Cavanaugh Macdonald
CONSULTING, LLC
*The experience and dedication you deserve*

May 1, 2014

Mr. Shawn Graham
Executive Director
Teachers Retirement System
State of Montana
1500 Sixth Avenue
Helena, MT 59620-0139

Dear Mr. Graham:

Enclosed are 15 copies of the "Montana Teachers' Retirement System Experience Study for the Five-Year Period Ending July 1, 2013".

Let us know if there are any questions concerning this report.

Sincerely,

Edward A. Macdonald ASA, FCA, MAAA
President

Todd B. Green, ASA, FCA, MAAA
Principal & Consulting Actuary

EAM:TBG/jnw

S:\Montana Teachers\Experience Studies\2014\Montana TRS Experience Study.docx

Cavanaugh Macdonald
CONSULTING, LLC
*The experience and dedication you deserve*

# Experience Study

# For the Five-Year Period

# Ending July 1, 2013

www.CavMacConsulting.com

# TABLE OF CONTENTS

Cavanaugh Macdonald
CONSULTING, LLC
*The experience and dedication you deserve*

May 1, 2014

Teachers' Retirement Board
State of Montana
1500 Sixth Avenue
Helena, MT 59620-0139

Dear Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the Montana Teachers' Retirement System. The purpose of this investigation is to assess the reasonability of the actuarial assumptions for the System. This investigation covers the five-year period from July 1, 2008 to July 1, 2013. As a result of the investigation, it is recommended that revised assumptions be adopted by the Board for future use.

The experience study includes all active full-time members, retired members and beneficiaries of deceased members. The mortality experience was studied separately for males and females. Incidences of withdrawal, disability, retirement and compensation increases were investigated without regard to gender. Retirement experience and compensation increases were investigated separately for university and non-university members.

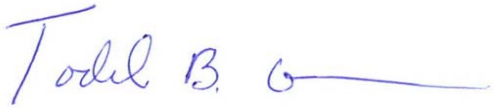
This report shows comparisons between the actual and expected cases of separation from active service, actual and expected number of deaths, and actual and expected salary increases. Tables and graphs are used to show the actual decrement rates, the expected decrement rates and, where applicable, the proposed decrement rates.

The recommended decrement tables are shown in Appendix D of this report. In the actuary's judgment, the recommended rates are suitable for use until further experience indicates that modifications are needed.

Actuarial assumptions are used to measure and budget future costs. Changing assumptions will not change the actual cost of future benefits. Once the assumptions have been adopted, the actuarial valuation measures the adequacy of the contributions rates set in Montana State Law.

The experience study 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 meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,



Edward A. Macdonald ASA, FCA, MAAA
President

Todd B. Green, ASA, FCA, MAAA
Principal & Consulting Actuary

EAM:TBG\jnw

S:\Montana Teachers\Experience Studies\2014\Montana TRS Experience Study.docx

## Summary of Results

The following summarizes the findings and recommendations with regard to the assumptions utilized by the Montana Teachers' Retirement System. Explanations for the recommendations are found in the sections that follow.

### Recommended Economic Assumption Changes

The table below lists the three economic assumptions used in the actuarial valuation and their current and proposed rates. We recommend reducing the assumed rates of price inflation and real wage growth.

| Item | Current | Proposed |
|---|---|---|
| Price Inflation | 3.50% | 3.25% |
| Investment Return | 7.75% | 7.75% |
| Real Wage Growth | 1.00% | 0.75% |

### Recommended Demographic Assumption Changes

The table below lists the demographic assumptions that we recommend be changed based on the experience of the last five years.

| Assumption Change |
|---|
| Update pre and post retirement mortality rates |

### Recommended Method Changes

#### Payroll Growth Assumption

In keeping with the real wage growth change, we recommend that the payroll growth assumption for amortization as a level percent of pay be reduced from 4.50% to 4.00%.

#### Administrative Expense Load

We have recommended an investment return assumption that is net of investment expenses only, therefore the normal cost rate must be loaded for administrative expenses. The administrative expense load is equal to the prior year's administrative expenses adjusted for non-recurring items as a percentage of payroll plus an additional amount for GASB Statements 67 & 68 reporting fees.

## Financial Impact

The following table highlights the impact of the recommended changes noted on the previous page on the unfunded accrued liability (UAL) and funded status for the System as of July 1, 2013.

($ Thousands)

| | Before Change | Reduced GABA After Change | Full GABA After Change |
|---|---|---|---|
| UAL | $1,524,780 | $1,565,438 | $1,944,206 |
| Funded Status | 66.80% | 66.21% | 61.21% |

## Economic Assumptions

There are three economic assumptions used in performing the actuarial valuation for the Montana Teachers' Retirement System. The assumptions are:

- Price Inflation
- Investment Return
- Wage Inflation

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"*, which provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. As noted in ASOP No. 27, because no one knows what the future holds, the best an actuary can do is to use professional judgment to estimate possible future economic outcomes based on a mixture of past experience and future expectations. These estimates therefore are best stated as a range utilizing the actuary's professional judgment. In setting the range and the single point within that range to use, the actuary should consider a number of factors, including the purpose and nature of the measurement, and appropriate recent and long-term historical economic data. However, the standard explicitly advises the actuary not to give undue weight to recent experience.

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

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 explanations of each assumption.

| Item | Current | Proposed |
|---|---|---|
| Price Inflation | 3.50% | 3.25% |
| Real Rate of Return | 4.25 | 4.50 |
| Investment Return | 7.75% | 7.75% |
| | | |
| Price Inflation | 3.50% | 3.25% |
| Real Wage Growth | 1.00 | 0.75 |
| Wage Inflation | 4.50% | 4.00% |

## Price Inflation

**Background:** As seen in the table on the previous page, assumed price inflation is used as a component for both the investment return assumption and the wage inflation assumption. The 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.

The current price inflation assumption is 3.50% per year.

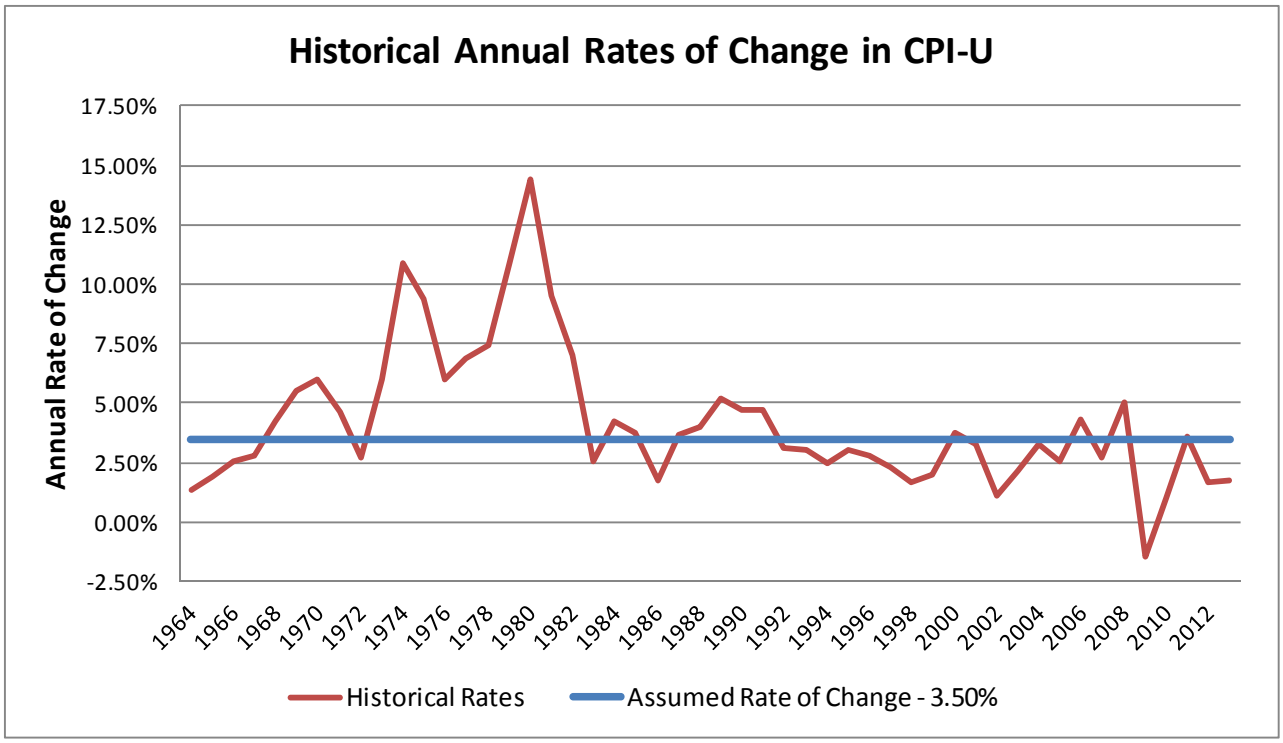
**Past Experience:** The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The level of that index in June of each of the last 50 years is provided in Appendix A.

In analyzing this data, average rates of inflation have been determined by measuring the compound growth rate of the CPI (U) over various time periods. The results are as follows:

| Period | Average Annual Rate of Inflation |
|---|---|
| 2003 – 2013 | 2.43% |
| 1993 – 2013 | 2.43% |
| 1983 – 2013 | 2.88% |
| 1973 – 2013 | 4.25% |
| 1963 – 2013 | 4.15% |
| 1953 – 2013 | 3.67% |
| 1926 – 2013 | 2.99% |

Over shorter historic periods, the average annual rate of increase in the CPI-U has been below 3.00%. The years of high inflation occurring from 1973 to 1982 has a significant impact on the averages over periods which include these rates. We should add that since 1926, the average annual rate of inflation was 2.99%.

The graph below shows the annual increases in the CPI (U) over a 50 year period.




Additional information to consider when determining the reasonable range is obtained from measuring the spread on inflation protected treasury bills (TIPS) and from the prevailing economic forecasts. The spread between the nominal yield on treasury securities and the inflation indexed nominal yield on TIPS of the same maturity is referred to as the "breakeven rate of inflation" and represents the bond market's expectation of inflation over the period to maturity. The table below provides the calculation of the breakeven rate of inflation as of December 31, 2013 over various periods.

| Years to Maturity | Bond Nominal Yield | TIPS Nominal Yield | Breakeven Rate of Inflation |
|---|---|---|---|
| 10 | 3.04% | 0.80% | 2.24% |
| 20 | 3.72% | 1.36% | 2.36% |
| 30 | 3.96% | 1.64% | 2.32% |

The bond market's expectation for the rate of inflation is significantly lower than historical average annual rates. Additionally, based upon information provided from the "Survey of Professional Forecasters" published by the Philadelphia Federal Reserve Bank, the median annual rate of inflation for the ten years beginning January 1, 2014 is 2.30%.

***Recommendation:*** It is difficult to accurately predict inflation. Current economic forecasts and the bond market suggest lower inflation over the next ten to twenty years when compared to the historical averages, which is a shorter time period than appropriate for our purposes. In the 2013 OASDI Trustees Report, the Chief Actuary for Social Security bases the 75 year cost projections on an intermediate inflation assumption of 2.8% with a range of 1.8% - 3.8%. We concur in general with a range of 2.0% - 4.0%, and recommend use of a 3.25% per year rate recognizing the likely inflation pressures built into the economy at the current time.

| Price Inflation Assumption | |
|---|---|
| Current | 3.50% |
| Reasonable Range | 2.00% - 4.00% |
| Recommended | 3.25% |

## 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 of the System. 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 Investments.

The current assumption is 7.75%, consisting of a price inflation assumption of 3.50% and a real rate of return assumption of 4.25%. The return is net of all investment and administrative expenses.

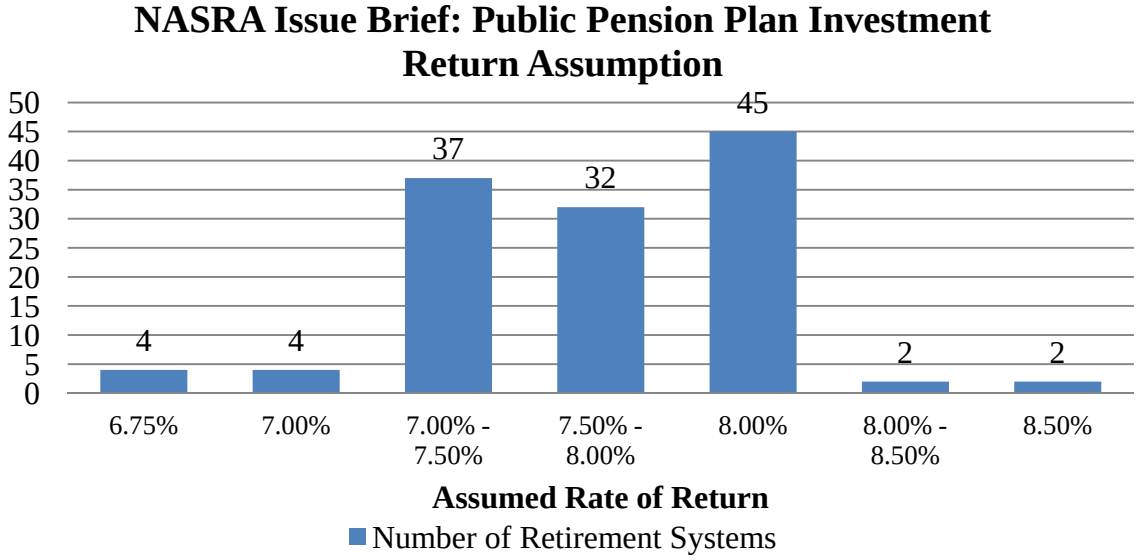
***Recent Experience:*** The actuarial value of assets of the System are developed using a widely accepted asset-smoothing methodology that fully recognizes investment gains and losses over a four year period. The recent experience for the retirement funds over the last fifteen years is shown in the table below.

| Nominal Total Rate of Return | | |
|---|---|---|
| Year Ending 6/30 | Market Value | Actuarial Value |
| 1999 | 11.9% | 12.3% |
| 2000 | 7.8% | 12.8% |
| 2001 | (5.1)% | 9.2% |
| 2002 | (7.3)% | 3.8% |
| 2003 | 6.2% | 1.6% |
| 2004 | 13.3% | 2.1% |
| 2005 | 8.0% | 2.7% |
| 2006 | 8.9% | 8.5% |
| 2007 | 17.6% | 10.2% |
| 2008 | (4.9)% | 7.2% |
| 2009 | (20.8)% | (10.3)% |
| 2010 | 12.9% | 9.8% |
| 2011 | 21.7% | (0.1)% |
| 2012 | 2.2% | 3.2% |
| 2013 | 12.9% | 12.0% |
| **Average** | **5.1%** | **5.5%** |

***Historical Analysis:*** The historical 50-year real rate of return of the S&P 500 has averaged 5.60%, and the 50-year real rate of return of intermediate-term government bonds as provided by *Ibbotson SBBI 2014 Classic Yearbook* has averaged 2.81%. By weighting these rates by common allocation of large retirement funds (30%/70% to 70%/30%) we construct the reasonable range for real rates of return to be from 3.98% to 5.11%. The following table shows various annualized rates of return based on different time periods and different allocations between equities and bonds.

| Time Span In Years | Real Returns by Portfolio Allocation Equities vs. Bonds | | | |
|---|---|---|---|---|
| | 30%/70% | 35%/65% | 65%/35% | 70%/30% |
| 10 | 3.41% | 3.61% | 4.53% | 4.64% |
| 20 | 4.59 | 4.82 | 5.97 | 6.12 |
| 30 | 5.89 | 6.11 | 7.21 | 7.36 |
| 40 | 4.67 | 4.86 | 5.85 | 5.98 |
| **50** | **3.98** | 4.14 | 4.99 | **5.11** |

***Peer Analysis:*** Review of the *NASRA Issue Brief: Public Pension Plan Investment Return Assumptions* update as of December 2013, 8.00% is the predominant assumption for public sector pension systems while the median is 7.72%.



***Capital Market Assumption Analysis:*** The current capital market assumptions and target asset allocations are shown in Appendix B. Using statistical distribution properties based upon capital market assumptions utilized by the Montana Board of Investments, provided by RVKuhns in setting the System's asset allocation targets, provides an expected range of real rates of return over various time horizons.

It is important to note that capital market assumptions can be quite volatile from year to year as they tend to forecast shorter time horizons than typically required by the public plan actuarial community when looking at the long-term time horizon of a public pension system.

| Time Span In Years | Mean Real Return | Standard Deviation | Real Returns by Percentile | | | | |
|---|---|---|---|---|---|---|---|
| | | | 5th | 25th | 50th | 75th | 95th |
| 1 | 4.75% | 13.42% | (15.77)% | (4.67)% | 3.90% | 13.24% | 28.17% |
| 5 | 4.07% | 5.94% | (5.41)% | (0.02)% | 3.90% | 7.98% | 14.13% |
| 10 | 3.99% | 4.20% | (2.77)% | 1.11% | 3.90% | 6.77% | 11.03% |
| 20 | 3.95% | 2.97% | **(0.86)%** | 1.92% | 3.90% | 5.92% | 8.90% |
| 30 | 3.93% | 2.42% | 0.00% | 2.28% | 3.90% | 5.55% | 7.96% |
| 50 | 3.92% | 1.88% | 0.86% | **2.65%** | 3.90% | **5.18%** | 7.03% |

The percentile ranks are the outcomes based on the log normal random variable distribution that produce returns of less than the return at that particular percentile level over the time span. Thus for the 20 year time span, 5% of the resulting real rates of return were below -0.86% and 95% were above that. As the time span increases, the results begin to merge. Over a 50 year time span, the result indicate there is a 25% chance that real return will be above 5.18% and a 25% chance they will be below 2.65%. In other words there is a 50% chance the real returns will be between 2.65% and 5.18%.

***Investment Expenses:*** Administrative expenses are directly reflected as a separate component in the calculation of the contribution rate. However, the investment return is assumed to be net of all investment-related expenses. The following table shows the ratio of expenses to Plan assets over the last eight years. The expense ratio is calculated as the total expense divided by the ending asset balance at fair market value. The table below compares, for the last nine years, the expense levels during the fiscal year to the market value of assets for the systems at the end of the fiscal years.

| FY Ending June 30 | Investment Expenses | Market Value of Assets | Expense Ratio |
|---|---|---|---|
| 2005 | 5,988,496 | 2,487,136,540 | 0.24% |
| 2006 | 7,687,038 | 2,745,771,047 | 0.28 |
| 2007 | 13,126,101 | 3,209,259,107 | 0.41 |
| 2008 | 23,228,638 | 2,993,392,632 | 0.78 |
| 2009 | 15,459,976 | 2,301,828,565 | 0.67 |
| 2010 | 15,701,678 | 2,521,445,720 | 0.62 |
| 2011 | 16,313,266 | 2,972,419,220 | 0.55 |
| 2012 | 16,154,418 | 2,932,202,476 | 0.55 |
| 2013 | 15,148,782 | 3,185,064,406 | 0.48 |

Over the five-year period the expense ratio averaged approximately 0.50%. The capital market assumptions provided by RVKuhns are net of investment expenses; therefore a separate investment expense assumption is not necessary

***Recommendation:*** Using the building block approach of ASOP No. 27 and the projection results outlined above, we recommend a range for the investment return assumption of the 25th to 75th percentile real returns over the 50 year time span plus the recommended inflation assumption less the recommended expense ratio assumption. The following table details the range. It should be noted that the time horizon that the reasonable range is relatively short compared to the time horizon required by actuaries. The difference in these time horizons can account for increased return in the long term.

| Item | 25th Percentile | 50th Percentile | 75th Percentile |
|---|---|---|---|
| Real Rate of Return | 2.65% | 3.90% | 5.18% |
| Inflation | 3.25 | 3.25 | 3.25 |
| Expenses* | 0.00 | 0.00 | 0.00 |
| Net Investment Return | 5.90% | 7.15% | 8.43% |

* *The capital market assumptions used to develop the reasonable range for the real rate of return are net of investment expenses. Therefore a separate assumption for investment expenses is not necessary.*

The current assumed rate of return of 7.75% is in line with its peer group of other public retirement systems, however, the 50th percentile net return based on the analysis utilizing the capital market assumptions provided by RVKuhns is 7.15% for the Montana Teachers' Retirement System.

Historically, a portfolio of assets that consisted of 65% S&P 500 and 35% intermediate-term government bonds yielded a compound average real rate of return on of 4.99% over the last 50 years. When combined with the inflation assumption of 3.25% that would yield an assumed rate of return of 8.24% on a historical basis.

The capital market assumptions provided by RVKuhns are based on a shorter time horizon relative to the time horizon required by actuaries. The capital market assumptions reflect the current economic environment that has outperformed current expectations. Due to the cyclical nature of the economy it is expected that the financial markets cannot continue at the current pace, therefore expectations are muted in the short run which has heavily biased the capital market assumptions. The actuary does not put undo weight on recent experience when setting the long-term assumed rate of return. In addition, the capital market assumptions do not reflect excess return that is derived through active management and other asset deployment strategies.

Our recommendation taking into account historical analysis, peer group analysis and the capital market assumption analysis is to maintain the current assumed rate of return of 7.75%.

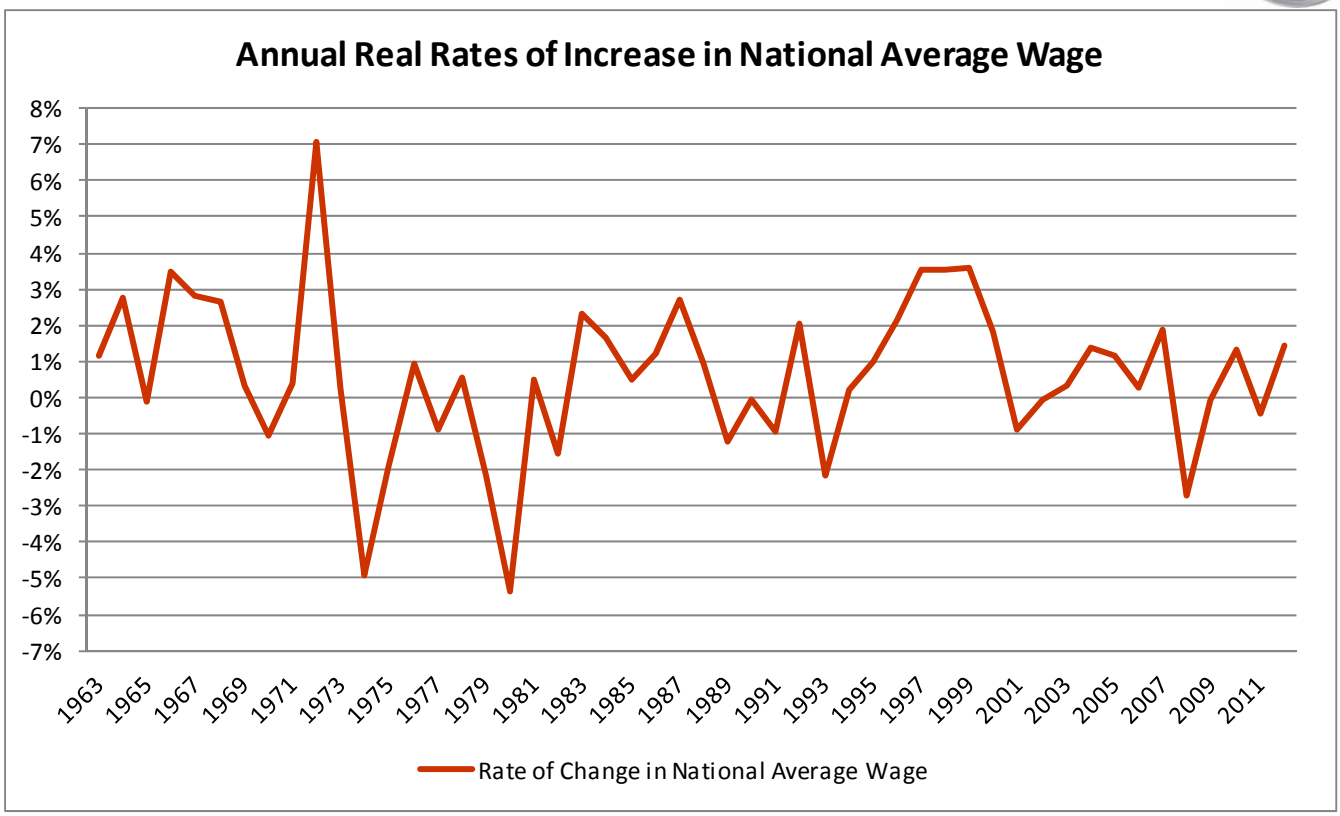
## Wage Inflation

***Background:*** The assumed future increases in salaries consist of an inflation component and a component for promotion and longevity, often called merit increases. Merit increases are generally age and or service related, and will be studied in the demographic assumption section of the report. Wage inflation normally is above price inflation, which reflects the overall return on labor in the economy. The current wage inflation assumption is 4.50%, or 1.00% above price inflation.

***Past Experience:*** The Social Security Administration publishes data on wage growth in the United States. Appendix C shows the last 50 calendar years' data. As we did in our analysis of inflation, on the following page, we show the wage inflation and a comparison with the price inflation over various time periods. Since wage data is only available through 2008 we use that year as the end point.

| Period | Wage Inflation | Price Inflation | Real Wage Growth |
|---|---|---|---|
| 2002-2012 | 2.92% | 2.46% | 0.44% |
| 1992-2012 | 3.35 | 2.49 | 0.83 |
| 1982-2012 | 3.79 | 2.91 | 0.85 |
| 1972-2012 | 4.67 | 4.36 | 0.30 |
| 1962-2012 | 4.78 | 4.14 | 0.62 |

Thus, over the last 50 years, annual real wage growth has averaged 0.62%. The graph on the following page shows the annual increases in real wage growth over the entire 50-year period.




***Recommendation:*** As we did with price inflation, we again look at the 2013 OASDI Trustees Report. The Chief Actuary for Social Security bases the 75 year cost projections on a national wage growth assumption 1.1% greater than the price inflation assumption of 2.8%. We concur in general with a range of .5% - 1.5%, and recommend use of a 0.75% per year rate at the current time.

| Wage Inflation Assumption | | |
|---|---|---|
| Current | 4.50% | |
| | Reasonable Range | |
| Real Wage Growth | 0.50% | 1.50% |
| Inflation | 3.25 | 3.25 |
| Total | 3.75% | 4.75% |
| Recommended | 4.00% | |

## Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for the Montana Teachers' Retirement System. They are:

- Rates of Withdrawal
- Rates of Disability Retirement
- Rates of Service Retirement
- Rates of Post-retirement Mortality
- Rates of Post-retirement Disabled Mortality
- Rates of Salary Increase for Merit and Promotions

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 35, *"Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations"*, which 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, 2008 through July 1, 2013) 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 identifying 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 under the current assumptions. If a change is being proposed, the revised actual to expected ratios are shown as well.

## Rates of Withdrawal

The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service that will occur prior to attaining the eligibility requirement for a retirement benefit as a result of resignation or dismissal.

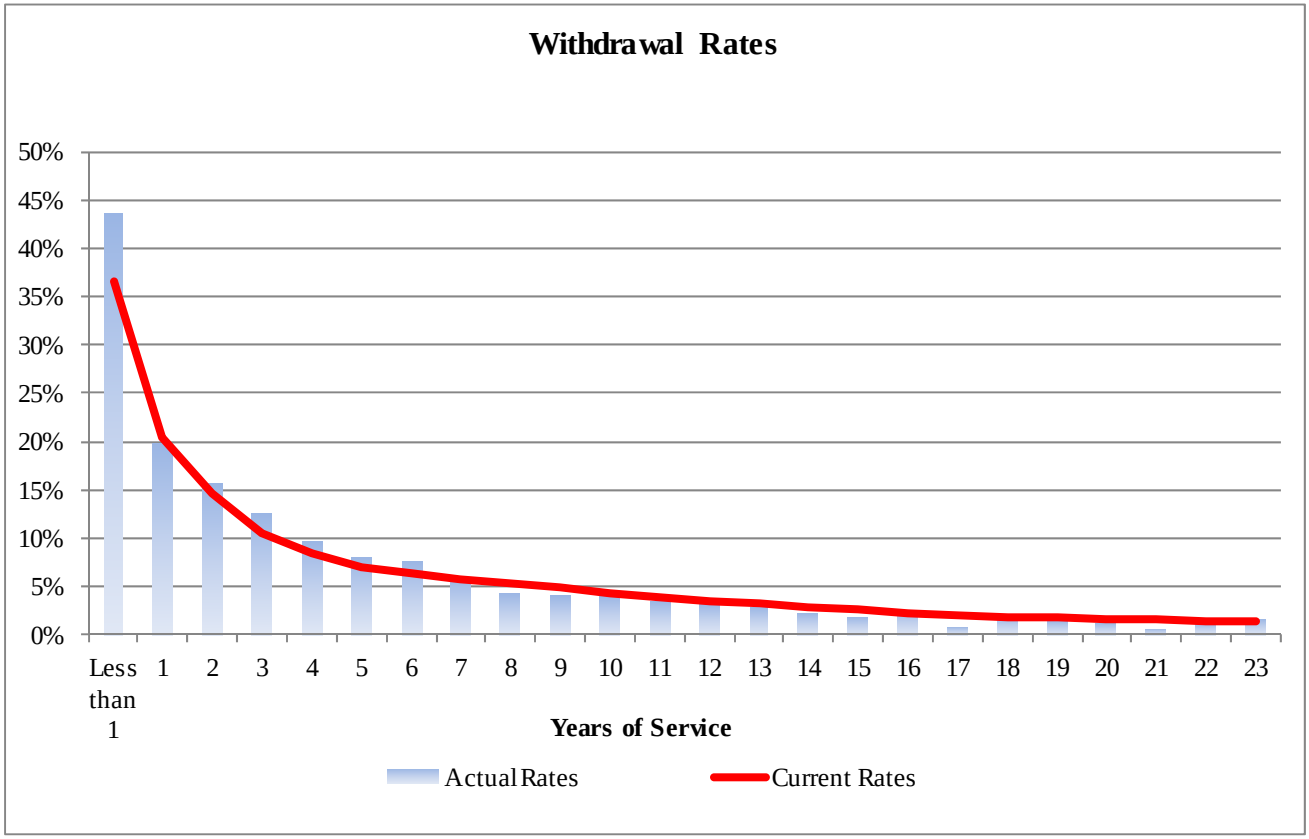
The current assumption utilizes a service based approach that sets the withdrawal rates based on years of service. Withdrawal experience was investigated without regard to gender for both Non-University and University members combined.

The analysis of the actual withdrawal experience for both University and Non-University members over the five-year period indicates an overall actual/expected ratio of 103%. A ratio that is greater than 100% indicates that there were more withdrawals during the experience period than were anticipated by the assumption.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| Years of Service | Withdrawal Experience | | |
|---|---|---|---|
| | Actual | Expected | Ratio Actual/Expected |
| Less than 1 | 91 | 76.25 | 1.19 |
| 1 | 621 | 644.02 | 0.96 |
| 2 | 501 | 465.67 | 1.08 |
| 3 | 387 | 325.24 | 1.19 |
| 4 | 283 | 248.84 | 1.14 |
| 5 | 185 | 159.27 | 1.16 |
| 6 | 153 | 127.77 | 1.20 |
| 7 | 107 | 104.77 | 1.02 |
| 8 | 73 | 89.82 | 0.81 |
| 9 | 67 | 79.87 | 0.84 |
| 10 | 61 | 65.42 | 0.93 |
| 11 | 51 | 56.56 | 0.90 |
| 12 | 44 | 46.67 | 0.94 |
| 13 | 35 | 39.18 | 0.89 |
| 14 | 25 | 33.07 | 0.76 |
| 15 | 20 | 29.13 | 0.69 |
| 16 | 26 | 24.25 | 1.07 |
| 17 | 8 | 19.87 | 0.40 |
| 18 | 17 | 18.04 | 0.94 |
| 19 | 12 | 15.65 | 0.77 |
| 20 | 8 | 12.42 | 0.64 |
| 21 | 3 | 9.88 | 0.30 |
| 22 | 6 | 7.88 | 0.76 |
| 23 | 8 | 6.86 | 1.17 |
| 24 | 15 | 6.04 | 2.48 |
| TOTAL | 2,807 | 2,712.44 | 1.03 |

The chart below shows (i) the actual average withdrawal rates of employment by years of service during the past five years and (ii) the current assumed withdrawal rates.




**Findings and Recommendations**

The data reflects that in general the assumption is sufficient in predicting withdrawal rates and we make no recommended changes at this time.

## Rates of Disability Retirement

The rates of disability used in the actuarial valuation project the percentage of employees who are expected to become disabled each year.

Disability experience was investigated without regard to gender for both Non-University and University members combined.

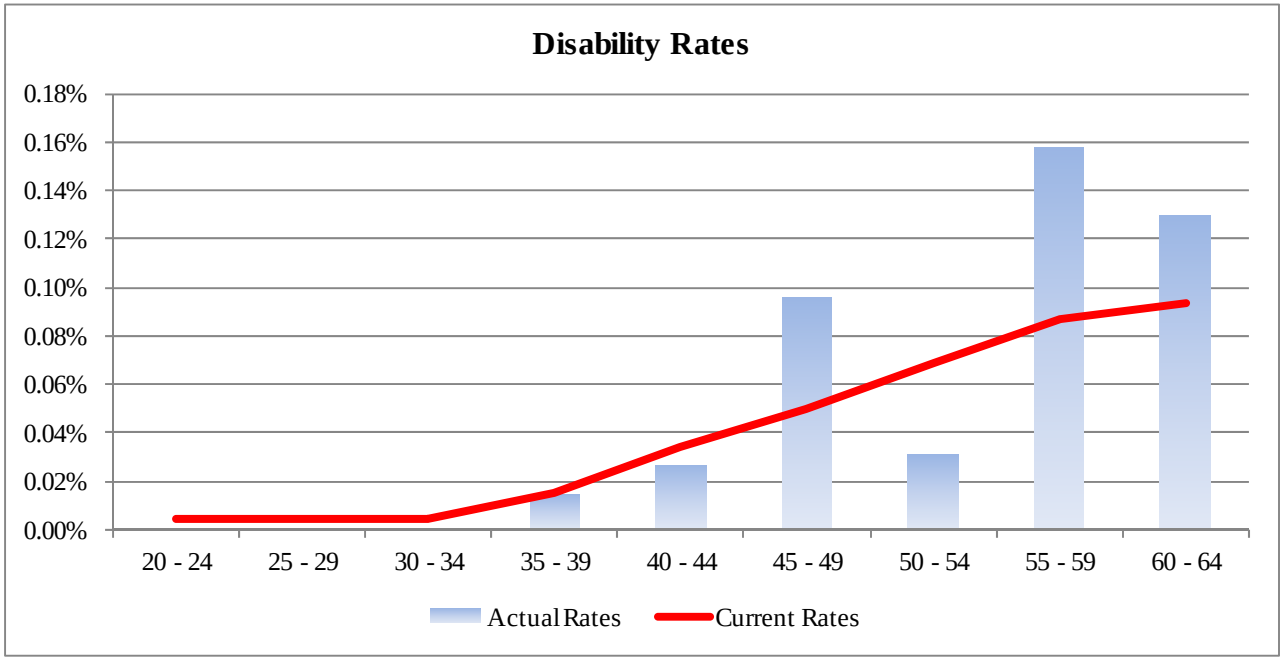
The analysis of the actual disability experience for both Non-University and University members over the five-year experience period yields an actual/expected ratio of 123%. A ratio that is greater than 100% indicates that there were more disability retirements during the experience period than were anticipated by the assumption.

The table below details the actual/expected ratio by age group and in total.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| | Disability Experience | | |
|---|---|---|---|
| | | | Ratio |
| Age Group | Actual | Expected | Actual/Expected |
| Under 20 | 0 | 0.00 | 0.00 |
| 20 - 24 | 0 | 0.02 | 0.00 |
| 25 - 29 | 0 | 0.24 | 0.00 |
| 30 - 34 | 0 | 0.32 | 0.00 |
| 35 - 39 | 1 | 1.09 | 0.92 |
| 40 - 44 | 2 | 2.58 | 0.78 |
| 45 - 49 | 8 | 4.14 | 1.93 |
| 50 - 54 | 3 | 6.68 | 0.45 |
| 55 - 59 | 16 | 8.84 | 1.81 |
| 60 - 64 | 8 | 5.75 | 1.39 |
| 65 & Over | 0 | 1.13 | 0.00 |
| TOTAL | 38 | 30.79 | 1.23 |

The chart below shows (i) the actual disability rates for employees by age during the past five years and (ii) the current assumed disability rates.




**Findings and Recommendations**

The data reflects that in general the assumption is sufficient in predicting disability retirements and we make no recommended changes at this time.

## Rates of Retirement

The retirement rates used in the actuarial valuation project the percentage of employees who are expected to retire during the upcoming year. Separate rates are assumed for University and Non-University members.

In addition to membership type, retirement rates are set based on type of retirement. The rates of retirement were studied separately for those eligible for a reduced benefit, first eligible for an unreduced benefit and beyond first eligibility for an unreduced benefit.

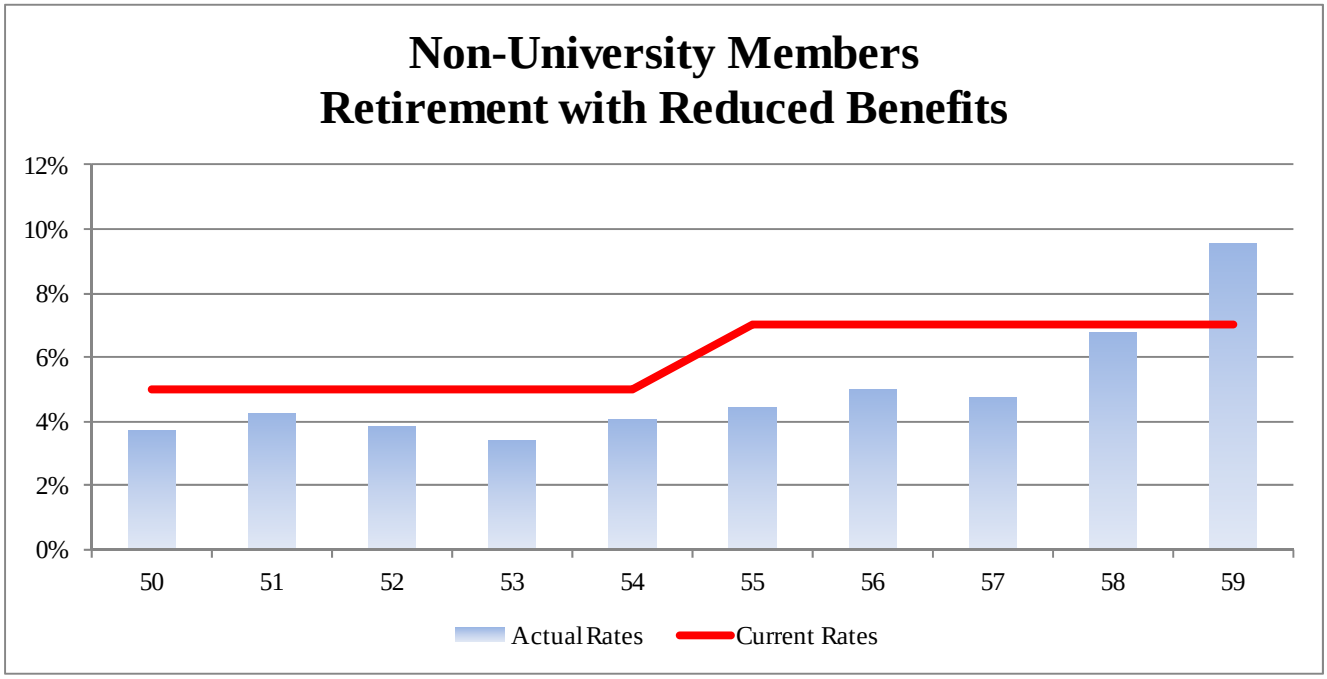
### Eligible for a Reduced Benefit

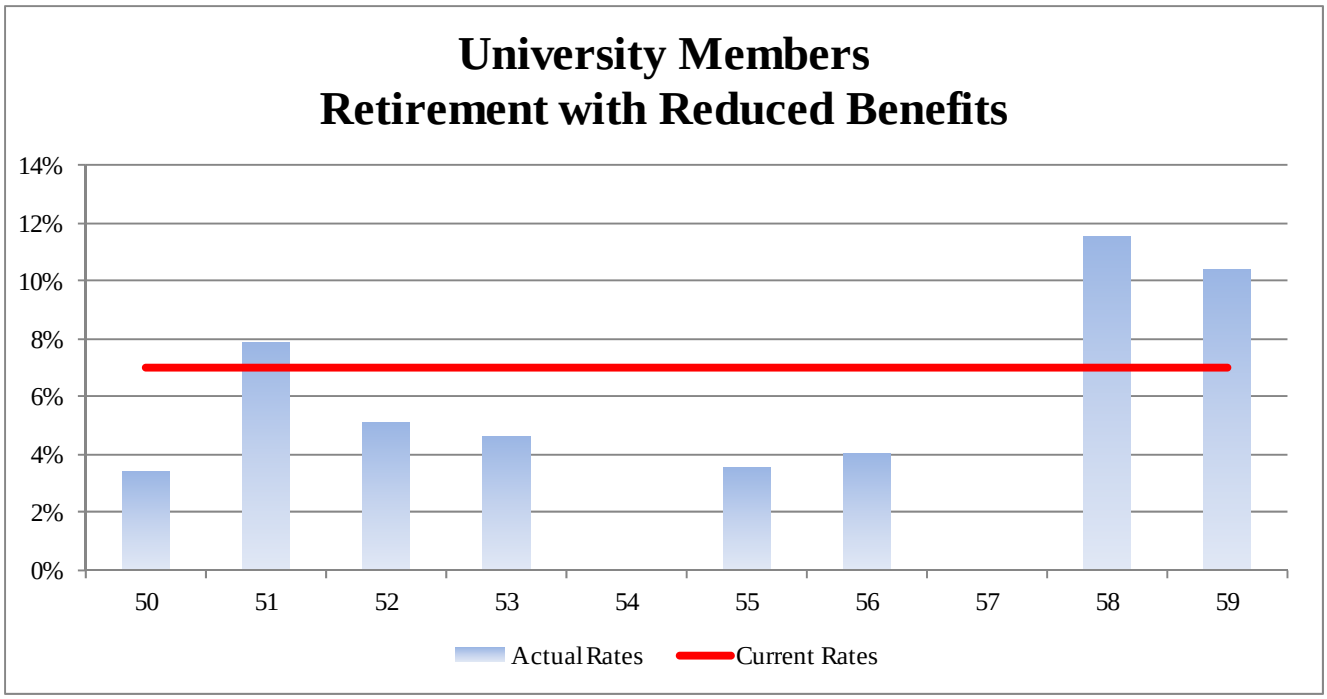
The analysis of the actual retirement experience over the five-year period yields actual/expected ratios of 81% and 73% respectively for Non-University and University members. Actual/expected ratios that are less than 100% indicate that in general less people have retired with a reduced retirement benefit than were anticipated by the current assumption.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| Number of Service Retirements<br>Eligible for a Reduced Benefit | | | | | | |
|---|---|---|---|---|---|---|
| | Current Rates | | | | | |
| | Non-University | | | Universtiy | | |
| Age | Actual | Expected | Ratio<br>Actual/Expected | Actual | Expected | Ratio<br>Actual/Expected |
| 50 | 42 | 56.80 | 0.74 | 1 | 2.03 | 0.49 |
| 51 | 49 | 57.44 | 0.85 | 3 | 2.66 | 1.13 |
| 52 | 43 | 55.99 | 0.77 | 2 | 2.73 | 0.73 |
| 53 | 38 | 55.33 | 0.69 | 2 | 3.01 | 0.66 |
| 54 | 45 | 55.03 | 0.82 | 0 | 3.29 | 0.00 |
| 55 | 47 | 73.46 | 0.64 | 2 | 3.91 | 0.51 |
| 56 | 50 | 70.24 | 0.71 | 2 | 3.49 | 0.57 |
| 57 | 45 | 66.31 | 0.68 | 0 | 3.56 | 0.00 |
| 58 | 60 | 61.83 | 0.97 | 6 | 3.63 | 1.65 |
| 59 | 77 | 56.30 | 1.37 | 5 | 3.35 | 1.49 |
| TOTAL | 496 | 608.73 | 0.81 | 23 | 31.66 | 0.73 |

The charts below show (i) the actual retirement rates for employees by age during the past five years and (ii) the current assumed retirement rates separately for Non-University and University members.



**Findings and Recommendations**

In general, actual retirements for members who were eligible for a reduced benefit were fewer than expected for both Non-University and University members. We are not recommending changing this assumption at this time. We will continue to monitor this trend in future experience studies to confirm that this is a pattern of behavior before recommending any changes to this assumptions.

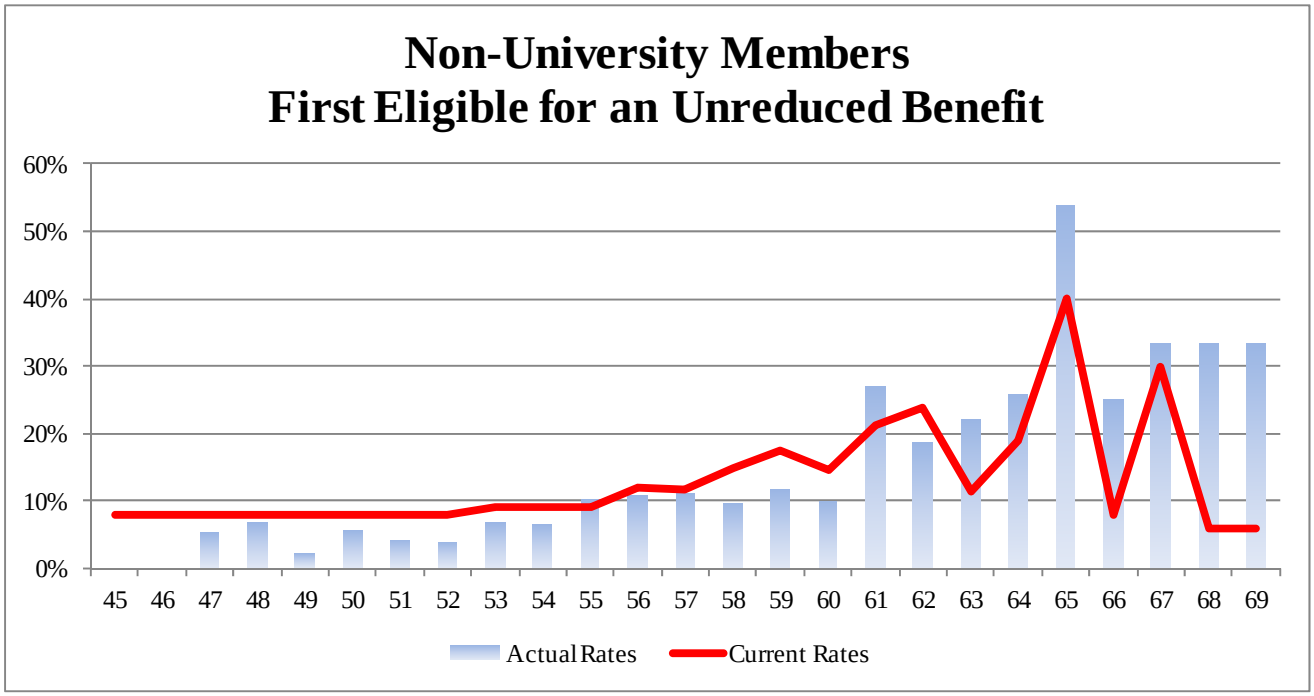
**First Eligible for an Unreduced Benefit**

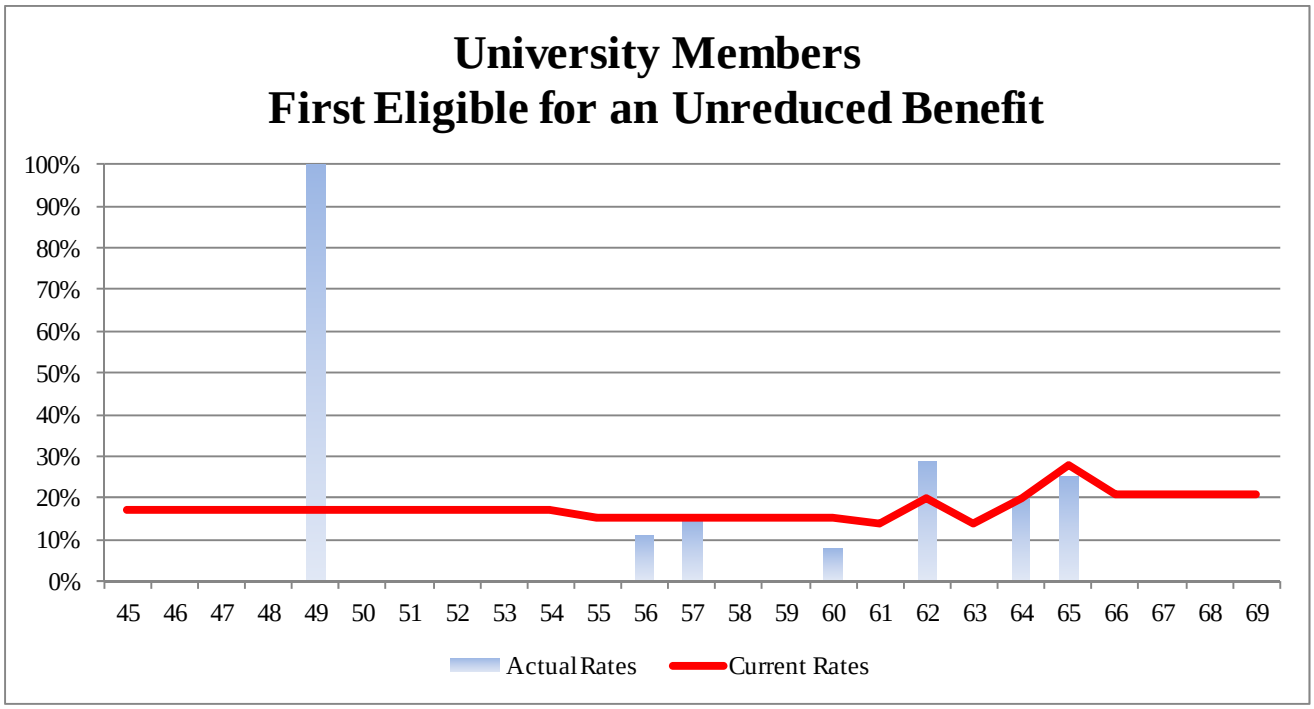
The analysis of the actual retirement experience over the five-year period yields an actual/expected ratio of 78% and 51% respectively for Non-University and University members respectively. An actual/expected ratio that is less than 100% indicates that fewer members are retiring when they become first eligible for a retirement than is anticipated by the assumption.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| Number of Service Retirements<br>First Eligible for an Unreduced Benefit | | | | | | |
|---|---|---|---|---|---|---|
| | Current Rates | | | | | |
| | Non-University | | | University | | |
| | | | Ratio | | | Ratio |
| Age | Actual | Expected | Actual/Expected | Actual | Expected | Actual/Expected |
| 45 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 46 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 47 | 4 | 6.00 | 0.67 | 0 | 0.00 | 0.00 |
| 48 | 9 | 10.47 | 0.86 | 0 | 0.17 | 0.00 |
| 49 | 3 | 11.11 | 0.27 | 1 | 0.17 | 5.88 |
| 50 | 5 | 7.11 | 0.70 | 0 | 0.17 | 0.00 |
| 51 | 3 | 5.75 | 0.52 | 0 | 0.17 | 0.00 |
| 52 | 3 | 5.99 | 0.50 | 0 | 0.51 | 0.00 |
| 53 | 6 | 7.82 | 0.77 | 0 | 0.68 | 0.00 |
| 54 | 4 | 5.57 | 0.72 | 0 | 0.34 | 0.00 |
| 55 | 8 | 7.10 | 1.13 | 0 | 0.75 | 0.00 |
| 56 | 6 | 6.71 | 0.89 | 1 | 1.35 | 0.74 |
| 57 | 9 | 9.54 | 0.94 | 1 | 1.05 | 0.95 |
| 58 | 7 | 10.63 | 0.66 | 0 | 1.05 | 0.00 |
| 59 | 5 | 7.47 | 0.67 | 0 | 1.20 | 0.00 |
| 60 | 76 | 110.55 | 0.69 | 4 | 7.78 | 0.51 |
| 61 | 17 | 15.04 | 1.13 | 0 | 0.72 | 0.00 |
| 62 | 9 | 11.79 | 0.76 | 2 | 1.34 | 1.49 |
| 63 | 11 | 10.15 | 1.08 | 0 | 0.87 | 0.00 |
| 64 | 8 | 7.43 | 1.08 | 1 | 0.90 | 1.11 |
| 65 | 7 | 4.88 | 1.43 | 1 | 1.04 | 0.96 |
| 66 | 2 | 1.35 | 1.48 | 0 | 0.42 | 0.00 |
| 67 | 2 | 1.39 | 1.44 | 0 | 0.73 | 0.00 |
| 68 | 2 | 1.19 | 1.68 | 0 | 0.19 | 0.00 |
| 69 | 1 | 0.46 | 2.17 | 0 | 0.00 | 0.00 |
| TOTAL | 207 | 265.50 | 0.78 | 11 | 21.60 | 0.51 |

The charts below show (i) the actual rates of retirement for employees by age during past five years and (ii) the current assumed rates of retirement for both non-university and university members.



**Findings and Recommendations**

We are not recommending changing this assumption at this time. We will continue to monitor this trend in future experience studies to confirm that this is a pattern of behavior before recommending any changes to this assumptions.

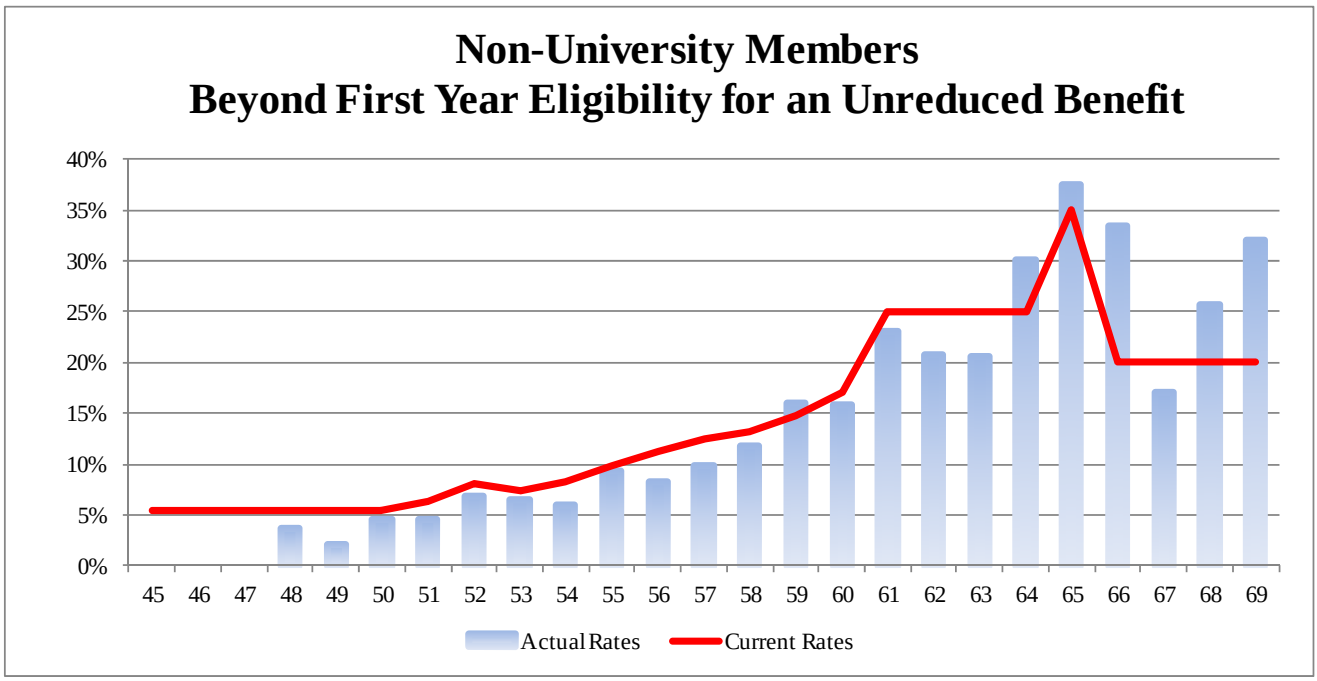
**Beyond First Year of Eligibility for an Unreduced Benefit**

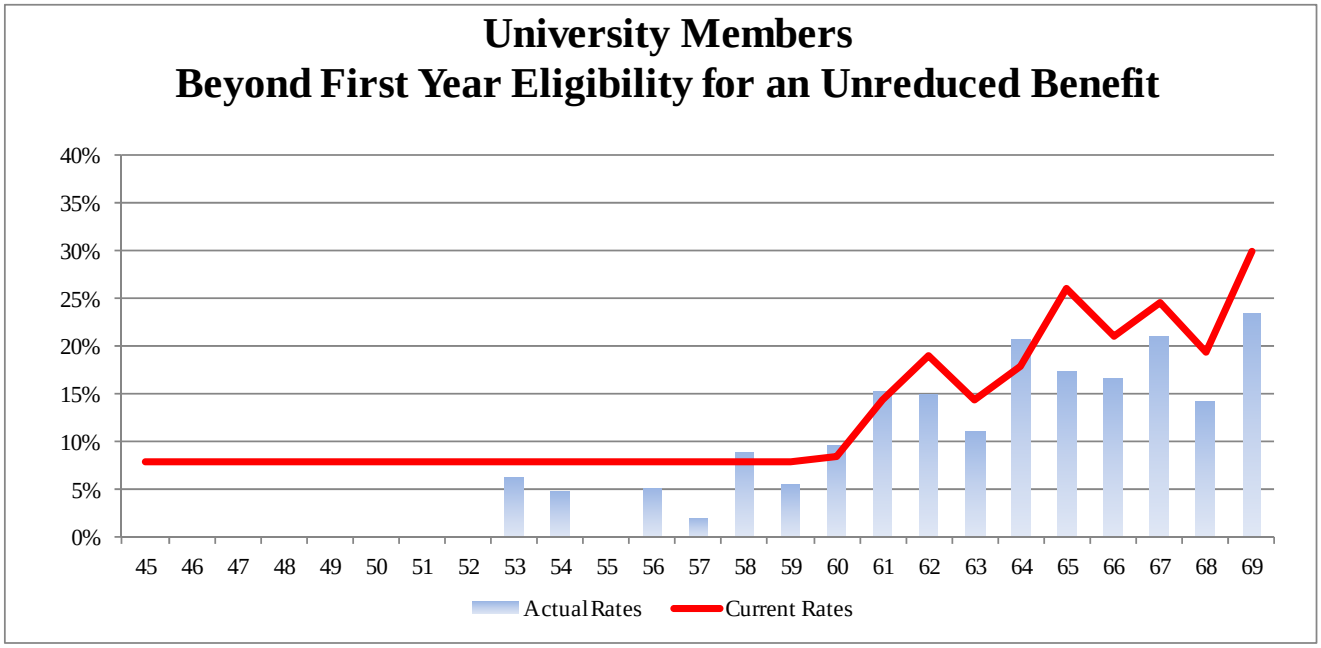
The analysis of the actual retirement experience over the five-year period yields an actual/expected ratio of 93% and 84% respectively for Non-University and University members respectively. An actual/expected ratio that is less than 100% indicates that fewer members are retiring than are anticipated by the assumption.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| Number of Service Retirements<br>Beyond First Year of Eligibility for an Unreduced Benefit | | | | | | |
|---|---|---|---|---|---|---|
| | Current Rates | | | | | |
| | Non-University | | | University | | |
| | | | Ratio | | | Ratio |
| Age | Actual | Expected | Actual/Expected | Actual | Expected | Actual/Expected |
| 45 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 46 | 0 | 0.05 | 0.00 | 0 | 0.00 | 0.00 |
| 47 | 0 | 0.05 | 0.00 | 0 | 0.00 | 0.00 |
| 48 | 3 | 4.40 | 0.68 | 0 | 0.08 | 0.00 |
| 49 | 5 | 12.97 | 0.39 | 0 | 0.16 | 0.00 |
| 50 | 17 | 20.33 | 0.84 | 0 | 0.24 | 0.00 |
| 51 | 22 | 30.08 | 0.73 | 0 | 0.56 | 0.00 |
| 52 | 36 | 42.35 | 0.85 | 0 | 0.72 | 0.00 |
| 53 | 39 | 43.60 | 0.89 | 1 | 1.28 | 0.78 |
| 54 | 41 | 55.60 | 0.74 | 1 | 1.68 | 0.60 |
| 55 | 70 | 74.17 | 0.94 | 0 | 2.08 | 0.00 |
| 56 | 67 | 91.04 | 0.74 | 2 | 3.03 | 0.66 |
| 57 | 85 | 107.56 | 0.79 | 1 | 3.91 | 0.26 |
| 58 | 101 | 112.30 | 0.90 | 5 | 4.47 | 1.12 |
| 59 | 135 | 125.08 | 1.08 | 4 | 5.75 | 0.70 |
| 60 | 122 | 131.43 | 0.93 | 8 | 6.62 | 1.21 |
| 61 | 308 | 332.10 | 0.93 | 22 | 20.68 | 1.06 |
| 62 | 202 | 242.01 | 0.83 | 20 | 25.19 | 0.79 |
| 63 | 145 | 175.65 | 0.83 | 13 | 17.05 | 0.76 |
| 64 | 158 | 130.49 | 1.21 | 22 | 19.01 | 1.16 |
| 65 | 126 | 117.09 | 1.08 | 14 | 20.96 | 0.67 |
| 66 | 58 | 34.43 | 1.68 | 11 | 13.79 | 0.80 |
| 67 | 15 | 17.50 | 0.86 | 11 | 12.67 | 0.87 |
| 68 | 18 | 13.92 | 1.29 | 6 | 8.14 | 0.74 |
| 69 | 17 | 10.53 | 1.61 | 8 | 10.13 | 0.79 |
| TOTAL | 1,790 | 1,924.73 | 0.93 | 149 | 178.20 | 0.84 |

The charts below show (i) the actual retirement rates by age and (ii) the current assumed rates of retirement for both non-university and university members.



**Findings and Recommendations**

We are not recommending changing this assumption at this time. We will continue to monitor this trend in future experience studies to confirm that this is a pattern of behavior before recommending any changes to this assumptions.

## Rates of Mortality

Mortality tables are a fundamental assumption in actuarial valuations. Because benefits are typically paid over a retiree's lifetime, it is important to appropriately reflect what a typical lifetime looks like. In addition, deaths before retirement may also result in the payout of benefits to a spouse or survivor. For valuation purposes, we must consider mortality tables for retirees, beneficiaries of retirees, disabled retirees, and active members.

The post-retirement mortality rates used in the actuarial valuation project the percentage of retirees who are expected to die in a given future year. This assumption is a very important demographic assumption since it typically has the most significant impact on liability projections.

Based upon the long term trend of mortality improvement, actuaries seek to account for future improvements in longevity, either by directly projecting future improvements or by maintaining a sufficient margin in expected rates of mortality to allow for future improvement. We propose that the selected table reflect some degree of future improvement now, thereby providing a margin for improvement.

### Retiree and Beneficiary Mortality

The analysis of the actual post-retirement mortality experience over the five-year experience study period yields actual/expected ratios of 99% and 97% respectively for males and females. The table below details the actual/expected ratios by individual age group and total.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

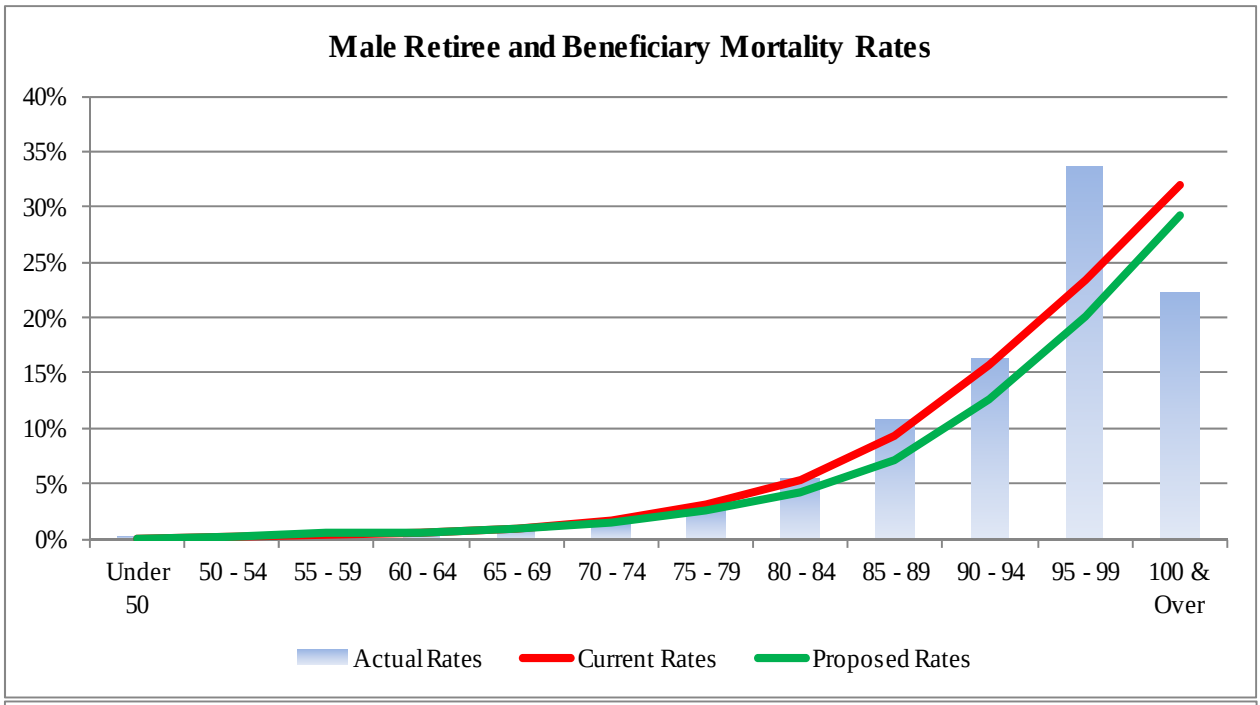
| | Post-Retirement Mortality Experience | | | | | |
|---|---|---|---|---|---|---|
| | Males | | | Females | | |
| Age Group | Actual | Expected | Ratio Actual/Expected | Actual | Expected | Ratio Actual/Expected |
| Under 50 | 1 | 0.27 | 3.70 | 1 | 0.24 | 4.17 |
| 50 - 54 | 0 | 0.96 | 0.00 | 3 | 1.35 | 2.22 |
| 55 - 59 | 10 | 5.71 | 1.75 | 6 | 8.70 | 0.69 |
| 60 - 64 | 22 | 27.57 | 0.80 | 35 | 37.94 | 0.92 |
| 65 - 69 | 57 | 62.04 | 0.92 | 40 | 70.22 | 0.57 |
| 70 - 74 | 64 | 81.89 | 0.78 | 58 | 81.69 | 0.71 |
| 75 - 79 | 95 | 105.94 | 0.90 | 75 | 101.54 | 0.74 |
| 80 - 84 | 115 | 113.81 | 1.01 | 111 | 127.29 | 0.87 |
| 85 - 89 | 132 | 112.60 | 1.17 | 192 | 167.27 | 1.15 |
| 90 - 94 | 71 | 68.28 | 1.04 | 208 | 178.74 | 1.16 |
| 95 - 99 | 35 | 24.31 | 1.44 | 115 | 102.45 | 1.12 |
| 100 & Over | 6 | 8.61 | 0.70 | 31 | 23.20 | 1.34 |
| TOTAL | 608 | 611.99 | 0.99 | 875 | 900.63 | 0.97 |

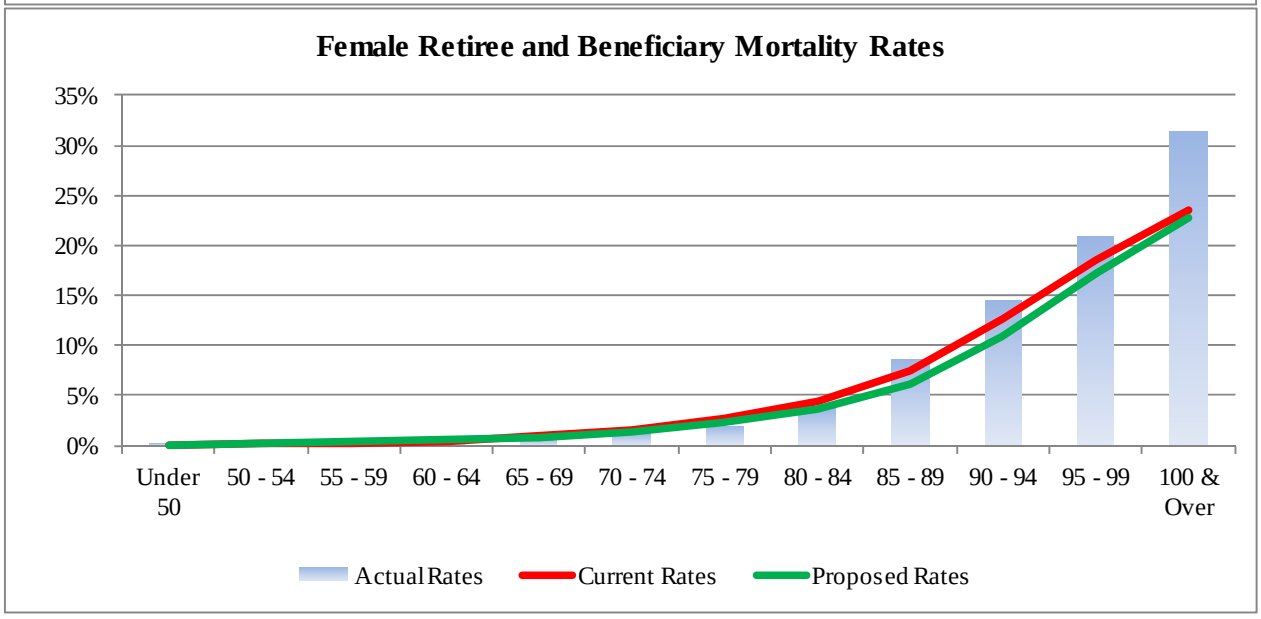
**Findings and Recommendations**

Experience indicates that overall slightly fewer members have died than were anticipated during the study period. The table currently in use is the RP-2000 Combined Healthy Mortality for Males set back three years, with mortality improvements projected by Scale AA to 2008, and Females set back two years, with mortality improvements projected by Scale AA to 2008. Since the current table no longer provides sufficient margin for mortality improvement, we recommend updating the post-retirement mortality assumption to the RP-2000 Healthy Annuitant Mortality for ages 50 and above and the RP-2000 combined healthy annuitant mortality for ages below 50 projected to 2018 Scale BB set back 4 years for males and set back 2 years for females.

The number of deaths among active members is not large enough to provide statistics credible enough to develop a unique table. Therefore, it is assumed that pre-retirement mortality follows the same table for healthy post-retirement mortality.

The charts below show (i) actual mortality rates for retirees by age group, (ii) the currently assumed mortality rates for retirees and (iii) the recommended mortality rates for retirees and beneficiaries.



## EXPERIENCE UNDER PROPOSED ASSUMPTIONS

The actual/expected ratios under the proposed assumptions are 117% compared to 99% for males and 111% compared to 97% for females. The recommended table provides sufficient margin for mortality improvement in the future. The table below details the actual/expected ratios by individual age group and total.

| | Post-Retirement Mortality Experience | | | | | |
|---|---|---|---|---|---|---|
| | Males | | | Females | | |
| Age Group | Actual | Proposed | Ratio Actual/Expected | Actual | Proposed | Ratio Actual/Expected |
| Under 50 | 1 | 0.28 | 3.57 | 1 | 0.27 | 3.70 |
| 50 - 54 | 0 | 1.48 | 0.00 | 3 | 1.80 | 1.67 |
| 55 - 59 | 10 | 10.62 | 0.94 | 6 | 10.14 | 0.59 |
| 60 - 64 | 22 | 32.41 | 0.68 | 35 | 38.55 | 0.91 |
| 65 - 69 | 57 | 56.56 | 1.01 | 40 | 62.70 | 0.64 |
| 70 - 74 | 64 | 69.76 | 0.92 | 58 | 69.68 | 0.83 |
| 75 - 79 | 95 | 86.97 | 1.09 | 75 | 86.69 | 0.87 |
| 80 - 84 | 115 | 90.31 | 1.27 | 111 | 108.36 | 1.02 |
| 85 - 89 | 132 | 87.43 | 1.51 | 192 | 139.35 | 1.38 |
| 90 - 94 | 71 | 54.87 | 1.29 | 208 | 154.89 | 1.34 |
| 95 - 99 | 35 | 20.98 | 1.67 | 115 | 95.32 | 1.21 |
| 100 & Over | 6 | 7.90 | 0.76 | 31 | 22.44 | 1.38 |
| TOTAL | 608 | 519.57 | 1.17 | 875 | 790.19 | 1.11 |

### Rates of Disabled Post-Retirement Mortality

The disability mortality rates used in the actuarial valuations project the percentage of disabled retirees who are expected to die in the upcoming year for both Non-University and University Members. Mortality for disabled retirees is expected to be higher than mortality for non-disabled retirees.

The analysis of the actual disabled mortality over the five-year experience study period yields actual/expected ratio of 119% and 108% respectively for disabled male and female retirees. The table below shows the actual/expected ratios by age groups and in total.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

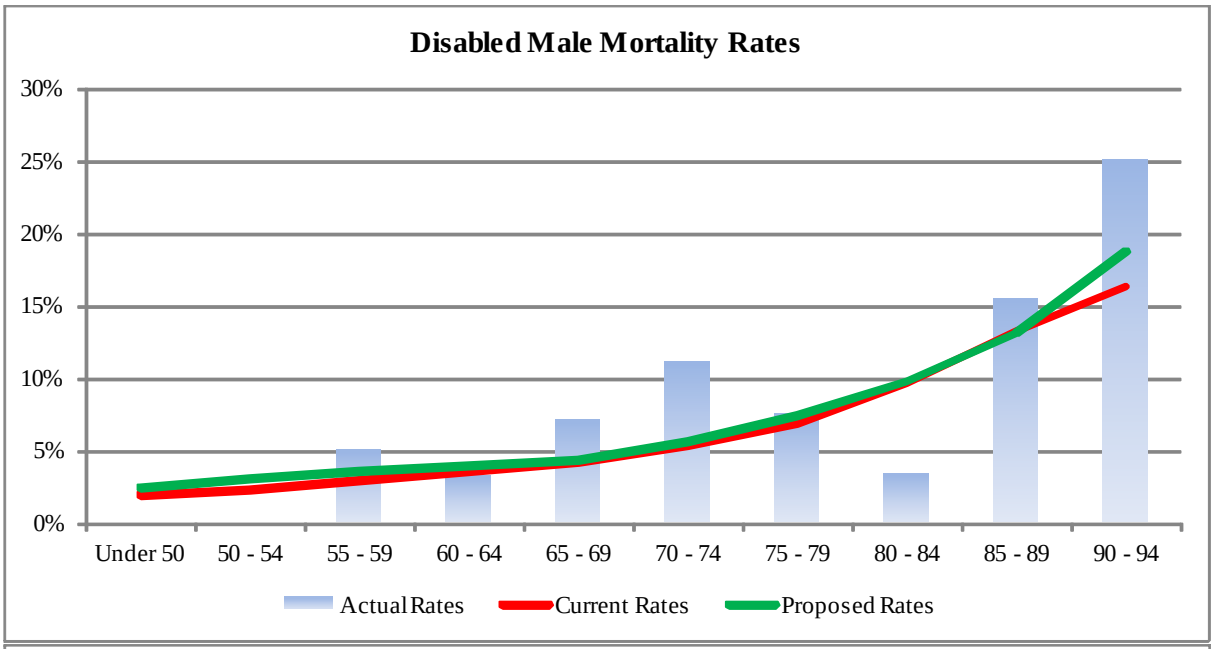
| | Post-Disablement Mortality Experience | | | | | |
|---|---|---|---|---|---|---|
| | Males | | | Females | | |
| Age Group | Actual | Expected | Ratio Actual/Expected | Actual | Expected | Ratio Actual/Expected |
| Under 25 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 25 - 29 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 30 - 34 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 35 - 39 | 0 | 0.04 | 0.00 | 0 | 0.02 | 0.00 |
| 40 - 44 | 0 | 0.04 | 0.00 | 1 | 0.09 | 11.11 |
| 45 - 49 | 0 | 0.24 | 0.00 | 0 | 0.35 | 0.00 |
| 50 - 54 | 0 | 0.29 | 0.00 | 3 | 0.80 | 3.75 |
| 55 - 59 | 2 | 1.22 | 1.64 | 5 | 2.36 | 2.12 |
| 60 - 64 | 2 | 2.24 | 0.89 | 2 | 4.75 | 0.42 |
| 65 - 69 | 4 | 2.40 | 1.67 | 3 | 4.16 | 0.72 |
| 70 - 74 | 4 | 1.95 | 2.05 | 0 | 4.35 | 0.00 |
| 75 - 79 | 3 | 2.79 | 1.08 | 4 | 2.80 | 1.43 |
| 80 - 84 | 1 | 2.79 | 0.36 | 8 | 4.60 | 1.74 |
| 85 - 89 | 2 | 1.72 | 1.16 | 2 | 2.37 | 0.84 |
| 90 - 94 | 3 | 1.95 | 1.54 | 4 | 3.00 | 1.33 |
| 95 - 99 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 100 & Over | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| TOTAL | 21 | 17.67 | 1.19 | 32 | 29.65 | 1.08 |

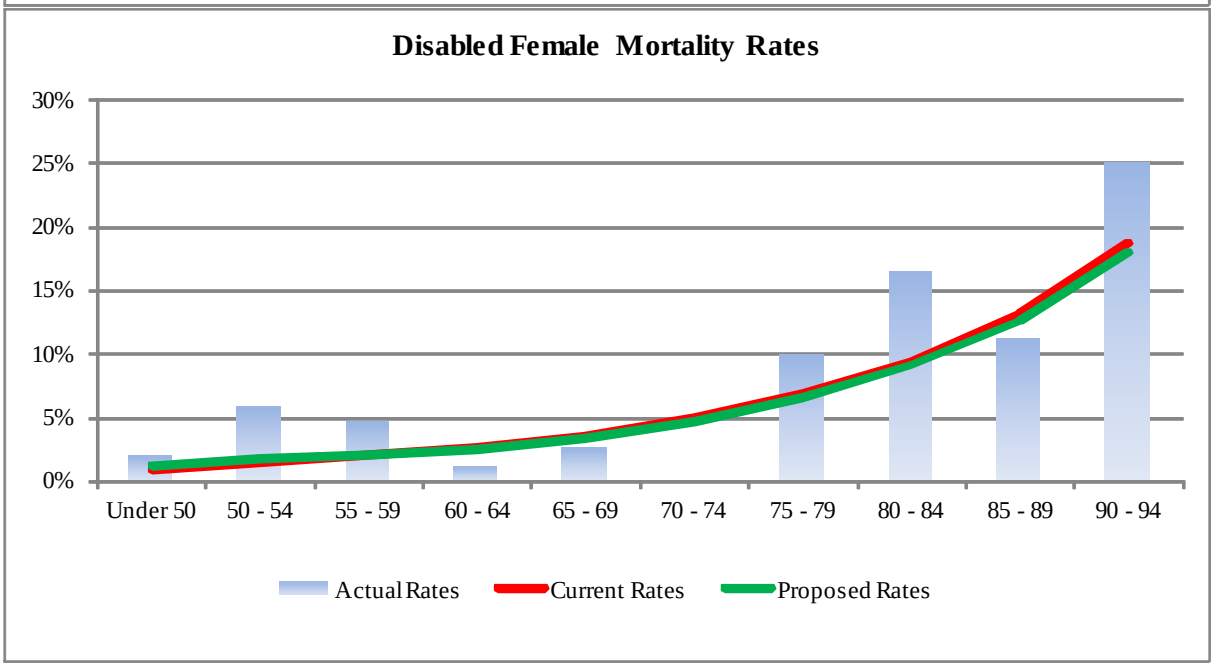
**Findings and Recommendations**

Experience indicates that overall more disabled retired members have died than expected during the study period. The table currently in use is the RP-2000 Disabled Mortality, setback three years for males and set forward three years for females, with mortality improvement projected by Scale AA to 2008.

The current table still provides sufficient margin, however we recommend the RP-2000 Disabled Mortality table projected to 2018 by Scale BB set forward 1 year for males and 5 years for females to maintain consistency between the healthy mortality assumption and the disabled mortality assumption.

The charts below show (i) actual mortality rates for disabled retirees by age during the past five years and (ii) the currently assumed disabled mortality rates.



## Rates of Salary Increase

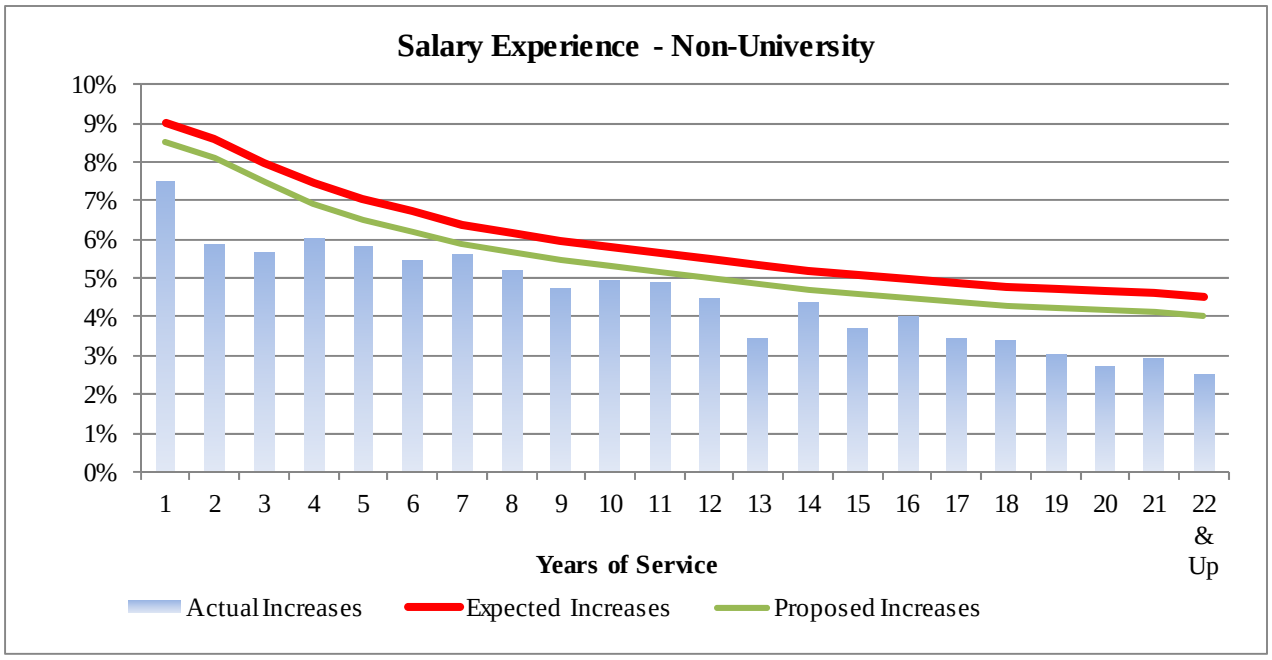
The past five years salary experience has been influenced by a number of factors. With pressures on state and local budgets, employers responded with strategies such as pay freezes or cuts and furloughs. In general, salary increases were less than anticipated. However, in light of the broader issues affecting pay during this period, we are not comfortable making any adjustments to the merit component of the salary scales at this time.

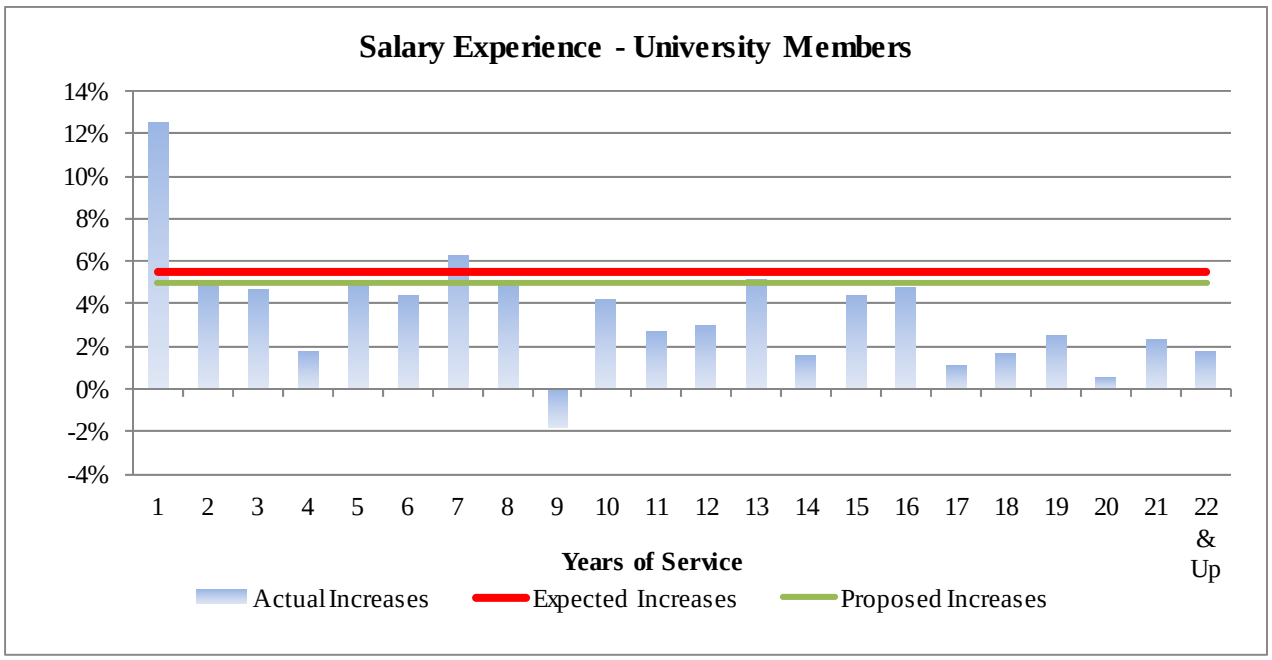
The analysis salary increases yielded an actual/expected ratio of 99% and 97% for non-university members and university members respectively. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. Due to the low inflation environment coupled with budgetary issues that faced state and local government during the experience period, we recommend no change to the salary scale other than the reduction due to the lowering of the wage base component of the total salary increase assumption from 4.50% to 4.00%.

### NON-UNIVERSITY EXPERIENCE UNDER CURRENT ASSUMPTIONS

| | Salaries End of Year (in thousands) | | | | | |
|---|---|---|---|---|---|---|
| | Non-University Members | | | University Members | | |
| Years of Service | Actual | Expected | Ratio Actual/Expected | Actual | Expected | Ratio Actual/Expected |
| 1 | 196,770 | 199,121 | 0.988 | 725 | 679 | 1.068 |
| 2 | 104,817 | 106,900 | 0.981 | 592 | 595 | 0.995 |
| 3 | 106,155 | 107,954 | 0.983 | 648 | 653 | 0.992 |
| 4 | 102,932 | 103,928 | 0.990 | 580 | 601 | 0.965 |
| 5 | 95,427 | 96,248 | 0.991 | 657 | 660 | 0.995 |
| 6 | 94,144 | 94,999 | 0.991 | 670 | 677 | 0.990 |
| 7 | 92,885 | 93,385 | 0.995 | 863 | 856 | 1.008 |
| 8 | 94,972 | 95,674 | 0.993 | 864 | 869 | 0.994 |
| 9 | 95,019 | 95,993 | 0.990 | 700 | 752 | 0.931 |
| 10 | 96,855 | 97,538 | 0.993 | 752 | 762 | 0.987 |
| 11 | 93,388 | 93,926 | 0.994 | 655 | 673 | 0.973 |
| 12 | 91,593 | 92,359 | 0.992 | 697 | 715 | 0.975 |
| 13 | 89,546 | 91,055 | 0.983 | 1,240 | 1,245 | 0.996 |
| 14 | 92,075 | 92,699 | 0.993 | 1,755 | 1,823 | 0.963 |
| 15 | 91,826 | 92,983 | 0.988 | 2,355 | 2,382 | 0.989 |
| 16 | 93,094 | 93,870 | 0.992 | 3,819 | 3,847 | 0.993 |
| 17 | 94,391 | 95,582 | 0.988 | 4,597 | 4,798 | 0.958 |
| 18 | 93,599 | 94,796 | 0.987 | 5,181 | 5,378 | 0.963 |
| 19 | 87,730 | 89,112 | 0.984 | 6,231 | 6,416 | 0.971 |
| 20 | 83,046 | 84,599 | 0.982 | 6,189 | 6,498 | 0.952 |
| 21 | 76,097 | 77,255 | 0.985 | 5,884 | 6,067 | 0.970 |
| 22 & Up | 743,122 | 757,539 | 0.981 | 94,090 | 97,591 | 0.964 |
| TOTAL | 2,809,483 | 2,847,515 | 0.990 | 139,744 | 144,537 | 0.970 |

The following graphs show a comparison of current, actual and proposed rates of salary increase for Non-University members and for University members.



**Percent Married:** Currently 100% of members are assumed to be married. The spouse is assumed to be the same age as the eligible member. This is a common and reasonable assumption and we recommend maintaining this assumption.

**Missing Data:** In preparing the valuation data, certain data items are missing, unavailable, or unreasonable. In such cases, we have developed assumptions for what the data element should be. We recommend keeping these assumptions.

**Part-time employees:** The valuation data for active members indentify part-time members. Part-time members earning less than $1000 during any given year are valued at current member contribution balance. We recommend keeping this assumption.

**Benefits for Terminating Members:** Members terminating with less than 5 years of service are assumed to request an immediate withdrawal of their contributions with interest. A probability is assumed for members terminating with 5 or more years of service for the likelihood of retaining membership in the System. Participants who retain membership are due a vested benefit upon reaching normal retirement while members who do not retain membership are entitled to an immediate refund of the member's contributions with interest. We recommend no change in this assumption at this time.

Actuarial valuations utilize methods to determine the liabilities, assets, and costs. While these are not like other assumptions that may change over time, an experience study is still a good opportunity to review these methods to see if they are still appropriate for systematically funding the promised benefits. Significant methods are described below.

**Actuarial Cost Method:** The cost method is used to allocate the present value of benefits between past service (actuarial accrued liability) and future service (normal cost). Currently the valuation uses the entry age normal cost method. This is the most widely used cost method of large public sector plans and has demonstrated the highest degree of stability as compared to alternative methods. We recommend no change in the use of this method.

**Actuarial Value of Assets:** The purpose of the asset smoothing is to dampen the impact that market volatility has on valuation results by spreading the unexpected market gains and losses over several years. Currently the System uses smoothing method that recognizes 25% of the difference between the actual and expected market value of assets, based on the assumed rate of return. The actuarial value of assets cannot be less than 80% or more than 120% of market value. We recommend no change in the use of this method.

**Amortization Method:** The unfunded actuarial accrued liability is amortized using a level percentage of payroll method over the amortization period. The payroll growth assumption is used to determine the percentage of payroll required over the remaining amortization period to fully amortize the unfunded liability. The current wage inflation assumption is being changed from 4.50% to 4.00%. We recommend the same change for the payroll growth assumption be made.

## Summary and Cost of Changes

### Assumption Changes

As a result of the experience investigation, we are recommending revised rates of pre and post retirement mortality for both healthy and disabled retirements, lowering the wage inflation assumption from 4.50% to 4.00%, and lowering the assumed rate of inflation from 3.50% to 3.25%. When these proposed assumption changes are applied to the July 1, 2013 valuation, the results will change. The change in results represents the financial impact of adopting the proposed assumptions.

### Method Changes

We have recommended an investment return assumption that is net of investment expenses only, therefore the normal cost rate must be loaded for administrative expenses adjusted for non-recurring items as a percentage of payroll and the additional cost for complying with GASB Statements Nos. 67 & 68.

The table below summarizes the financial impact of adopting the assumption changes on the reduced GABA and full GABA basis.

| | Valuation 7/1/2013 | Reduced GABA Assumption Changes | Full GABA Assumption Changes |
|---|---|---|---|
| **Employer Contribution Rate:** | | | |
| Normal Rate | 1.05% | 0.41% | 0.99% |
| Adm. Expense Load | N/A | 0.29% | 0.29% |
| UAAL | 9.91% | 10.26% | 9.68% |
| Total Statutory Employer Rate | 10.96% | 10.96% | 10.96% |
| Actuarial accrued liability* | $4,592,658 | $4,663,316 | $5,012,084 |
| Actuarial value of assets* | $3,067,878 | $3,067,878 | $3,067,878 |
| UAAL* | $1,524,780 | $1,565,438 | $1,944,206 |
| Amortization Period | 20 | 21 | 32 |

* In thousands

## Historical June CPI (U) Index

| Year | CPI (U) | Year | CPI (U) |
|---|---|---|---|
| 1963 | 30.60 | 1989 | 124.10 |
| 1964 | 31.00 | 1990 | 129.90 |
| 1965 | 31.60 | 1991 | 136.00 |
| 1966 | 32.40 | 1992 | 140.20 |
| 1967 | 33.30 | 1993 | 144.40 |
| 1968 | 34.70 | 1994 | 148.00 |
| 1969 | 36.60 | 1995 | 152.50 |
| 1970 | 38.80 | 1996 | 156.70 |
| 1971 | 40.60 | 1997 | 160.30 |
| 1972 | 41.70 | 1998 | 163.00 |
| 1973 | 44.20 | 1999 | 166.20 |
| 1974 | 49.00 | 2000 | 172.40 |
| 1975 | 53.60 | 2001 | 178.00 |
| 1976 | 56.80 | 2002 | 179.90 |
| 1977 | 60.70 | 2003 | 183.70 |
| 1978 | 65.20 | 2004 | 189.70 |
| 1979 | 72.30 | 2005 | 194.50 |
| 1980 | 82.70 | 2006 | 202.90 |
| 1981 | 90.60 | 2007 | 208.35 |
| 1982 | 97.00 | 2008 | 218.82 |
| 1983 | 99.50 | 2009 | 215.69 |
| 1984 | 103.70 | 2010 | 217.97 |
| 1985 | 107.60 | 2011 | 225.72 |
| 1986 | 109.50 | 2012 | 229.48 |
| 1987 | 113.50 | 2013 | 233.50 |
| 1988 | 118.00 | | |

## Capital Market Assumptions and Asset Allocation

### Rates of Return and Standard Deviation by Asset Class

| Asset Class | Return | Standard Deviation |
|---|---|---|
| Broad US Equity | 4.80% | 17.80% |
| Broad Int. Equity | 6.05% | 20.55% |
| Private Equity | 8.50% | 29.00% |
| Intermediate Bonds | 1.50% | 6.00% |
| Core Real Estate | 4.50% | 12.50% |
| High Yield Bonds | 3.25% | 15.00% |
| Non Core Real Estate | 7.50% | 22.50% |

### Asset Class Correlation Coefficients

| | Broad US Equity | Broad International Equity | Private Equity | Intermediate Bonds | Core Real Estate | High Yield Bonds | Non Core Real Estate |
|---|---|---|---|---|---|---|---|
| Broad US Equity | 1.00 | 0.84 | 0.71 | 0.18 | 0.24 | 0.60 | 0.23 |
| Broad International Equity | 0.84 | 1.00 | 0.71 | 0.01 | 0.29 | 0.68 | 0.23 |
| Private Equity | 0.71 | 0.71 | 1.00 | -0.18 | 0.51 | 0.50 | 0.45 |
| Intermediate Bonds | 0.18 | 0.01 | -0.18 | 1.00 | -0.06 | 0.28 | -0.03 |
| Core Real Estate | 0.24 | 0.29 | 0.51 | -0.06 | 1.00 | 0.05 | 0.91 |
| High Yield Bonds | 0.60 | 0.68 | 0.50 | 0.28 | 0.05 | 1.00 | 0.09 |
| Non Core Real Estate | 0.23 | 0.23 | 0.45 | -0.03 | 0.91 | 0.09 | 1.00 |

## Asset Allocation Targets

| Asset Class | Allocation Percentage |
|---|---|
| Broad US Equity | 36.00% |
| Broad International Equity | 18.00% |
| Private Equity | 12.00% |
| Intermediate Bonds | 23.40% |
| Core Real Estate | 4.00% |
| High Yield Bonds | 2.60% |
| Non Core Real Estate | 4.00% |

## Social Security Administration Wage Index

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

# Recommended Mortality Tables

| Age | Rates of Mortality Healthy Annuitants | | Rates of Mortality Disabled Annuitants | | Age | Rates of Mortality Healthy Annuitants | | Rates of Mortality Disabled Annuitants | |
|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | | Male | Female | Male | Female |
| 17 | 0.0269% | 0.0170% | 2.2571% | 0.7450% | 69 | 1.4543% | 1.2540% | 6.2583% | 4.8895% |
| 18 | 0.0269% | 0.0177% | 2.2571% | 0.7450% | 70 | 1.6113% | 1.3771% | 6.5841% | 5.2230% |
| 19 | 0.0269% | 0.0184% | 2.2571% | 0.7450% | 71 | 1.7838% | 1.5153% | 6.9405% | 5.5777% |
| 20 | 0.0284% | 0.0188% | 2.2571% | 0.7450% | 72 | 1.9724% | 1.6742% | 7.3292% | 5.9545% |
| 21 | 0.0301% | 0.0190% | 2.2571% | 0.7450% | 73 | 2.1788% | 1.8579% | 7.7512% | 6.3545% |
| 22 | 0.0316% | 0.0191% | 2.2571% | 0.7450% | 74 | 2.4065% | 2.0663% | 8.2067% | 6.7793% |
| 23 | 0.0331% | 0.0192% | 2.2571% | 0.7450% | 75 | 2.6627% | 2.2970% | 8.6951% | 7.2312% |
| 24 | 0.0345% | 0.0194% | 2.2571% | 0.7450% | 76 | 2.9565% | 2.5458% | 9.2149% | 7.7135% |
| 25 | 0.0357% | 0.0197% | 2.2571% | 0.7450% | 77 | 3.2931% | 2.8106% | 9.7640% | 8.2298% |
| 26 | 0.0366% | 0.0201% | 2.2571% | 0.7450% | 78 | 3.6738% | 3.0966% | 10.3392% | 8.7838% |
| 27 | 0.0373% | 0.0207% | 2.2571% | 0.7450% | 79 | 4.1002% | 3.4105% | 10.9372% | 9.3794% |
| 28 | 0.0376% | 0.0214% | 2.2571% | 0.7450% | 80 | 4.5699% | 3.7595% | 11.5544% | 10.0203% |
| 29 | 0.0376% | 0.0223% | 2.2571% | 0.7450% | 81 | 5.0833% | 4.1506% | 12.1877% | 10.7099% |
| 30 | 0.0378% | 0.0235% | 2.2571% | 0.7450% | 82 | 5.6487% | 4.5879% | 12.8343% | 11.4512% |
| 31 | 0.0382% | 0.0248% | 2.2571% | 0.7450% | 83 | 6.2777% | 5.0780% | 13.4923% | 12.2464% |
| 32 | 0.0393% | 0.0264% | 2.2571% | 0.7450% | 84 | 6.9757% | 5.6294% | 14.1603% | 13.0972% |
| 33 | 0.0412% | 0.0307% | 2.2571% | 0.7450% | 85 | 7.7444% | 6.2506% | 14.8374% | 14.0049% |
| 34 | 0.0444% | 0.0350% | 2.2571% | 0.7450% | 86 | 8.5828% | 6.9517% | 15.5235% | 14.9698% |
| 35 | 0.0499% | 0.0394% | 2.2571% | 0.7450% | 87 | 9.4904% | 7.7446% | 16.2186% | 15.9924% |
| 36 | 0.0562% | 0.0435% | 2.2571% | 0.7450% | 88 | 10.4700% | 8.6376% | 16.9233% | 17.0433% |
| 37 | 0.0631% | 0.0475% | 2.2571% | 0.7450% | 89 | 11.5289% | 9.6337% | 18.3408% | 18.2799% |
| 38 | 0.0702% | 0.0514% | 2.2571% | 0.7450% | 90 | 12.6798% | 10.7303% | 19.9769% | 19.4509% |
| 39 | 0.0773% | 0.0554% | 2.2571% | 0.7450% | 91 | 13.9353% | 11.9154% | 21.6605% | 20.5379% |
| 40 | 0.0841% | 0.0598% | 2.2571% | 0.7450% | 92 | 15.3021% | 13.1682% | 23.3662% | 21.5240% |
| 41 | 0.0904% | 0.0648% | 2.2571% | 0.8184% | 93 | 16.7757% | 14.4604% | 25.0693% | 22.3947% |
| 42 | 0.0964% | 0.0706% | 2.2571% | 0.8959% | 94 | 18.3408% | 15.7618% | 26.7491% | 23.1387% |
| 43 | 0.1021% | 0.0774% | 2.2571% | 0.9775% | 95 | 19.9769% | 17.0433% | 28.3905% | 23.7467% |
| 44 | 0.1079% | 0.0852% | 2.2571% | 1.0634% | 96 | 21.6605% | 18.2799% | 29.9852% | 24.4834% |
| 45 | 0.1142% | 0.0937% | 2.3847% | 1.1535% | 97 | 23.3662% | 19.4509% | 31.5296% | 25.4498% |
| 46 | 0.1215% | 0.1029% | 2.5124% | 1.2477% | 98 | 25.0693% | 20.5379% | 33.0207% | 26.6044% |
| 47 | 0.1299% | 0.1124% | 2.6404% | 1.3456% | 99 | 26.7491% | 21.5240% | 34.4556% | 27.9055% |
| 48 | 0.1397% | 0.1223% | 2.7687% | 1.4463% | 100 | 28.3905% | 22.3947% | 35.8628% | 29.3116% |
| 49 | 0.1508% | 0.1326% | 2.8975% | 1.5497% | 101 | 29.9852% | 23.1387% | 37.1685% | 30.7811% |
| 50 | 0.1616% | 0.1434% | 3.0268% | 1.6544% | 102 | 31.5296% | 23.7467% | 38.3040% | 32.2725% |
| 51 | 0.1734% | 0.1550% | 3.1563% | 1.7598% | 103 | 33.0207% | 24.4834% | 39.2003% | 33.7441% |
| 52 | 0.1860% | 0.2344% | 3.2859% | 1.8654% | 104 | 34.4556% | 25.4498% | 39.7886% | 35.1544% |
| 53 | 0.1995% | 0.2459% | 3.4152% | 1.9710% | 105 | 35.8628% | 26.6044% | 40.0000% | 36.4617% |
| 54 | 0.5566% | 0.2647% | 3.5442% | 2.0768% | 106 | 37.1685% | 27.9055% | 40.0000% | 37.6246% |
| 55 | 0.5801% | 0.2895% | 3.6732% | 2.1839% | 107 | 38.3040% | 29.3116% | 40.0000% | 38.6015% |
| 56 | 0.5970% | 0.3190% | 3.8026% | 2.2936% | 108 | 39.2003% | 30.7811% | 40.0000% | 39.3507% |
| 57 | 0.6102% | 0.3531% | 3.9334% | 2.4080% | 109 | 39.7886% | 32.2725% | 40.0000% | 39.8308% |
| 58 | 0.6232% | 0.3925% | 4.0668% | 2.5293% | 110 | 40.0000% | 33.7441% | 40.0000% | 40.0000% |
| 59 | 0.6399% | 0.4385% | 4.2042% | 2.6600% | 111 | 40.0000% | 35.1544% | 40.0000% | 40.0000% |
| 60 | 0.6637% | 0.4921% | 4.3474% | 2.8026% | 112 | 40.0000% | 36.4617% | 40.0000% | 40.0000% |
| 61 | 0.6984% | 0.5531% | 4.4981% | 2.9594% | 113 | 40.0000% | 37.6246% | 40.0000% | 40.0000% |
| 62 | 0.7472% | 0.6200% | 4.6584% | 3.1325% | 114 | 40.0000% | 38.6015% | 40.0000% | 40.0000% |
| 63 | 0.8112% | 0.6919% | 4.8307% | 3.3234% | 115 | 40.0000% | 39.3507% | 40.0000% | 100.0000% |
| 64 | 0.8882% | 0.7689% | 5.0174% | 3.5335% | 116 | 40.0000% | 39.8308% | 40.0000% | 100.0000% |
| 65 | 0.9755% | 0.8509% | 5.2213% | 3.7635% | 117 | 40.0000% | 40.0000% | 40.0000% | 100.0000% |
| 66 | 1.0745% | 0.9395% | 5.4450% | 4.0140% | 118 | 40.0000% | 40.0000% | 40.0000% | 100.0000% |
| 67 | 1.1868% | 1.0364% | 5.6909% | 4.2851% | 119 | 40.0000% | 40.0000% | 100.0000% | 100.0000% |
| 68 | 1.3131% | 1.1413% | 5.9613% | 4.5769% | 120 | 100.0000% | 100.0000% | 100.0000% | 100.0000% |

**Recommended Rates of Salary Increase**

| Years of Service | General Members | | | University Members | | |
|---|---|---|---|---|---|---|
| | Individual Merit & Longevity | General Wage Increase | Total Salary Increase | Individual Merit & Longevity | General Wage Increase | Total Salary Increase |
| 1 | 4.51% | 4.00% | 8.51% | 1.00% | 4.00% | 5.00% |
| 2 | 4.09% | 4.00% | 8.09% | 1.00% | 4.00% | 5.00% |
| 3 | 3.46% | 4.00% | 7.46% | 1.00% | 4.00% | 5.00% |
| 4 | 2.94% | 4.00% | 6.94% | 1.00% | 4.00% | 5.00% |
| 5 | 2.52% | 4.00% | 6.52% | 1.00% | 4.00% | 5.00% |
| 6 | 2.21% | 4.00% | 6.21% | 1.00% | 4.00% | 5.00% |
| 7 | 1.89% | 4.00% | 5.89% | 1.00% | 4.00% | 5.00% |
| 8 | 1.68% | 4.00% | 5.68% | 1.00% | 4.00% | 5.00% |
| 9 | 1.47% | 4.00% | 5.47% | 1.00% | 4.00% | 5.00% |
| 10 | 1.31% | 4.00% | 5.31% | 1.00% | 4.00% | 5.00% |
| 11 | 1.16% | 4.00% | 5.16% | 1.00% | 4.00% | 5.00% |
| 12 | 1.00% | 4.00% | 5.00% | 1.00% | 4.00% | 5.00% |
| 13 | 0.84% | 4.00% | 4.84% | 1.00% | 4.00% | 5.00% |
| 14 | 0.68% | 4.00% | 4.68% | 1.00% | 4.00% | 5.00% |
| 15 | 0.58% | 4.00% | 4.58% | 1.00% | 4.00% | 5.00% |
| 16 | 0.47% | 4.00% | 4.47% | 1.00% | 4.00% | 5.00% |
| 17 | 0.37% | 4.00% | 4.37% | 1.00% | 4.00% | 5.00% |
| 18 | 0.26% | 4.00% | 4.26% | 1.00% | 4.00% | 5.00% |
| 19 | 0.21% | 4.00% | 4.21% | 1.00% | 4.00% | 5.00% |
| 20 | 0.16% | 4.00% | 4.16% | 1.00% | 4.00% | 5.00% |
| 21 | 0.11% | 4.00% | 4.11% | 1.00% | 4.00% | 5.00% |
| 22 & Up | 0.00% | 4.00% | 4.00% | 1.00% | 4.00% | 5.00% |