and is that portion of the total cost of the employee's benefit that is allocated to the current year. The portion of the present value of future benefits allocated to the future is determined by multiplying this percentage times the present value of the member's assumed earnings for all future years including the current year. The Entry Age Normal actuarial accrued liability is then developed by subtracting from the present value of future benefits that portion of costs allocated to the future. To determine the unfunded actuarial accrued liability, the value of plan assets is subtracted from the Entry Age Normal actuarial accrued liability. The current year's cost to amortize the unfunded actuarial accrued liability is developed by applying an amortization factor.

It is to be expected that future events will not occur exactly as anticipated by the actuarial assumptions in each year. Actuarial gains/losses from experience under this actuarial cost method can be directly calculated and are reflected as a decrease/increase in the unfunded actuarial accrued liability. Consequently, the gain/loss results in a decrease/increase in the amortization payment, and therefore the contribution rate.

Considering that the Entry Age Normal cost method is the most commonly used cost method by public plans, that it develops a normal cost rate that tends to be stable and less volatile, and is the required cost method under calculations required by GASB Numbers 67 and 68, **we recommend the Entry Age Normal actuarial cost method be retained for PERS.**



ACTUARIAL VALUE OF ASSETS

In preparing an actuarial valuation, the actuary must assign a value to the assets of the fund. An adjusted market value is often used to smooth out the volatility that is reflected in the market value of assets. This is because most employers would rather have annual costs remain relatively smooth, as a percentage of payroll or in actual dollars, as opposed to a cost pattern that is extremely volatile.

The actuary does not have complete freedom in assigning this value. The Actuarial Standards Board also has basic principles regarding the calculation of a smoothed asset value, Actuarial Standard of Practice No. 44 (ASOP 44), *Selection and Use of Asset Valuation Methods for Pension Valuations*.

ASOP 44 provides that the asset valuation method should bear a reasonable relationship to the market value. Furthermore, the asset valuation method should be likely to satisfy both of the following:

- Produce values within a reasonable range around market value, AND
- Recognize differences from market value in a reasonable amount of time.

In lieu of both of the above, the standard will be met if either of the following requirements is satisfied:

- There is a sufficiently narrow range around the market value, OR
- The method recognizes differences from market value in a sufficiently short period.

These rules or principles prevent the asset valuation methodology from being used to manipulate annual funding patterns. No matter what asset valuation method is used, it is important to note that, like a cost method or actuarial assumptions, the asset valuation method does not affect the true cost of the plan; it only impacts the incidence of cost.

Currently, the actuarial value of assets recognizes a portion of the difference between the market value of assets and the expected market value of assets, based on the assumed valuation rate of return. The amount recognized each year is 20% of the difference between market value and expected market value. **We recommend no change in this methodology.**



AMORTIZATION OF THE UNFUNDED ACTUARIAL ACCRUED LIABILITY

The actuarial accrued liability is the portion of the actuarial present value of future benefits that are not included in future normal costs. Thus, it represents the liability that, in theory, should have been funded through normal costs for past service. Unfunded actuarial accrued liability (UAAL) exists when the actuarial accrued liability exceeds the actuarial value of plan assets. These deficiencies can result from:

- (i) plan improvements that have not been completely paid for,
- (ii) experience that is less favorable than expected,
- (iii) assumption changes that increase liabilities, or
- (iv) contributions that are less than the actuarial contribution rate.

There are a variety of different methods that can be used to amortize the UAAL. Each method results in a different payment stream and, therefore, has cost implications. For each methodology, there are three characteristics:

- The period over which the UAAL is amortized,
- The rate at which the amortization payment increases, and
- The number of components of UAAL (separate amortization bases).

Amortization Period: The amortization period can be either closed or open. If it is a closed amortization period, the number of years remaining in the amortization period declines by one in each future valuation. Alternatively, if the amortization period is an open or rolling period, the amortization period does not decline but is reset to the same number each years. This approach essentially “refinances” the System’s debt (UAAL) every year.

Amortization Payment: The level dollar amortization method is similar to the method in which a homeowner pays off a mortgage. The liability, once calculated, is financed by a constant fixed dollar amount, based on the amortization period until the liability is extinguished. This results in the liability steadily decreasing while the payments, though remaining level in dollar terms, in all probability decrease as a percentage of payroll. (Even if a plan sponsor’s population is not growing, inflationary salary increases will usually be sufficient to increase the aggregate covered payroll).

The rationale behind the level percentage of payroll amortization method is that since normal costs are calculated to be a constant percentage of pay, the unfunded actuarial accrued liability should be paid off in the same manner. When this method of amortizing the unfunded actuarial accrued liability is adopted, the initial amortization payments are lower than they would be under a level dollar amortization payment method, but the payments increase at a fixed rate each year so that



Section III – Actuarial Methods

ultimately the annual payment far exceeds the level dollar payment. The expectation is that total payroll will increase at the same rate so that the amortization payments will remain constant, as a percentage of payroll. In the initial years, the level percentage of payroll amortization payment is often less than the interest accruing on the unfunded actuarial accrued liability meaning that even if there are no experience losses, the dollar amount of the unfunded actuarial accrued liability will grow (called negative amortization). This is particularly true if the plan sponsor is paying off the unfunded actuarial accrued liability over a long period, such as 20 or more years.

Amortization Bases: The UAAL can be amortized either as one single amount or as components or “layers”, each with a separate amortization base, payment and period. If the UAAL is amortized as one amount, the UAAL is recalculated each year in the valuation and experience gains/losses or other changes in the UAAL are folded into the single UAAL amortization base. The amortization payment is then the total UAAL divided by an amortization factor for the applicable amortization period.

If separate amortization bases are maintained, the UAAL is composed of multiple amortization bases, each with its own payment schedule and remaining amortization period. In each valuation, the unexpected change in the UAAL is established as a new amortization base over the appropriate amortization period beginning on that valuation date. The UAAL is then the sum of all of the outstanding amortization bases on the valuation date and the UAAL payment is the sum of all of the amortization payments on the existing amortization bases. This approach provides transparency in that the current UAAL is paid off over a fixed period of time and the remaining components of the UAAL are clearly identified. Adjustments to the UAAL in future years are also separately identified in each future year. One downside of this approach is that it can create some discontinuities in contribution rates when UAAL layers/components are fully paid off. If this occurs, it likely would be far in the future, with adequate time to address any adjustments needed.

Recommendation

In the current PERS Board funding policy, an actuarially determined employer contribution (ADEC) is calculated during each annual valuation and the ADEC is compared to the Fixed Contribution Rate adopted by the Board as one of its Signal Light metrics. The methodology in calculating the ADEC is as follows:

- Amortization Period – Closed period with maximum period of 25 years for new bases
- Amortization Payment – Level Percentage of Payroll
- Amortization Bases – Separate bases for all experience gains and losses, assumption changes or benefit changes

We recommend no changes in these methods.



Section IV – Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for Mississippi PERS. They are:

- Rates of Withdrawal
- Pre-retirement Mortality
- Rates of Disability Retirement
- Rates of Service Retirement
- Post-retirement Mortality
- Rates of Merit Salary Increase

Actuarial Standard of Practice (ASOP) No. 35, “*Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*” provides guidance to actuaries in selecting demographic assumptions for measuring obligations under defined benefit plans. In our opinion, the demographic assumptions recommended in this report have been developed in accordance with ASOP No. 35.

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2014 through June 30, 2018) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

Detailed tabulations by age, service and/or gender are performed over the entire study period. These tabulations look at all active and retired members during the period as well as separately annotating those who experience a demographic event, also referred to as a decrement. In addition the tabulation of all members together with the current assumptions permits the calculation of the number of expected decrements during the study period.

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, gender, or service does not follow the expected pattern, new assumptions are recommended. Recommended changes usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior. In addition non-recurring events, such as early retirement windows, need to be taken into account in determining the weight to give to recent experience.

The remainder of this section presents the results of the demographic study. We have prepared tables that show a comparison of the actual and expected decrements and the overall ratio of actual to expected results (A/E Ratios) under the current assumptions. If a change is being proposed, the revised A/E Ratios are shown as well. Salary adjustments, other than the economic assumption for wage inflation discussed in the previous section, are treated as demographic assumptions.



PUBLIC EMPLOYEES’ RETIREMENT SYSTEM

RATES OF WITHDRAWAL

**COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS
FROM ACTIVE SERVICE**

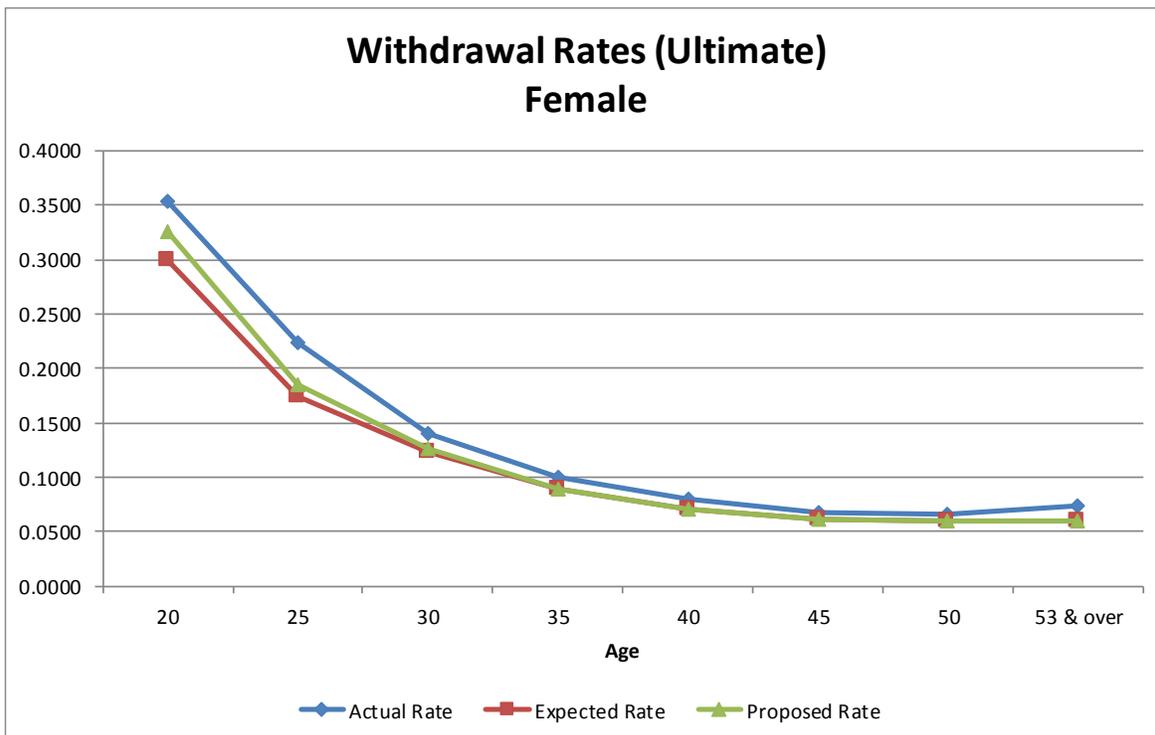
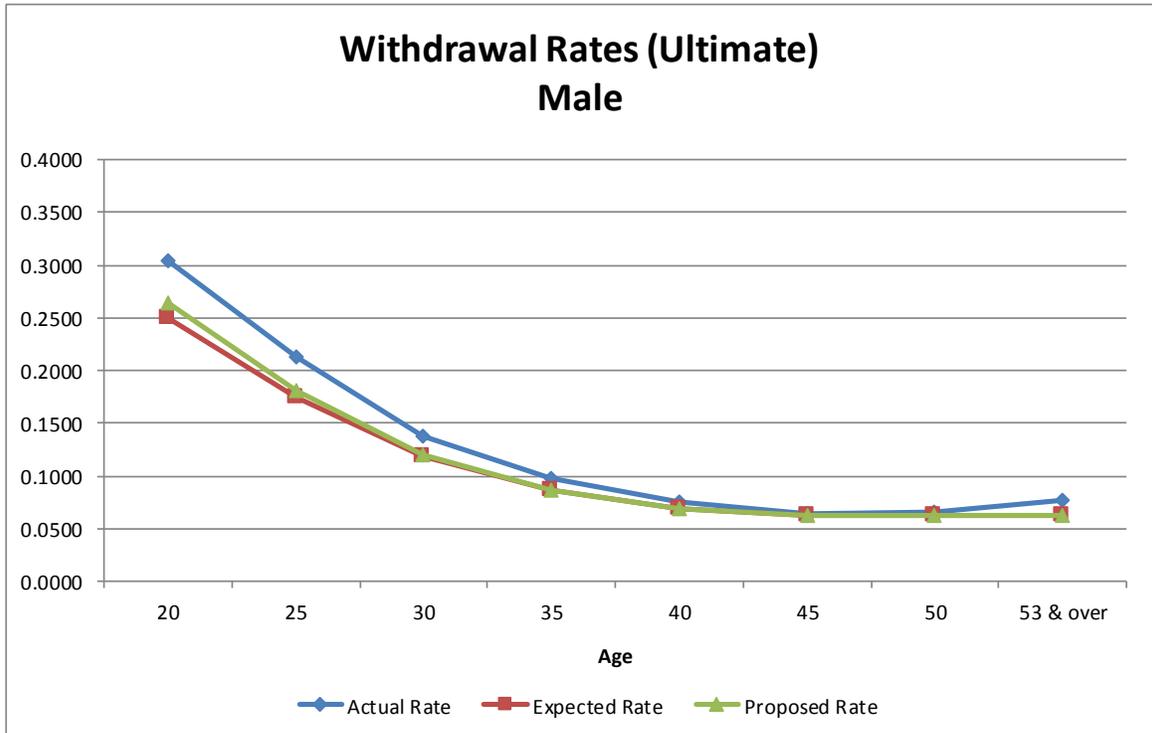
CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with more than 2 years of service					
20	148	122	1.213	116	98	1.184
25	1,856	1,528	1.215	2,985	2,317	1.288
30	2,546	2,172	1.172	4,592	4,007	1.146
35	2,209	1,955	1.130	4,230	3,746	1.129
40	1,803	1,654	1.090	3,582	3,202	1.119
45	1,690	1,665	1.015	3,366	3,073	1.095
50	1,476	1,391	1.061	2,848	2,563	1.111
53 & over	2,798	2,272	1.232	4,584	3,742	1.225
TOTAL	14,526	12,759	1.138	26,303	22,748	1.156

The following graphs show a comparison of the present, actual and proposed rates of withdrawal for withdrawals with more than 2 years of service.



PUBLIC EMPLOYEES’ RETIREMENT SYSTEM

**RATES OF WITHDRAWAL FOR ACTIVE MEMBERS
WITH MORE THAN 2 YEARS OF SERVICE**





Section IV – Demographic Assumptions

The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service which will occur as a result of resignation or dismissal. The results of our study indicate that for members with more than 2 years of service, the actual number of withdrawals was more at all age groups than expected over the four year period, especially at the youngest ages. Therefore, we recommend increasing the rates for both males and females at the youngest ages to partially reflect the higher numbers of terminations experience over the last four years.

Furthermore, the actual rates of withdrawal during the select period (first 2 years of employment) indicate that both male and female members are withdrawing at a slightly greater rate during the select period than currently expected. We recommend increasing the rate from 32.50% to 33.50% during the first year of employment and from 23.50% to 24.00% during the second year of employment.

The following table shows a comparison between the present withdrawal rates and the proposed withdrawal rates for members with more than 2 years of service.

COMPARATIVE RATES OF WITHDRAWAL

AGE	RATES OF WITHDRAWAL			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	25.00%	26.50%	30.00%	32.50%
25	18.00	18.50	18.25	18.50
30	11.50	11.75	12.00	12.00
35	8.50	8.50	8.75	8.75
40	6.75	6.75	7.00	7.00
45	6.25	6.25	6.00	6.00
50	6.25	6.25	6.00	6.00
55	6.25	6.25	6.00	6.00
60	6.25	6.25	6.00	6.00
65	6.25	6.25	6.00	6.00
70	6.25	6.25	6.00	6.00
74	6.25	6.25	6.00	6.00



**COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS
FROM ACTIVE SERVICE BASED ON PROPOSED RATES**

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	Withdrawals with more than 2 years of service					
20	148	129	1.147	116	107	1.084
25	1,856	1,580	1.175	2,985	2,475	1.206
30	2,546	2,217	1.148	4,592	4,147	1.107
35	2,209	1,961	1.126	4,230	3,746	1.129
40	1,803	1,654	1.090	3,582	3,202	1.119
45	1,690	1,665	1.015	3,366	3,073	1.095
50	1,476	1,391	1.061	2,848	2,563	1.111
53 & over	2,798	2,272	1.232	4,584	3,742	1.225
TOTAL	14,526	12,869	1.129	26,303	23,055	1.141

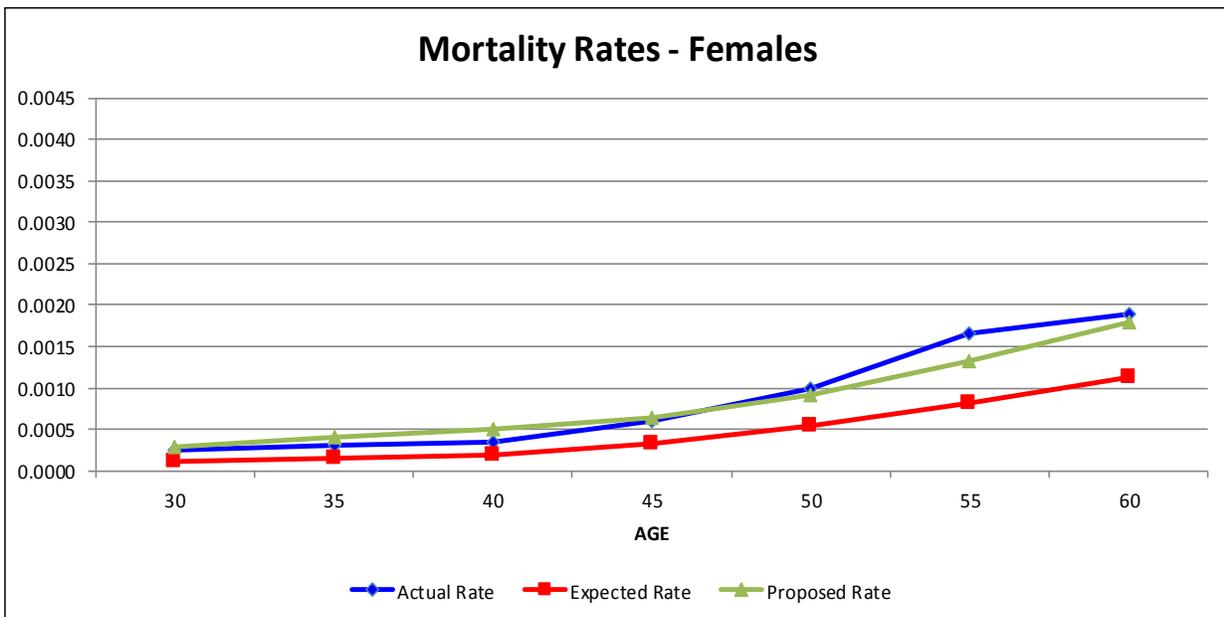
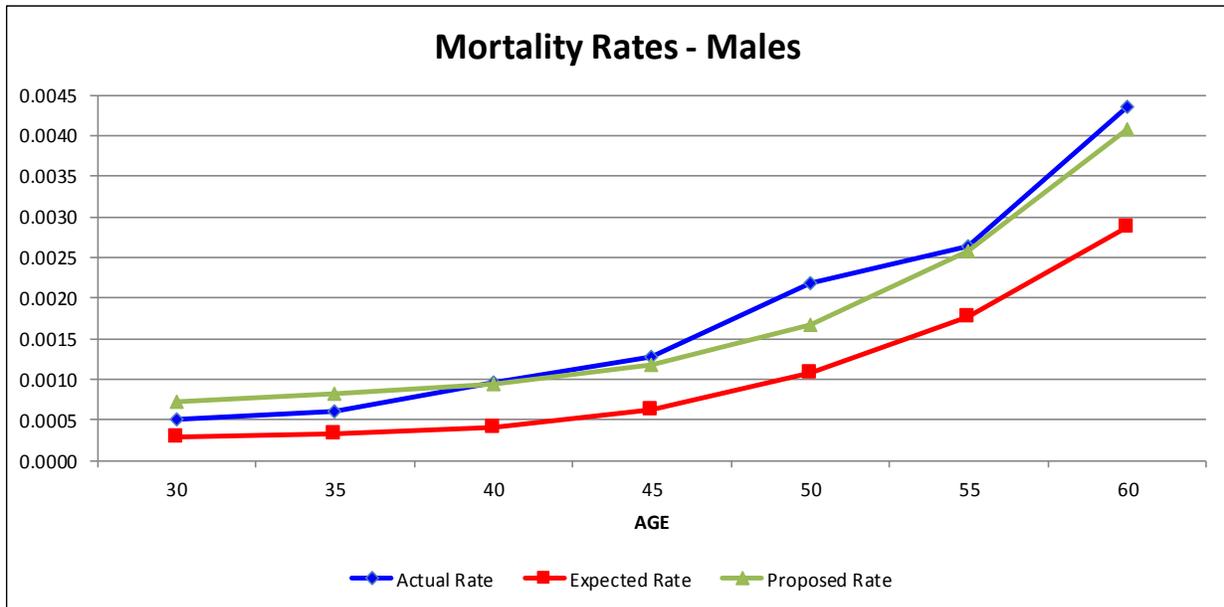


PUBLIC EMPLOYEES’ RETIREMENT SYSTEM
RATES OF PRE-RETIREMENT MORTALITY

COMPARISON OF ACTUAL AND EXPECTED PRE-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
30	12	7	1.714	10	5	2.000
35	16	9	1.778	15	7	2.143
40	26	11	2.364	18	10	1.800
45	38	19	2.000	34	18	1.889
50	62	30	2.067	52	29	1.793
55	73	49	1.490	87	43	2.023
60	106	70	1.514	80	48	1.667
63 & over	151	115	1.313	46	44	1.045
TOTAL	484	310	1.561	342	204	1.676

The following graphs show a comparison of the present, actual, and proposed rates of pre-retirement mortality.



We are recommending a change in the pre-retirement mortality assumption to a new mortality table developed by the Society of Actuaries using public plan mortality experience. The new mortality table will be 105% of the PubS.H-2010(B) Employee table for males and 70% of the PubS.H-2010(B) Employee table for females. Mortality rates will be projected generationally using the MP-2018 projection scale to account for future improvements in life expectancy.

The following table shows a comparison between the present pre-retirement mortality rates and the proposed rates. The proposed rates allow for some improved mortality in the future.



COMPARATIVE RATES OF PRE-RETIREMENT MORTALITY

AGE	RATES OF DEATH			
	MALES		FEMALES	
	Present	Proposed*	Present	Proposed*
20	0.0256%	0.0483%	0.0080%	0.0126%
25	0.0306	0.0567	0.0085	0.0189
30	0.0286	0.0630	0.0107	0.0259
35	0.0330	0.0714	0.0141	0.0350
40	0.0397	0.0893	0.0195	0.0483
45	0.0615	0.1218	0.0324	0.0665
50	0.1065	0.1764	0.0543	0.0917
55	0.1761	0.2594	0.0811	0.1274
60	0.2868	0.3980	0.1137	0.1757
65	0.4862	0.6353	0.1694	0.2429

*Base rates

**COMPARISON OF ACTUAL AND EXPECTED PRE-RETIREMENT DEATHS
BASED ON PROPOSED RATES**

CENTRAL AGE OF GROUP	NUMBER OF DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
30	12	17	0.706	10	12	0.833
35	16	22	0.727	15	20	0.750
40	26	25	1.040	18	26	0.692
45	38	35	1.086	34	36	0.944
50	62	47	1.319	52	48	1.083
55	73	72	1.014	87	69	1.261
60	106	99	1.071	80	75	1.067
63 & over	151	166	0.910	46	67	0.687
TOTAL	484	483	1.002	342	353	0.969



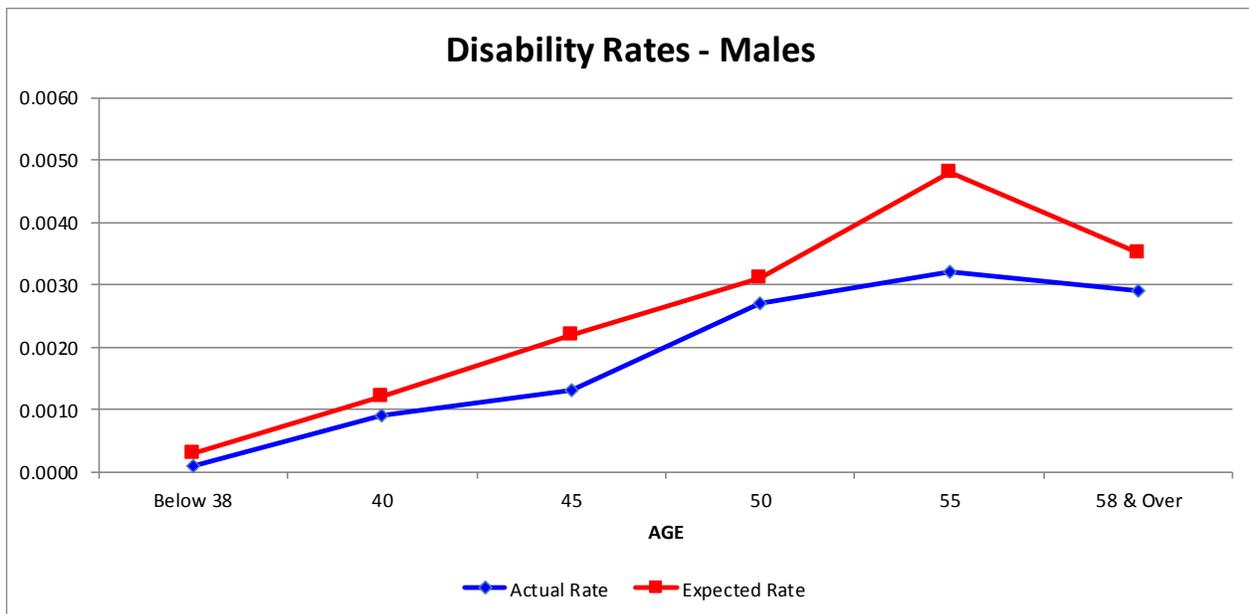
PUBLIC EMPLOYEES’ RETIREMENT SYSTEM

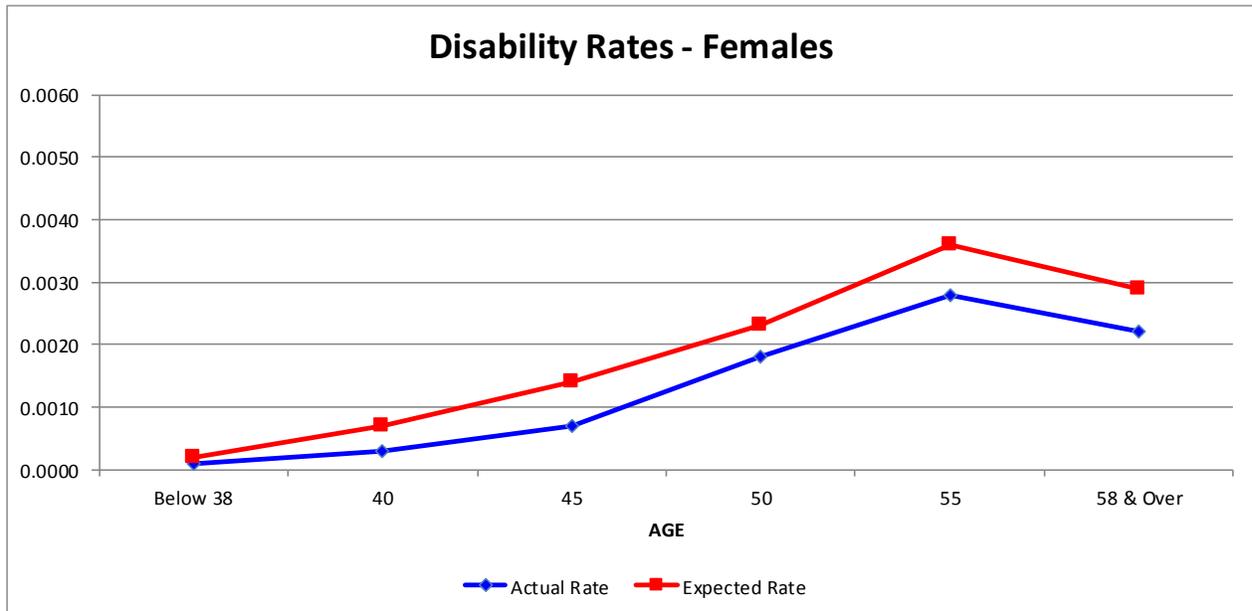
RATES OF DISABILITY RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 38	9	19	0.474	12	21	0.571
40	23	31	0.742	17	37	0.459
45	39	67	0.582	40	79	0.506
50	76	87	0.874	97	121	0.802
55	90	133	0.677	148	190	0.779
58 & over	132	157	0.841	144	190	0.758
TOTAL	369	494	0.747	458	638	0.718

The following graphs show a comparison of the present and actual rates of disability retirements.





As can be seen from the table on the previous page, the actual rates of disability retirement are less than expected for both males and females. The number of disabilities significantly declined for the last two years of this study period. In the previous experience study, the actual number of disability retirements was higher than this study. Since the disability rates were adjusted as a result of the last experience study, we recommend no change at this time and will wait until the next experience study to see if this pattern of fewer disability retirements continues.



PUBLIC EMPLOYEES’ RETIREMENT SYSTEM

RATES OF RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

Retirements with less than 25 years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
60	323	267	1.210	724	659	1.099
61	263	237	1.110	552	507	1.089
62	489	438	1.116	801	726	1.103
63	337	318	1.060	597	544	1.097
64	239	229	1.044	498	441	1.129
65	370	322	1.149	653	572	1.142
66	266	222	1.198	424	360	1.178
67	176	157	1.121	252	218	1.156
68	153	119	1.286	187	154	1.214
69	126	120	1.050	153	115	1.330
70	98	95	1.032	110	108	1.019
71	82	72	1.139	83	76	1.092
72	65	57	1.140	62	54	1.148
73	46	44	1.045	33	39	0.846
74	45	43	1.047	50	37	1.351
Subtotal	3,078	2,740	1.123	5,179	4,610	1.123
75 & Over	209	921	0.227	159	574	0.277
GRAND TOTAL	3,287	3,661	0.898	5,338	5,184	1.030



COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

Retirements with 25 or more years of service

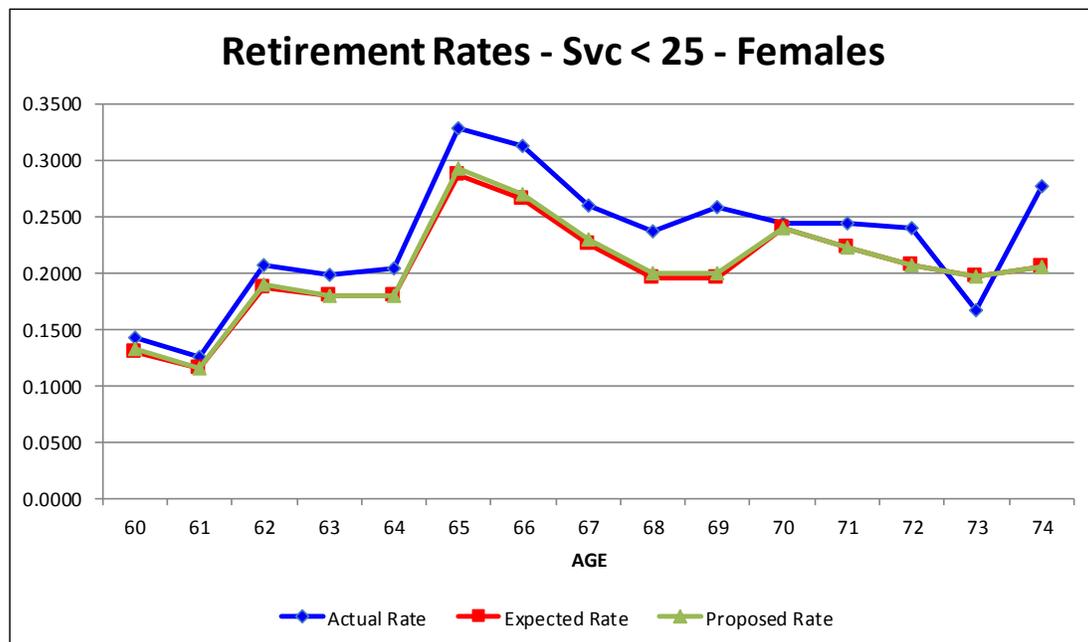
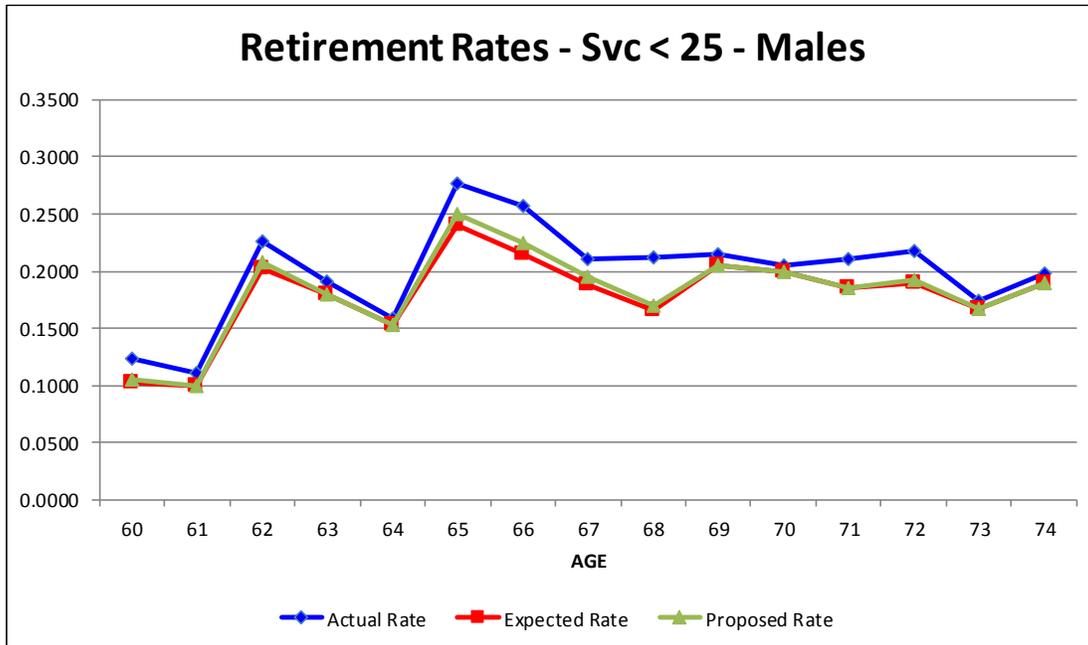
AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 48	191	156	1.224	160	124	1.290
48-51	498	373	1.335	725	578	1.254
52	177	147	1.204	255	220	1.159
53	172	134	1.284	324	273	1.187
54	196	167	1.174	315	285	1.105
55	182	180	1.011	371	348	1.066
56	209	191	1.094	397	338	1.175
57	182	165	1.103	415	360	1.153
58	177	146	1.212	377	354	1.065
59	162	152	1.066	414	401	1.032
60	187	186	1.005	391	396	0.987
61	180	191	0.942	433	420	1.031
62	242	274	0.883	531	554	0.958
63	182	186	0.978	330	353	0.935
64	135	144	0.938	280	286	0.979
65	137	145	0.945	323	313	1.032
66	135	120	1.125	191	177	1.079
67	75	72	1.042	98	106	0.925
68	77	71	1.085	76	71	1.070
69	51	51	1.000	65	61	1.066
70	47	38	1.237	56	43	1.302
71	34	26	1.308	42	40	1.050
72	18	24	0.750	29	23	1.261
73	21	19	1.105	19	17	1.118
74	20	19	1.053	16	14	1.143
Subtotal	3,687	3,377	1.092	6,633	6,155	1.078
75 & Over	89	324	0.275	59	241	0.245
GRAND TOTAL	3,776	3,701	1.020	6,692	6,396	1.046



Section IV – Demographic Assumptions

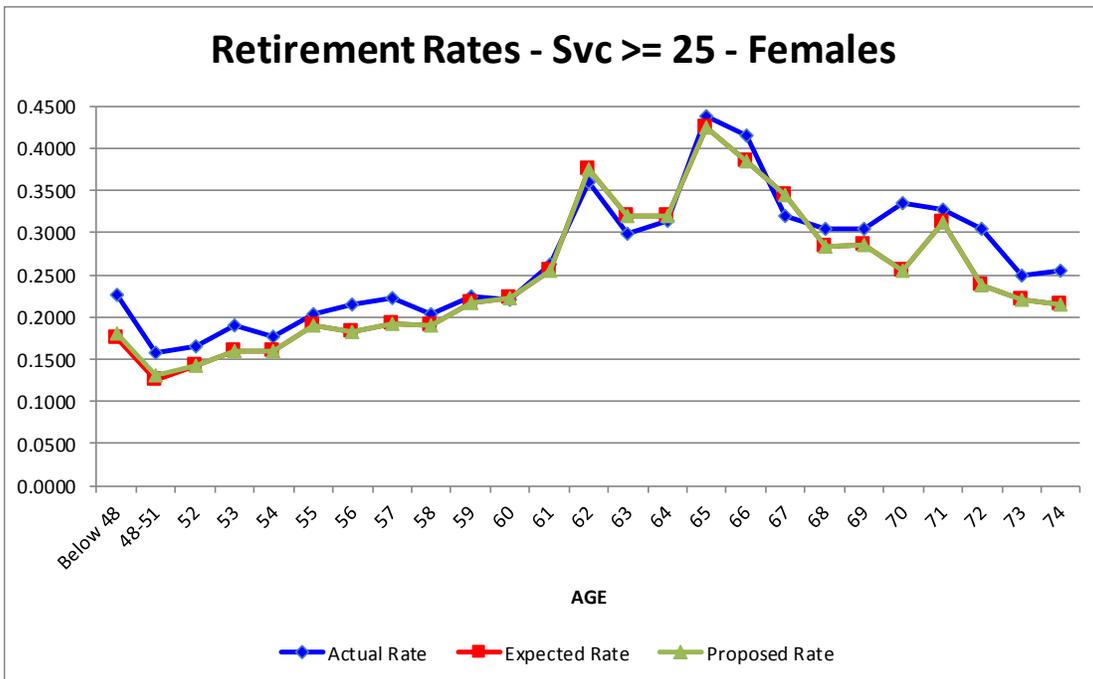
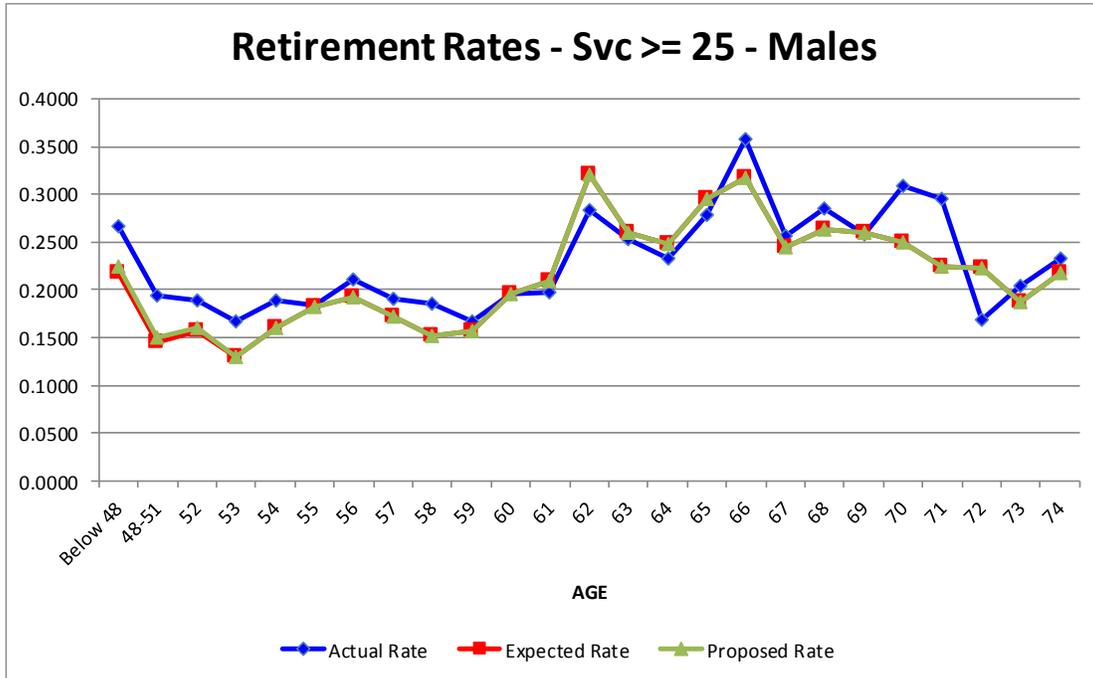
The following graphs show a comparison of the present, actual, and proposed rates of service retirements.

RATES OF RETIREMENT FOR ACTIVE MEMBERS WITH LESS THAN 25 YEARS OF SERVICE





**RATES OF RETIREMENT FOR ACTIVE MEMBERS
WITH 25 OR MORE YEARS OF SERVICE**





Section IV – Demographic Assumptions

As can be seen from the previous 4 pages, the actual rates of service retirement, for both under 25 years and over 25 years are reasonably close to expected at almost all ages. However, we do recommend a slight increase in the rates of retirement for retirements under 25 years of service below age 73 for males and below age 70 for females. We also recommend a slight increase in the rates of retirement at younger ages once a member reaches 25 years of service for both males and females to better reflect experience of the System.

The following table shows a comparison between the present retirement rates and the proposed rates.

COMPARATIVE RATES OF RETIREMENT

AGE	RATES OF SERVICE RETIREMENT*							
	MALES				FEMALES			
	Under 25 Years of Service		25 Years of Service and Over		Under 25 Years of Service		25 Years of Service and Over	
	Present	Proposed	Present	Proposed	Present	Proposed	Present	Proposed
45			21.75%	22.50%			17.50%	18.00%
50			14.50	15.00			12.50	13.00
55			18.25	18.25			19.00	19.00
60	10.25%	10.50%	19.50	19.50	13.00%	13.25%	22.25	22.25
62	20.25	20.75	32.00	32.00	18.75	19.00	37.50	37.50
65	24.00	25.00	29.50	29.50	28.75	29.25	42.50	42.50
70	20.00	20.00	25.00	25.00	24.00	24.00	25.50	25.50
75	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* The proposed changes shown above are used for Tier 4 service retirements as well, except the 25 years of service is 30 years of service for these members.



COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RATES

Retirements with less than 25 years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
60	323	273	1.183	724	672	1.077
61	263	237	1.110	552	507	1.089
62	489	449	1.089	801	736	1.088
63	337	318	1.060	597	544	1.097
64	239	229	1.044	498	441	1.129
65	370	335	1.104	653	581	1.124
66	266	233	1.142	424	366	1.158
67	176	163	1.080	252	223	1.130
68	153	123	1.244	187	158	1.184
69	126	120	1.050	153	118	1.297
70	98	95	1.032	110	108	1.019
71	82	72	1.139	83	76	1.092
72	65	58	1.121	62	54	1.148
73	46	44	1.045	33	39	0.846
74	45	43	1.047	50	37	1.351
Subtotal	3,078	2,792	1.102	5,179	4,660	1.111
75 & Over	209	921	0.227	159	574	0.277
GRAND TOTAL	3,287	3,713	0.885	5,338	5,234	1.020



COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RATES

Retirements with 25 or more years of service

AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Below 48	191	161	1.186	160	127	1.260
48-51	498	386	1.290	725	601	1.206
52	177	150	1.180	255	220	1.159
53	172	134	1.284	324	273	1.187
54	196	167	1.174	315	285	1.105
55	182	181	1.006	371	348	1.066
56	209	191	1.094	397	338	1.175
57	182	165	1.103	415	360	1.153
58	177	146	1.212	377	354	1.065
59	162	152	1.066	414	401	1.032
60	187	186	1.005	391	396	0.987
61	180	191	0.942	433	420	1.031
62	242	274	0.883	531	554	0.958
63	182	186	0.978	330	353	0.935
64	135	144	0.938	280	286	0.979
65	137	145	0.945	323	313	1.032
66	135	120	1.125	191	177	1.079
67	75	72	1.042	98	106	0.925
68	77	71	1.085	76	71	1.070
69	51	51	1.000	65	61	1.066
70	47	38	1.237	56	43	1.302
71	34	26	1.308	42	40	1.050
72	18	24	0.750	29	23	1.261
73	21	19	1.105	19	17	1.118
74	20	19	1.053	16	14	1.143
Subtotal	3,687	3,399	1.085	6,633	6,181	1.073
75 & Over	89	324	0.275	59	241	0.245
GRAND TOTAL	3,776	3,723	1.014	6,692	6,422	1.042



PUBLIC EMPLOYEES’ RETIREMENT SYSTEM

RATES OF POST-RETIREMENT MORTALITY

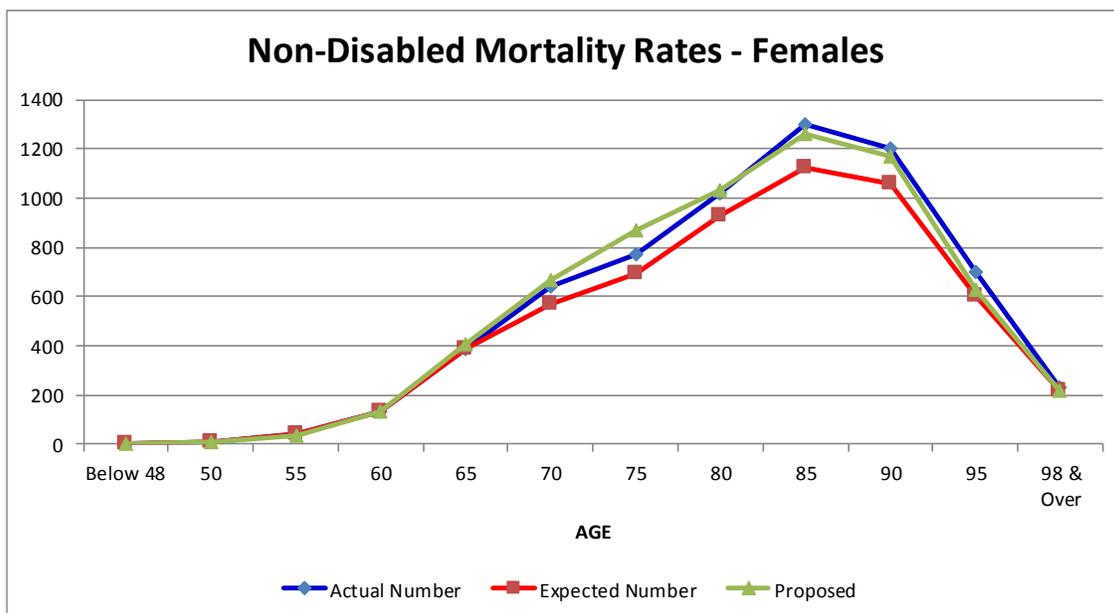
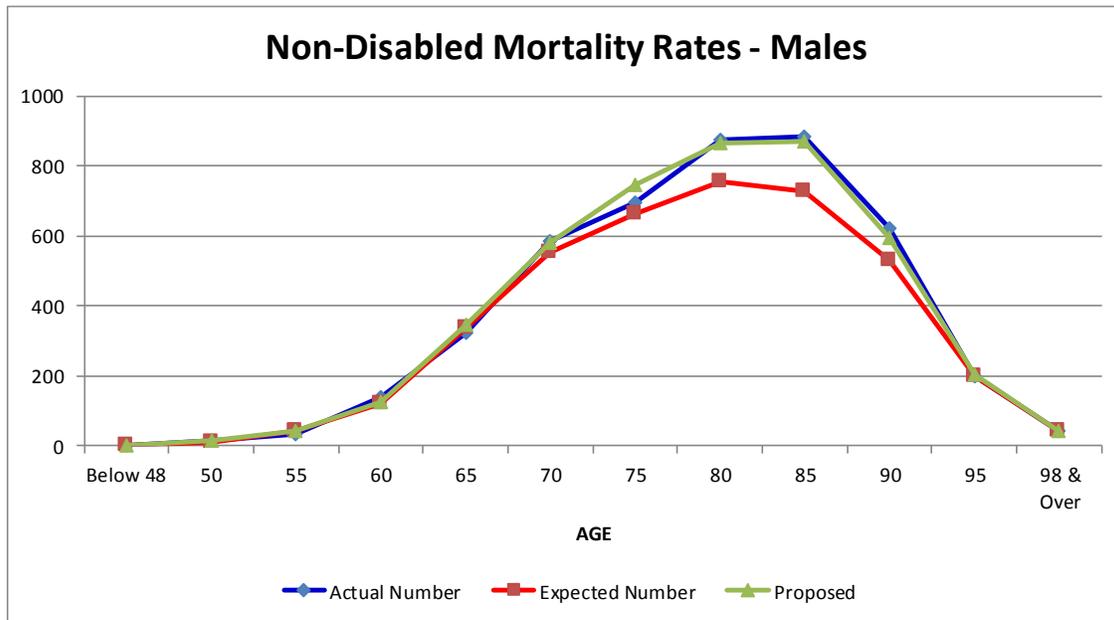
**COMPARISON OF ACTUAL AND EXPECTED CASES OF
POST-RETIREMENT DEATHS**

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	SERVICE RETIREMENTS AND BENEFICIARIES					
Below 53	24	15	1.600	11	10	1.100
55	36	45	0.800	42	41	1.024
60	138	120	1.150	135	133	1.015
65	325	337	0.964	388	386	1.005
70	586	555	1.056	642	573	1.120
75	696	664	1.048	775	695	1.115
80	876	753	1.163	1,020	931	1.096
85	882	727	1.213	1,302	1,126	1.156
90	623	529	1.178	1,201	1,060	1.133
95	201	198	1.015	700	603	1.161
98 & over	45	45	1.000	231	219	1.055
TOTAL	4,432	3,988	1.111	6,447	5,777	1.116
	DISABILITY RETIREMENTS					
Below 48	10	14	0.714	18	9	2.000
50	18	23	0.783	26	16	1.625
55	50	41	1.220	56	37	1.514
60	77	69	1.116	84	60	1.400
65	103	89	1.157	77	75	1.027
70	95	76	1.250	85	73	1.164
75	63	48	1.313	47	58	0.810
80	39	35	1.114	39	50	0.780
85	17	14	1.214	22	27	0.815
88 & over	12	9	1.333	24	21	1.143
TOTAL	484	418	1.158	478	426	1.122



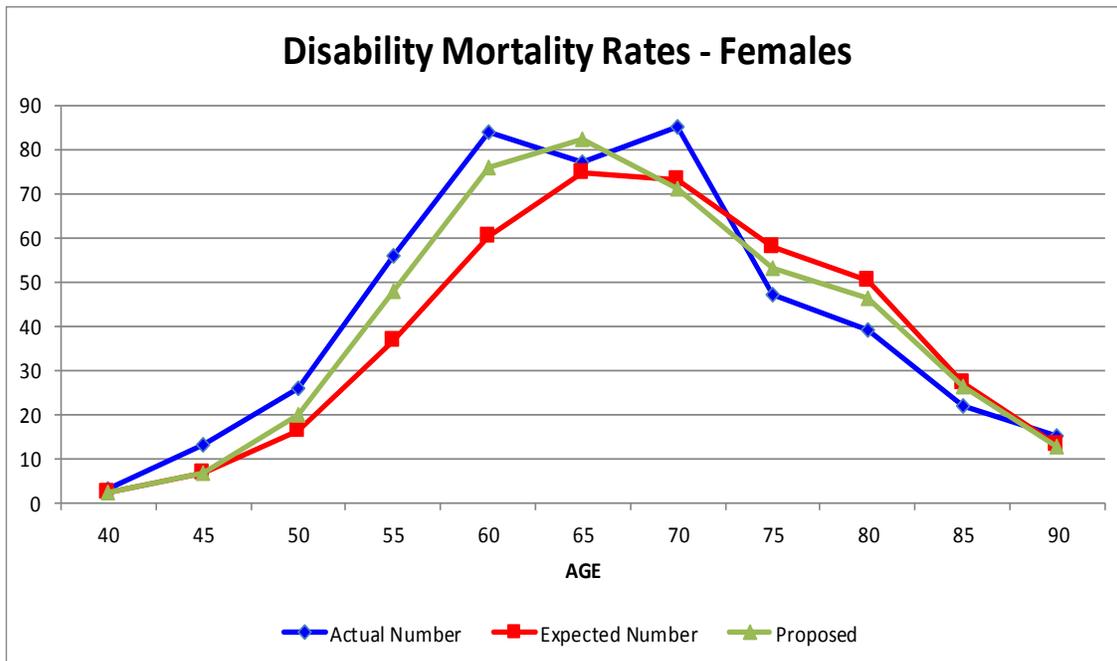
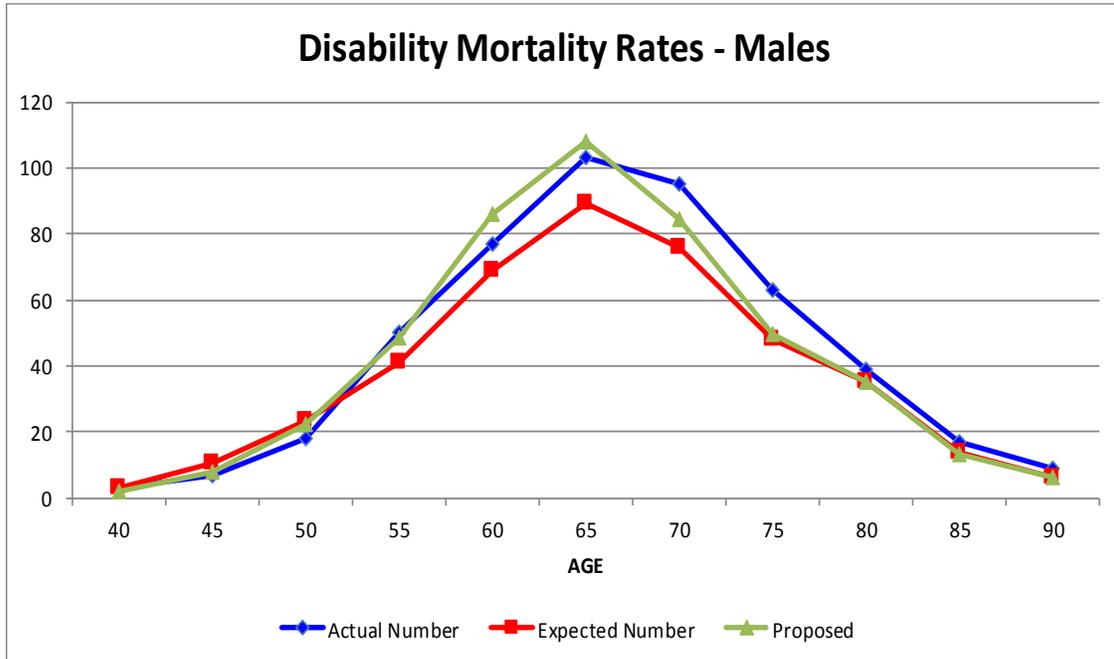
The following graphs show a comparison of the present, actual and proposed rates of post-retirement deaths.

**POST-RETIREMENT DEATHS
SERVICE RETIREMENTS AND BENEFICIARIES
OF DECEASED MEMBERS**





**POST-RETIREMENT DEATHS
DISABILITY RETIREMENTS**





Section IV – Demographic Assumptions

The current basis for rate of post-retirement mortality for service retirees and beneficiaries is the static mortality table, RP-2014 Healthy Annuitant Blue Collar Mortality Table projected with Scale BB to 2022 with male rates set forward one year and adjusted by 106% for males at all ages and as follows for females: 90% for ages less than 76, 95% for age 76, 105% for age 78, and 110% for ages 79 and greater. The current basis for post-retirement mortality for disability retirements is the RP-2014 Disabled Retiree Mortality Table set forward 4 years for males and 3 years for females.

The results of the experience analysis indicate that this table actually provides a reasonable margin for future mortality improvements (11-12%). However, we are recommending changing from a static mortality table to a dynamic mortality table with generational projection of future mortality improvement. This approach is recommended by the Society of Actuaries.

In August 2018, the Society of Actuaries' Retirement Plans Experience Committee (RPEC) released an exposure draft of the Pub-2010 Public Retirement Plans Mortality Tables. The primary focus of this study was a comprehensive review of recent mortality experience of public retirement plans in the United States. A total of 46 million life-years of exposure and approximately 580,000 deaths, covering 78 public sector pension plans, were used to develop the new tables. The new mortality tables were separated into three job classifications; (1) Teachers, (2) Public Safety, and (3) General Employees and each table was further studied by either headcount or income level. RPEC released the final Pub-2010 report and tables are now available on the SOA website.

Since these new mortality tables are now available, we reviewed them as part of this experience study and find that the tables provide a nice fit to the Mississippi PERS actual experience. Therefore, for service retirees and beneficiaries, we recommend the PubS.H-2010(B) Retiree Table with the following adjustments:

- For males, 112% of male rates from ages 18 to age 75 scaled down to 105% for ages 80 to 119.
- For females, 85% of the female rates from ages 18 to age 65 scaled up to 102% for ages 75 to 119.
- Projection scale MP-2018 will be used to project future improvements in life expectancy generationally.

We also recommend adoption of the PubT.H-2010 Disabled Retiree Table for disabled retirees with the following adjustments - 137% of male rates at all ages and 115% of female rates at all ages. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally



The following table shows a comparison between the present and proposed base rates of mortality.

COMPARATIVE RATES OF POST-RETIREMENT MORTALITY

AGE	RATES OF POST-RETIREMENT DEATH			
	MALES		FEMALES	
	Present	Proposed*	Present	Proposed*
	SERVICE RETIREMENTS & BENEFICIARIES OF DECEASED MEMBERS			
55	0.6659%	0.6126%	0.3481%	0.2771%
60	0.9047	0.9162	0.4763	0.4633
65	1.3141	1.3451	0.7130	0.7744
70	2.0267	2.2154	1.1412	1.4231
75	3.2631	3.9267	1.8771	2.5949
80	5.3947	6.5121	3.8115	4.3381
85	9.0513	11.4986	6.4928	7.4705
90	15.8263	18.3908	11.2631	12.8999
DISABILITY RETIREMENTS				
35	1.0420%	0.7151%	0.4669%	0.4681%
40	1.5340	0.9905	0.7286	0.7234
45	1.9757	1.4988	1.0787	1.1328
50	2.2791	2.3290	1.3494	1.7066
55	2.5868	3.0524	1.5931	2.0033
60	3.0433	3.7291	1.9028	2.3460
65	3.8253	4.6443	2.4702	2.8256
70	5.0965	5.9431	3.5148	3.6237
75	7.1235	7.8378	5.2059	5.0071
80	10.4436	11.0545	7.7357	7.3922
85	15.8714	16.1318	11.3909	11.4000
90	23.1944	23.2311	16.7890	16.6658

* Base rates



The following shows a comparison of the actual and expected post-retirement deaths based on new revised rates of mortality.

**COMPARISON OF ACTUAL AND EXPECTED CASES OF
POST-RETIREMENT DEATHS
BASED ON PROPOSED RATES**

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
	SERVICE RETIREMENTS AND BENEFICIARIES					
Below 53	24	17	1.412	11	8	1.375
55	36	42	0.857	42	35	1.200
60	138	125	1.104	135	134	1.007
65	325	348	0.934	388	409	0.949
70	586	581	1.009	642	670	0.958
75	696	745	0.934	775	871	0.890
80	876	866	1.012	1,020	1,030	0.990
85	882	871	1.013	1,302	1,258	1.035
90	623	593	1.051	1,201	1,173	1.024
95	201	203	0.990	700	626	1.118
98 & over	45	44	1.023	231	220	1.050
TOTAL	4,432	4,435	0.999	6,447	6,434	1.002
DISABILITY RETIREMENTS						
Below 48	10	10	1.000	18	9	2.000
50	18	22	0.818	26	20	1.300
55	50	48	1.042	56	48	1.167
60	77	86	0.895	84	76	1.105
65	103	108	0.954	77	82	0.939
70	95	84	1.131	85	71	1.197
75	63	50	1.260	47	53	0.887
80	39	35	1.114	39	46	0.848
85	17	13	1.308	22	26	0.846
88 & over	12	9	1.333	24	20	1.200
TOTAL	484	465	1.041	478	451	1.060



PUBLIC EMPLOYEES’ RETIREMENT SYSTEM
RATES OF SALARY INCREASE

**COMPARISON OF ACTUAL AND EXPECTED SALARIES
 OF ACTIVE MEMBERS**

SERVICE OF GROUP	SALARIES AT END OF YEAR (\$1,000’s)		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
0	\$438,325	\$435,508	1.006
1	1,433,050	1,451,895	0.987
2	1,291,043	1,302,815	0.991
3	1,177,806	1,180,525	0.998
4	1,032,515	1,034,596	0.998
5-9	4,692,030	4,691,833	1.000
10-14	4,070,414	4,081,800	0.997
15-19	3,334,055	3,357,439	0.993
20-24	2,437,473	2,457,036	0.992
25-29	1,297,363	1,305,103	0.994
30-34	489,844	493,613	0.992
35 & Over	254,810	257,516	0.989
TOTAL	\$21,948,728	\$22,049,679	0.995

Over the past four years, actual rates of salary increase have been less than expected at almost all service breakdowns. In the economic section of this experience study report, we are recommending the wage inflation assumption be reduced from 3.25% to 3.00% (see page 22). As the wage inflation assumption is part of our building block approach to determining the salary scale, the total salary scale will be reduced accordingly at all service intervals. The following table shows a comparison between the present and proposed rates of salary increase.



SERVICE OF GROUP	SALARY INCREASE RATES	
	MALES AND FEMALES	
	Present	Proposed
0	18.50%	18.25%
1	8.50%	8.25%
2	6.00%	5.75%
3	5.00%	4.75%
4	4.50%	4.25%
5-7	4.00%	3.75%
8-27	3.50%	3.25%
28 and Over	3.25%	3.00%

**COMPARISON OF ACTUAL AND EXPECTED SALARIES
OF ACTIVE MEMBERS
BASED ON PROPOSED RATES**

SERVICE OF GROUP	SALARIES AT END OF YEAR (\$1,000's)		
	MALES AND FEMALES		
	Actual	Expected	Ratio of Actual to Expected
0	\$438,325	\$434,588	1.009
1	1,433,050	1,448,550	0.989
2	1,291,043	1,299,742	0.993
3	1,177,806	1,177,713	1.000
4	1,032,515	1,032,121	1.000
5-9	4,692,030	4,680,534	1.002
10-14	4,070,414	4,071,942	1.000
15-19	3,334,055	3,349,330	0.995
20-24	2,437,473	2,451,102	0.994
25-29	1,297,363	1,301,948	0.996
30-34	489,844	492,418	0.995
35 & Over	254,810	256,893	0.992
TOTAL	\$21,948,728	\$21,996,881	0.998



PUBLIC EMPLOYEES' RETIREMENT SYSTEM

OTHER ASSUMPTIONS

DEFERRED VESTEDS: Currently, the valuation assumes 60% of participants that leave the System as deferred vested will receive a deferred benefit upon attaining the eligibility requirements for retirement. During this investigation period, the plan experienced an estimated 62% assumption. **Therefore, we recommend no change at this time.**

DEATH ASSUMPTION: Currently, it is assumed that 6% of active member deaths are in the line of duty and 94% of active member deaths are not in the line of duty. During this experience investigation period, about 3.7% of active deaths each year were in the line of duty. In the previous experience study, the rate was 5.7%. We will review this carefully in the next experience study but for now, **we recommend no change in this assumption at this time.**

DISABILITY ASSUMPTION: Currently, it is assumed that 7% of active member disabilities are in the line of duty and 93% of active member disabilities are not in the line of duty. During the experience investigation period, an average of about 11% of disabilities each year were in the line of duty. During the last experience study, the average for the period was 9%. **Therefore, we recommend that the assumption be increased so that 9% of active member disabilities are assumed to be in the line of duty and 91% of active member disabilities are assumed to be not in the line of duty.**

PERCENT MARRIED: Currently, 85% of active members are assumed to be married and elect a joint & survivor payment form. We are not provided with marital status on the census data. **However, we believe the current assumption is fairly conservative and recommend no change at this time.**

SPOUSE AGE DIFFERENCE: Currently, for married members, it is assumed a male is three years older than his spouse. **We have reviewed this assumption and recommend no change at this time.**

UNUSED LEAVE: Currently, we assume that participants will have on average 0.50 years of unused leave (sick and personal) at retirement. We reviewed this assumption for those participants who retired during this four year period and the average number of years of unused leave was 0.64 years. **We recommend no change at this time.**



Section IV – Demographic Assumptions

FINAL AVERAGE COMPENSATION: We compared the actual final average compensation used to determine retiree benefits with the compensation predicted by our pension software. Based on our findings, **we recommend a 0.25% load on the final average compensation produced by our valuation software.**

MILITARY SERVICE: Currently, we assume that participants will have on average 0.25 years of military service at retirement. We reviewed this assumption for those participants who retired during this four year period and the average number of years of military service was 0.23 years. **Therefore, we recommend no change at this time.**

ASSUMED INTEREST RATE ON EMPLOYEE CONTRIBUTIONS: 2.00%

OTHER ASSUMPTION LOADS: Varying loads for pre-retirement dependent children option and for disability dependent children options.

OPTION FACTORS: The option factors, currently in use by all of the Retirement Systems, are based on the mortality table and investment rate of return (discount rate) used in the valuation. **We recommend that the factors be revised to be based on the proposed mortality table and the investment rate of return recommended for the valuation.**



HIGHWAY SAFETY PATROL RETIREMENT SYSTEM

SUMMARY OF RESULTS

Over the period of this investigation, we have noted the following observations:

- There were 37 actual withdrawals versus 34 expected withdrawals over the four year period of this investigation. In the prior investigation, the number of actual withdrawals was higher than the number of expected withdrawals and the rates of withdrawal were increased. **At this time, we recommend no change in the rates of withdrawal.**
- There were 48 actual retirements versus 57 expected retirements over the four-year period of this investigation. There are numerous members eligible to retire that we expect to retire in the next few years. **Therefore, we do not recommend a change in the retirement decrements.**
- There was one death while in active service over the four-year period of this investigation and there were two deaths in the prior study. **We recommend updating the mortality assumption to be consistent with our change to PERS.**
- There was one disability retirements over the four-year period of this investigation compared to none in the prior study. The rates of disability were decreased in the prior study. **We recommend no change in the rates of disability at this time.**
- Actual rates of salary increase were higher than expected over the four year period but this was mainly due to the negotiated increase by the System and the State during this study period. **Since we recommend lowering the wage inflation assumption from 3.25% to 3.00%, total expected salary increases will be one-quarter percent lower.**



Section V – HSPRS Summary of Results

- As mentioned in the PERS section of this report, we recommend that the rates of mortality for service retirements be revised to match the PERS mortality table, the PubS.H-2010(B) Retiree Table with the following adjustments. For males, 112% of male rates from age 18 – 75 scaled down to 105% for ages 80 – 119. For females, 85% of the female rates from age 18 – 65 scaled up to 102% from ages 75 – 119. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally. In addition, we recommend that the rates of mortality for disability retirements be revised to the PubT.H-2010 Disabled Retiree Table for disabled retirees with the following adjustments - 137% of male rates at all ages and 115% of female rates at all ages. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally. We recommend each of the Systems have the same mortality table.



SUPPLEMENTAL LEGISLATIVE RETIREMENT PLAN

SUMMARY OF RESULTS

Over the period of this investigation, we have noted the following observations:

- We have reviewed the withdrawal rates for both non-election years and election years. The number of withdrawals during non-election years (1% of exposed) was not enough to warrant adding withdrawal rates during these years. The actual number of withdrawals during the election year was very close to the expected withdrawals (15 vs. 18). **We recommend no change in the rates of withdrawal.**
- We also reviewed the service retirements rates for both non-election years and election years. The number of service retirements during non-election years (3% of exposed) was not enough to warrant adding rates during those years. The actual number of service retirements during the election year was very close to expected (25 vs. 27). **Therefore, we recommend no change in the retirement rates.**
- There were 2 deaths while in active service over the four-year period of this investigation compared with 2 expected. **We recommend updating the mortality assumption to be consistent with our change to PERS.**
- There were no disability retirements over the four-year period of this investigation which is close to what was expected. **Therefore, we recommend no change at this time.**
- Actual salary increases were about 97% of what was expected. In conjunction with the recommended decrease in the wage inflation assumption, **we recommend that the salary scale be reduced to 3.00% for all ages.**
- As mentioned in the PERS section of this report, we recommend that the rates of mortality for service retirements be revised to match the PERS mortality table, the PubS.H-2010(B)



Section VI – SLRP Summary of Results

Retiree Table with the following adjustments. For males, 112% of male rates from age 18 – 75 scaled down to 105% for ages 80 – 119. For females, 85% of the female rates from age 18 – 65 scaled up to 102% from ages 75 – 119. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally. In addition, we recommend that the rates of mortality for disability retirements be revised to the PubT.H-2010 Disabled Retiree Table for disabled retirees with the following adjustments - 137% of male rates at all ages and 115% of female rates at all ages. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally. We recommend each of the Systems have the same mortality table.



MUNICIPAL RETIREMENT SYSTEMS

SUMMARY OF RESULTS

Since this is a closed System with very few actives remaining, we have not investigated the active decrements, but have concentrated on the post-retirement mortality experience. Over the period of this investigation, we have found the following observations:

- As mentioned in the PERS section of this report, we recommend that the rates of mortality for service retirements be revised to match the PERS mortality table, the PubS.H-2010(B) Retiree Table with the following adjustments. For males, 112% of male rates from age 18 – 75 scaled down to 105% for ages 80 – 119. For females, 85% of the female rates from age 18 – 65 scaled up to 102% from ages 75 – 119. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally. In addition, we recommend that the rates of mortality for disability retirements be revised to the PubT.H-2010 Disabled Retiree Table for disabled retirees with the following adjustments - 137% of male rates at all ages and 115% of female rates at all ages. Projection scale MP-2018 will be used to project future improvements in life expectancy generationally. We recommend each of the Systems have the same mortality table.



Appendix A – Historical June CPI (U) Index

Year	CPI (U)	Year	CPI (U)
1961	29.8	1990	129.9
1962	30.2	1991	136.0
1963	30.6	1992	140.2
1964	31.0	1993	144.4
1965	31.6	1994	148.0
1966	32.4	1995	152.5
1967	33.3	1996	156.7
1968	35.7	1997	160.3
1969	34.7	1998	163.0
1970	38.8	1999	166.2
1971	40.6	2000	172.4
1972	41.7	2001	178.0
1973	44.2	2002	179.9
1974	49.0	2003	183.7
1975	53.6	2004	189.7
1976	56.8	2005	194.5
1977	60.7	2006	202.9
1978	65.2	2007	208.352
1979	72.3	2008	218.815
1980	82.7	2009	215.693
1981	90.6	2010	217.965
1982	97.0	2011	225.722
1983	99.5	2012	229.478
1984	103.7	2013	233.504
1985	107.6	2014	238.343
1986	109.5	2015	238.638
1987	113.5	2016	241.018
1988	118.0	2017	244.955
1989	124.1	2018	251.989



**Callan’s Capital Market Assumptions and
PERS’ Board of Trustees Asset Allocation**

Geometric Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return	Standard Deviation
Domestic Equity	4.90%	18.00%
International Equity	4.75	19.75
Global Equity	5.00	21.10
Fixed Income	1.50	3.75
Real Estate	4.00	15.70
Private Equity	6.25	29.30
Cash Equivalents	0.25	0.90

Asset Allocation Targets

Asset Class	Asset Allocation
Domestic Equity	27.00%
International Equity	22.00
Global Equity	12.00
Fixed Income	20.00
Real Estate	10.00
Private Equity	8.00
Cash Equivalents	1.00



Appendix C – Social Security Administration Wage Index

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1960	\$4,007.12	3.92%	1989	\$20,099.55	3.96%
1961	4,086.76	1.99	1990	21,027.98	4.62
1962	4,291.40	5.01	1991	21,811.60	3.73
1963	4,396.64	2.45	1992	22,935.42	5.15
1964	4,576.32	4.09	1993	23,132.67	0.86
1965	4,658.72	1.80	1994	23,753.53	2.68
1966	4,938.36	6.00	1995	24,705.66	4.01
1967	5,213.44	5.57	1996	25,913.90	4.89
1968	5,571.76	6.87	1997	27,426.00	5.84
1969	5,893.76	5.78	1998	28,861.44	5.23
1970	6,186.24	4.96	1999	30,469.84	5.57
1971	6,497.08	5.02	2000	32,154.82	5.53
1972	7,133.80	9.80	2001	32,921.92	2.39
1973	7,580.16	6.26	2002	33,252.09	1.00
1974	8,030.76	5.94	2003	34,064.95	2.44
1975	8,630.92	7.47	2004	35,648.55	4.65
1976	9,226.48	6.90	2005	36,952.94	3.66
1977	9,779.44	5.99	2006	38,651.41	4.60
1978	10,556.03	7.94	2007	40,405.48	4.54
1979	11,479.46	8.75	2008	41,334.97	2.30
1980	12,513.46	9.01	2009	40,711.61	-1.51
1981	13,773.10	10.07	2010	41,673.83	2.36
1982	14,531.34	5.51	2011	42,979.61	3.13
1983	15,239.24	4.87	2012	44,321.67	3.12
1984	16,135.07	5.88	2013	44,888.16	1.28
1985	16,822.51	4.26	2014	46,481.52	3.55
1986	17,321.82	2.97	2015	48,098.63	3.48
1987	18,426.51	6.38	2016	48,642.15	1.13
1988	19,334.04	4.93	2017	50,321.89	3.45



TABLE 1
PUBLIC EMPLOYEES’ RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES

AGE	ULTIMATE RATES OF WITHDRAWAL*	RATES OF DEATH**	RATES OF DISABILITY	RATES OF RETIREMENT	
				LESS THAN 25 YRS OF SERVICE***	25 OR MORE YEARS OF SERVICE***
20	0.2650	0.000483	0.00010		
21	0.2650	0.000515	0.00010		
22	0.2650	0.000536	0.00011		
23	0.2425	0.000546	0.00011		
24	0.2225	0.000557	0.00011		
25	0.1850	0.000567	0.00012		
26	0.1715	0.000578	0.00014		
27	0.1580	0.000588	0.00016		
28	0.1445	0.000609	0.00017		
29	0.1310	0.000620	0.00017		
30	0.1175	0.000630	0.00017		
31	0.1110	0.000651	0.00020		
32	0.1045	0.000662	0.00025		
33	0.0980	0.000683	0.00030		
34	0.0915	0.000693	0.00034		
35	0.0850	0.000714	0.00036		
36	0.0815	0.000746	0.00051		
37	0.0780	0.000767	0.00066		
38	0.0745	0.000809	0.00081		
39	0.0710	0.000840	0.00096		
40	0.0675	0.000893	0.00110		0.2250
41	0.0665	0.000935	0.00134		0.2250
42	0.0655	0.000998	0.00158		0.2250
43	0.0645	0.001061	0.00182		0.2250
44	0.0635	0.001134	0.00206		0.2250
45	0.0625	0.001218	0.00230		0.2250
46	0.0625	0.001302	0.00242		0.2250
47	0.0625	0.001407	0.00254		0.2250
48	0.0625	0.001512	0.00266		0.1500
49	0.0625	0.001638	0.00278		0.1500
50	0.0625	0.001764	0.00290		0.1500
51	0.0625	0.001901	0.00332		0.1500
52	0.0625	0.002058	0.00374		0.1600
53	0.0625	0.002216	0.00416		0.1300
54	0.0625	0.002394	0.00458		0.1600
55	0.0625	0.002594	0.00500		0.1825
56	0.0625	0.002804	0.00506		0.1925
57	0.0625	0.003045	0.00512		0.1725
58	0.0625	0.003329	0.00518		0.1525
59	0.0625	0.003633	0.00524		0.1575
60	0.0625	0.003980	0.00530	0.1050	0.1950
61	0.0625	0.004358	0.00530	0.1000	0.2100
62	0.0625	0.004788	0.00530	0.2075	0.3200
63	0.0625	0.005261	0.00530	0.1800	0.2600
64	0.0625	0.005775	0.00530	0.1525	0.2475
65	0.0625	0.006353	0.00200	0.2500	0.2950
66	0.0625	0.007172	0.00200	0.2250	0.3175
67	0.0625	0.008096	0.00200	0.1950	0.2450
68	0.0625	0.009146	0.00200	0.1700	0.2625
69	0.0625	0.010322	0.00200	0.2050	0.2600
70	0.0625	0.011655	0.00200	0.2000	0.2500
71	0.0625	0.013157	0.00200	0.1850	0.2250
72	0.0625	0.014858	0.00200	0.1925	0.2225
73	0.0625	0.016779	0.00200	0.1675	0.1875
74	0.0625	0.018942	0.00200	0.1900	0.2175
75	0.0000	0.021389	0.00000	1.0000	1.0000

*For all ages, rates of 33.50% for the first year of employment and 24.00% for the second year of employment.

** Base rates

***For Tier 4 members, 30 years of service.



TABLE 2

**PUBLIC EMPLOYEES’ RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES**

AGE	ULTIMATE RATES OF WITHDRAWAL*	RATES OF DEATH**	RATES OF DISABILITY	RATES OF RETIREMENT	
				LESS THAN 25 YRS OF SERVICE***	25 OR MORE YEARS OF SERVICE***
20	0.3250	0.000126	0.00009		
21	0.3250	0.000140	0.00009		
22	0.3250	0.000154	0.00009		
23	0.2850	0.000161	0.00009		
24	0.2350	0.000175	0.00009		
25	0.1850	0.000189	0.00011		
26	0.1800	0.000203	0.00011		
27	0.1700	0.000210	0.00014		
28	0.1570	0.000224	0.00014		
29	0.1440	0.000238	0.00014		
30	0.1200	0.000259	0.00014		
31	0.1135	0.000273	0.00015		
32	0.1070	0.000287	0.00015		
33	0.1005	0.000308	0.00016		
34	0.0940	0.000329	0.00017		
35	0.0875	0.000350	0.00017		
36	0.0840	0.000371	0.00028		
37	0.0805	0.000399	0.00039		
38	0.0770	0.000420	0.00050		
39	0.0735	0.000448	0.00061		
40	0.0700	0.000483	0.00070		0.1800
41	0.0680	0.000511	0.00084		0.1800
42	0.0660	0.000546	0.00098		0.1800
43	0.0640	0.000581	0.00112		0.1800
44	0.0620	0.000623	0.00126		0.1800
45	0.0600	0.000665	0.00140		0.1800
46	0.0600	0.000707	0.00156		0.1800
47	0.0600	0.000756	0.00172		0.1800
48	0.0600	0.000805	0.00188		0.1300
49	0.0600	0.000861	0.00204		0.1300
50	0.0600	0.000917	0.00220		0.1300
51	0.0600	0.000980	0.00252		0.1300
52	0.0600	0.001043	0.00284		0.1425
53	0.0600	0.001113	0.00316		0.1600
54	0.0600	0.001190	0.00348		0.1600
55	0.0600	0.001274	0.00380		0.1900
56	0.0600	0.001358	0.00384		0.1825
57	0.0600	0.001449	0.00388		0.1925
58	0.0600	0.001540	0.00392		0.1900
59	0.0600	0.001645	0.00396		0.2175
60	0.0600	0.001757	0.00410	0.1325	0.2225
61	0.0600	0.001876	0.00410	0.1150	0.2550
62	0.0600	0.002002	0.00410	0.1900	0.3750
63	0.0600	0.002135	0.00410	0.1800	0.3200
64	0.0600	0.002275	0.00410	0.1800	0.3200
65	0.0600	0.002429	0.00150	0.2925	0.4250
66	0.0600	0.002779	0.00150	0.2700	0.3850
67	0.0600	0.003171	0.00150	0.2300	0.3450
68	0.0600	0.003626	0.00150	0.2000	0.2825
69	0.0600	0.004144	0.00150	0.2000	0.2850
70	0.0600	0.004739	0.00150	0.2400	0.2550
71	0.0600	0.005418	0.00150	0.2225	0.3125
72	0.0600	0.006195	0.00150	0.2075	0.2375
73	0.0600	0.007077	0.00150	0.1975	0.2200
74	0.0600	0.008092	0.00150	0.2050	0.2150
75	0.0000	0.009247	0.00000	1.0000	1.0000

*For all ages, rates of 33.50% for the first year of employment and 24.00% for the second year of employment.

**Base Rates

***For Tier 4 members, 30 years of service.



TABLE 3

**HIGHWAY SAFETY PATROL RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE**

AGE	RATES OF WITHDRAWAL	RATES OF DEATH* MALES	RATES OF DEATH* FEMALES	RATES OF DISABILITY	SERVICE	RATES OF RETIREMENT**
20	0.080	0.000483	0.000126	0.000675	0	0.00
21	0.080	0.000515	0.000140	0.000675	1	0.00
22	0.080	0.000536	0.000154	0.000675	2	0.00
23	0.072	0.000546	0.000161	0.000765	3	0.00
24	0.064	0.000557	0.000175	0.000765	4	0.00
25	0.056	0.000567	0.000189	0.000765	5	0.05
26	0.048	0.000578	0.000203	0.000765	6	0.05
27	0.046	0.000588	0.000210	0.000900	7	0.05
28	0.044	0.000609	0.000224	0.000900	8	0.05
29	0.042	0.000620	0.000238	0.000945	9	0.05
30	0.040	0.000630	0.000259	0.001035	10	0.05
31	0.038	0.000651	0.000273	0.001080	11	0.05
32	0.036	0.000662	0.000287	0.001215	12	0.05
33	0.034	0.000683	0.000308	0.001350	13	0.05
34	0.032	0.000693	0.000329	0.001395	14	0.05
35	0.030	0.000714	0.000350	0.001530	15	0.05
36	0.028	0.000746	0.000371	0.001575	16	0.05
37	0.026	0.000767	0.000399	0.001710	17	0.05
38	0.024	0.000809	0.000420	0.001800	18	0.05
39	0.022	0.000840	0.000448	0.001890	19	0.05
40	0.020	0.000893	0.000483	0.002025	20	0.05
41	0.018	0.000935	0.000511	0.002115	21	0.05
42	0.016	0.000998	0.000546	0.002295	22	0.05
43	0.014	0.001061	0.000581	0.002385	23	0.05
44	0.012	0.001134	0.000623	0.002565	24	0.05
45	0.010	0.001218	0.000665	0.002700	25	0.01
46	0.010	0.001302	0.000707	0.002970	26	0.15
47	0.010	0.001407	0.000756	0.003240	27	0.20
48	0.010	0.001512	0.000805	0.003465	28	0.25
49	0.010	0.001638	0.000861	0.003825	29	0.25
50	0.010	0.001764	0.000917	0.004140	30	0.25
51	0.010	0.001901	0.000980	0.004545	31	0.25
52	0.010	0.002058	0.001043	0.005040	32	0.25
53	0.010	0.002216	0.001113	0.005625	33	0.25
54	0.010	0.002394	0.001190	0.006165	34	0.25
55	0.000	0.002594	0.001274	0.006975	35	0.25
56	0.000	0.002804	0.001358	0.008010	36	0.35
57	0.000	0.003045	0.001449	0.009000	37	0.50
58	0.000	0.003329	0.001540	0.010170	38	0.75
59	0.000	0.003633	0.001645	0.011655	39	0.75
60	0.000	0.003980	0.001757	0.011655	40+	1.00
61	0.000	0.004358	0.001876	0.000000		

*Base Rates

**The annual rate of service retirement is 100% at age 61.



TABLE 4

**SUPPLEMENTAL LEGISLATIVE RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE**

AGE	BASE RATES OF DEATH		RATES OF DISABILITY
	MALES	FEMALES	
20	0.000483	0.000126	0.0004
21	0.000515	0.000140	0.0004
22	0.000536	0.000154	0.0005
23	0.000546	0.000161	0.0005
24	0.000557	0.000175	0.0005
25	0.000567	0.000189	0.0005
26	0.000578	0.000203	0.0006
27	0.000588	0.000210	0.0006
28	0.000609	0.000224	0.0007
29	0.000620	0.000238	0.0007
30	0.000630	0.000259	0.0007
31	0.000651	0.000273	0.0008
32	0.000662	0.000287	0.0009
33	0.000683	0.000308	0.0010
34	0.000693	0.000329	0.0011
35	0.000714	0.000350	0.0011
36	0.000746	0.000371	0.0012
37	0.000767	0.000399	0.0013
38	0.000809	0.000420	0.0014
39	0.000840	0.000448	0.0016
40	0.000893	0.000483	0.0017
41	0.000935	0.000511	0.0018
42	0.000998	0.000546	0.0019
43	0.001061	0.000581	0.0021
44	0.001134	0.000623	0.0022
45	0.001218	0.000665	0.0023
46	0.001302	0.000707	0.0025
47	0.001407	0.000756	0.0026
48	0.001512	0.000805	0.0027
49	0.001638	0.000861	0.0028
50	0.001764	0.000917	0.0030
51	0.001901	0.000980	0.0031
52	0.002058	0.001043	0.0032
53	0.002216	0.001113	0.0033
54	0.002394	0.001190	0.0034
55	0.002594	0.001274	0.0035
56	0.002804	0.001358	0.0036
57	0.003045	0.001449	0.0037
58	0.003329	0.001540	0.0038
59	0.003633	0.001645	0.0039
60	0.003980	0.001757	0.0040
61	0.004358	0.001876	0.0041
62	0.004788	0.002002	0.0042
63	0.005261	0.002135	0.0044
64	0.005775	0.002275	0.0045
65	0.006353	0.002429	0.0000
66	0.007172	0.002779	0.0000
67	0.008096	0.003171	0.0000
68	0.009146	0.003626	0.0000
69	0.010322	0.004144	0.0000
70	0.011655	0.004739	0.0000
71	0.013157	0.005418	0.0000
72	0.014858	0.006195	0.0000
73	0.016779	0.007077	0.0000
74	0.018942	0.008092	0.0000
75	0.021389	0.009247	0.0000
76	0.024150	0.010570	0.0000
77	0.027258	0.012082	0.0000
78	0.030776	0.013811	0.0000
79	0.034755	0.015785	0.0000
80	0.039239	0.018046	0.0000

- Withdrawal and Vesting: 20% in an election year, none in a non-election year.
- Service Retirement: 30% in an election year, none in a non-election year. All members assumed to retire no later than age 80.



TABLE 5

**MUNICIPAL RETIREMENT SYSTEM
RATES OF SEPARATION FROM ACTIVE SERVICE**

AGE	RATES OF WITHDRAWAL	RATES OF DEATH	RATES OF DISABILITY*	RATES OF RETIREMENT	
				SERVICE	RATE**
20	0.10650	0.00060	0.00140	20	0.450
21	0.10248	0.00064	0.00160	21	0.175
22	0.09846	0.00068	0.00180	22	0.175
23	0.09444	0.00072	0.00200	23	0.175
24	0.09042	0.00076	0.00220	24	0.175
25	0.08640	0.00080	0.00240	25	0.175
26	0.08238	0.00084	0.00260	26	0.175
27	0.07836	0.00088	0.00280	27	0.175
28	0.07434	0.00092	0.00300	28	0.175
29	0.07032	0.00096	0.00320	29	0.350
30	0.06630	0.00100	0.00340	30	0.350
31	0.06228	0.00104	0.00360	31	0.350
32	0.05826	0.00108	0.00380	32	0.350
33	0.05424	0.00112	0.00400	33	0.350
34	0.05022	0.00116	0.00420	34	0.200
35	0.04620	0.00120	0.00440	35+	0.200
36	0.04218	0.00124	0.00460		
37	0.03816	0.00128	0.00480		
38	0.03414	0.00132	0.00500		
39	0.03012	0.00136	0.00520		
40	0.02610	0.00140	0.00540		
41	0.02208	0.00144	0.00560		
42	0.01806	0.00148	0.00580		
43	0.01404	0.00152	0.00600		
44	0.01002	0.00156	0.00620		
45	0.00600	0.00160	0.00640		
46	0.00198	0.00164	0.00660		
47	0.00000	0.00168	0.00680		
48		0.00172	0.00700		
49		0.00176	0.00720		
50		0.00180	0.00740		
51		0.00184	0.00760		
52		0.00188	0.00780		
53		0.00192	0.00800		
54		0.00196	0.00820		
55		0.00200	0.00840		
56		0.00204	0.00860		
57		0.00208	0.00880		
58		0.00212	0.00900		
59		0.00216	0.00920		
60		0.00220	0.00940		
61		0.00224	0.00960		
62		0.00228	0.00980		
63		0.00232	0.01000		
64		0.00236	0.01020		
65		0.00240	0.01040		

* No rates of disability for greater than 20 years of service.

**The annual rate of service retirement is 100% at age 65.



TABLE 6

RATES OF ANTICIPATED SALARY INCREASES*
(For Both Males and Females)

SERVICE	PERS	AGE	HSPRS	SLRP	MRS
0	0.1825	20	0.08564	0.0300	0.0450
1	0.0825	21	0.08180	0.0300	0.0450
2	0.0575	22	0.06780	0.0300	0.0450
3	0.0475	23	0.06380	0.0300	0.0450
4	0.0425	24	0.05948	0.0300	0.0450
5	0.0375	25	0.05309	0.0300	0.0450
6	0.0375	26	0.04990	0.0300	0.0450
7	0.0375	27	0.04891	0.0300	0.0450
8	0.0325	28	0.04493	0.0300	0.0450
9	0.0325	29	0.04493	0.0300	0.0450
10	0.0325	30	0.04493	0.0300	0.0450
11	0.0325	31	0.04493	0.0300	0.0450
12	0.0325	32	0.04493	0.0300	0.0450
13	0.0325	33	0.04493	0.0300	0.0450
14	0.0325	34	0.04493	0.0300	0.0450
15	0.0325	35	0.04493	0.0300	0.0450
16	0.0325	36	0.04493	0.0300	0.0450
17	0.0325	37	0.04493	0.0300	0.0450
18	0.0325	38	0.04493	0.0300	0.0450
19	0.0325	39	0.04493	0.0300	0.0450
20	0.0325	40	0.04493	0.0300	0.0450
21	0.0325	41	0.04493	0.0300	0.0450
22	0.0325	42	0.04493	0.0300	0.0450
23	0.0325	43	0.03995	0.0300	0.0400
24	0.0325	44	0.03995	0.0300	0.0400
25	0.0325	45	0.03995	0.0300	0.0400
26	0.0325	46	0.03995	0.0300	0.0400
27	0.0325	47	0.03995	0.0300	0.0400
28	0.0300	48	0.03498	0.0300	0.0350
29	0.0300	49	0.03498	0.0300	0.0350
30	0.0300	50	0.03498	0.0300	0.0350
31	0.0300	51	0.03498	0.0300	0.0350
32	0.0300	52	0.03498	0.0300	0.0350
33	0.0300	53	0.03498	0.0300	0.0300
34	0.0300	54	0.03498	0.0300	0.0300
35	0.0300	55	0.03498	0.0300	0.0300
36	0.0300	56	0.03498	0.0300	0.0300
37	0.0300	57	0.03498	0.0300	0.0300
38	0.0300	58	0.03498	0.0300	0.0300
39	0.0300	59	0.03498	0.0300	0.0300
40	0.0300	60	0.03000	0.0300	0.0300
		61	0.03000	0.0300	0.0300
		62	0.03000	0.0300	0.0300
		63	0.03000	0.0300	0.0300
		64	0.03000	0.0300	0.0300
		65	0.03000	0.0300	0.0300
		66	0.03000	0.0300	0.0300
		67	0.03000	0.0300	0.0300
		68	0.03000	0.0300	0.0300
		69	0.03000	0.0300	0.0300
		70	0.03000	0.0300	0.0300
		71	0.03000	0.0300	0.0300
		72	0.03000	0.0300	0.0300
		73	0.03000	0.0300	0.0300
		74	0.03000	0.0300	0.0300
		75	0.03000	0.0300	0.0300

* Includes wage inflation of 3.00%



TABLE 7

ALL SYSTEMS

**BASE RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE
AND BENEFICIARIES OF DECEASED MEMBERS**

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000482	0.000136	71	0.024875	0.016060
20	0.000515	0.000153	72	0.027966	0.018111
21	0.000549	0.000170	73	0.031394	0.020430
22	0.000571	0.000187	74	0.035134	0.023029
23	0.000582	0.000196	75	0.039267	0.025949
24	0.000594	0.000213	76	0.043311	0.028764
25	0.000605	0.000230	77	0.047808	0.031875
26	0.000616	0.000247	78	0.052854	0.035323
27	0.000627	0.000255	79	0.058605	0.039137
28	0.000650	0.000272	80	0.065121	0.043381
29	0.000661	0.000289	81	0.073385	0.048256
30	0.000672	0.000315	82	0.082593	0.053825
31	0.000694	0.000332	83	0.092684	0.060037
32	0.000706	0.000349	84	0.103530	0.066973
33	0.000728	0.000374	85	0.114986	0.074705
34	0.000739	0.000400	86	0.127061	0.083324
35	0.000762	0.000425	87	0.139839	0.092942
36	0.000795	0.000451	88	0.153447	0.103673
37	0.000818	0.000485	89	0.168063	0.115648
38	0.000862	0.000510	90	0.183908	0.128999
39	0.000896	0.000544	91	0.200057	0.142871
40	0.000952	0.000587	92	0.216027	0.156805
41	0.000997	0.000621	93	0.231672	0.170697
42	0.001064	0.000663	94	0.247107	0.186568
43	0.001131	0.000706	95	0.262616	0.203286
44	0.001210	0.000757	96	0.278586	0.220820
45	0.003517	0.000995	97	0.295386	0.239261
46	0.003797	0.001097	98	0.313310	0.258692
47	0.004077	0.001216	99	0.332462	0.279062
48	0.004368	0.001352	100	0.352706	0.300247
49	0.004659	0.001496	101	0.373559	0.321932
50	0.004939	0.001658	102	0.394076	0.343638
51	0.005174	0.001836	103	0.414120	0.365160
52	0.005398	0.002040	104	0.433545	0.386305
53	0.005611	0.002253	105	0.452225	0.406898
54	0.005835	0.002499	106	0.470064	0.426778
55	0.006126	0.002771	107	0.486980	0.445801
56	0.006485	0.003069	108	0.502908	0.463865
57	0.006978	0.003400	109	0.517829	0.480879
58	0.007605	0.003774	110	0.525000	0.496791
59	0.008333	0.004182	111	0.525000	0.510000
60	0.009162	0.004633	112	0.525000	0.510000
61	0.010046	0.005134	113	0.525000	0.510000
62	0.010920	0.005687	114	0.525000	0.510000
63	0.011771	0.006307	115	0.525000	0.510000
64	0.012600	0.006987	116	0.525000	0.510000
65	0.013451	0.007744	117	0.525000	0.510000
66	0.014661	0.008748	118	0.525000	0.510000
67	0.016072	0.009883	119	0.525000	0.510000
68	0.017763	0.011163	120	1.000000	1.000000
69	0.019790	0.012613			
70	0.022154	0.014231			



TABLE 8

ALL SYSTEMS

BASE RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.005768	0.002818	71	0.062513	0.038433
20	0.005644	0.002680	72	0.065883	0.040894
21	0.005288	0.002473	73	0.069596	0.043620
22	0.004905	0.002231	74	0.073747	0.046667
23	0.004617	0.002047	75	0.078378	0.050071
24	0.004411	0.001990	76	0.083543	0.053866
25	0.004357	0.002036	77	0.089283	0.058087
26	0.004576	0.002208	78	0.095653	0.062802
27	0.004795	0.002404	79	0.102723	0.068057
28	0.005028	0.002622	80	0.110545	0.073922
29	0.005288	0.002852	81	0.119135	0.080420
30	0.005549	0.003105	82	0.128520	0.087630
31	0.005823	0.003370	83	0.138699	0.095600
32	0.006110	0.003657	84	0.149645	0.104363
33	0.006425	0.003968	85	0.161318	0.114000
34	0.006768	0.004313	86	0.173730	0.124097
35	0.007151	0.004681	87	0.186950	0.134447
36	0.007562	0.005095	88	0.201061	0.144946
37	0.008042	0.005532	89	0.216145	0.155641
38	0.008590	0.006026	90	0.232311	0.166658
39	0.009206	0.006601	91	0.249641	0.178193
40	0.009905	0.007234	92	0.269945	0.190475
41	0.010700	0.007924	93	0.291632	0.203757
42	0.011590	0.008671	94	0.313538	0.218282
43	0.012590	0.009488	95	0.335842	0.234290
44	0.013727	0.010373	96	0.358789	0.251908
45	0.014988	0.011328	97	0.382614	0.271239
46	0.016385	0.012340	98	0.407479	0.292250
47	0.017920	0.013421	99	0.433400	0.314778
48	0.019591	0.014571	100	0.460197	0.338514
49	0.021386	0.015790	101	0.487405	0.362963
50	0.023290	0.017066	102	0.514175	0.387435
51	0.024701	0.017653	103	0.540328	0.411700
52	0.026140	0.018251	104	0.565673	0.435540
53	0.027606	0.018860	105	0.590045	0.458758
54	0.029071	0.019458	106	0.613322	0.481172
55	0.030524	0.020033	107	0.635392	0.502619
56	0.031948	0.020654	108	0.656175	0.522986
57	0.033305	0.021321	109	0.675643	0.542168
58	0.034620	0.022000	110	0.685000	0.560108
59	0.035935	0.022713	111	0.685000	0.575000
60	0.037291	0.023460	112	0.685000	0.575000
61	0.038757	0.024265	113	0.685000	0.575000
62	0.040388	0.025128	114	0.685000	0.575000
63	0.042210	0.026082	115	0.685000	0.575000
64	0.044237	0.027117	116	0.685000	0.575000
65	0.046443	0.028256	117	0.685000	0.575000
66	0.048799	0.029521	118	0.685000	0.575000
67	0.051279	0.030935	119	0.685000	0.575000
68	0.053868	0.032511	120	1.000000	1.000000
69	0.056567	0.034270			
70	0.059431	0.036237			