Recommended Actuarial Assumptions 2021 Report

New York State Teachers' Retirement System

Office of the Actuary

October 19, 2021

NEW YORK STATE TEACHERS' RETIREMENT SYSTEM

Report on the 2021 Recommended Actuarial Assumptions

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EXECUTIVE SUMMARY

Changes are recommended for actuarial assumptions used in the annual actuarial valuation of the Retirement System's assets and liabilities, commencing with the actuarial valuation as of June 30, 2021. These recommended revisions are intended to make the actuarial assumptions more consistent with recent member experience and future expectations. **The most significant actuarial assumption, the valuation rate of interest, is recommended to be lowered to 6.95%.** Discussion and analysis regarding the valuation rate of interest assumption, as well as all other actuarial assumptions, is provided in the report.

The new actuarial assumptions will first be applied to the next actuarial valuation, as of June 30, 2021. The ECR produced by this valuation will not only reflect this change in assumptions, but also any actuarial gains or losses for the fiscal year ending June 30, 2021. **Although the System is in the favorable position of recognizing an actuarial gain on assets due to strong investment returns in the fiscal year ending June 30, 2021, it is projected that the cumulative cost impact of the new actuarial assumptions combined with annual gains and losses may result in a net increase in the ECR.**

The individual recommendations for changes in the actuarial assumptions and the corresponding estimated impact on the ECR are presented in the table on the following page. The estimated cost impact is based on the June 30, 2020 valuation ECR.

Assumption	Estimated Impact on ECR based on June 30, 2020 valuation
Valuation Rate of Interest: Recommended to be decreased to 6.95% per annum.	*Increase of 2.03% of pay*
Active Member Mortality: Recommended rates are generally slightly higher than current rates, reflecting recent active member experience.	*Decrease of 0.04% of pay*
Healthy Annuitant Mortality: Recommended rates will incorporate the Society of Actuaries MP-2020 mortality improvement scale to reflect ongoing mortality improvements of retired members and beneficiaries.	*Increase of 0.46% of pay*
Disabled Annuitant Mortality: Recommended rates are higher than the current assumptions at some ages and lower at others, reflecting recent disabled member experience.	*Increase of 0.09% of pay*
Survivor and Beneficiary Annuitant Morality: Recommended introduction of new table specific to survivor and beneficiary mortality	*Decrease of 0.15% of pay*
Service Retirement: Recommended rates are generally higher at younger ages than current rates.	*Increase of 1.28% of pay*
Disability Retirement: Recommended rates of disability are generally higher than current rates, reflecting recent member experience.	*Increase of 0.04% of pay*
Withdrawal: Recommended rates of withdrawal are generally lower, reflecting recent member experience.	*Increase of 0.40% of pay*
Salary Scale: Recommended rates of salary increase have increased from the prior period.	*Increase of 0.45% of pay*
Cost of Living Assumption (COLA): Recommended no change	*No change*
Actuarial Value of Assets Method: Recommended no change	*No change*
Estimated Compounding Effect:	*Decrease of 0.05% of pay*
Overall Estimated Impact on ECR	***Increase of 4.51% of pay***

As illustrated by the previous table, certain actuarial assumptions have more of an impact on plan costs than others. The valuation rate of interest, the retirement rates, the healthy annuitant mortality rates, and the salary scale are typically the most critical assumptions in terms of their impact on plan costs. The retirement rates are the probabilities of retirement during the year for retirement-eligible members. These rates are critical in two respects; they are a big factor in determining how many years of pension payments there will be, and how many years of active service remain over which to fund the benefit. The healthy annuitant mortality rates determine how long we expect our retirees to live, which tells us how many years of benefit payments we expect the System to have to make. The salary scale, or estimated rates of future salary increases, helps determine how large the projected benefits at retirement will be. Note that assumptions concerning disability have very little effect on plan costs since System members have a low incidence of disability, and the System has a relatively low number of disabled members. Also noted above is something called the "compounding effect", which approximates the cost impact of the changing assumptions' impact on one another.

The following table provides a comparison of the life expectancies for service retirees at the current average retirement age of 61 as of June 30, 2020. The proposed assumptions, along with ongoing mortality

improvement, will increase life expectancy by less than one year for retirees who are age 61 in 2020. To further illustrate the impact of mortality improvement, the life expectancy at retirement for a member who will retire 20 years from now at age 61 is also shown. Since this member will be subject to mortality improvement over a longer period, life expectancy at retirement will further increase. More detail on the mortality improvement assumption is provided on page 9.

	Life Expectancy at Age 61			
	Current Assumptions with Member Currently Age 61	**Proposed Assumptions with Member Currently Age 61**	**Current Assumptions with Member Age 61 in 20 years**	**Proposed Assumptions with Member Age 61 in 20 Years**
Female	28.6 years	28.7 years	30.1 years	29.9 years
Male	26.1 years	26.2 years	27.7 years	27.6 years

Additionally, the following table displays the probability that a member retiring at age 61 in 2020 will live to selected ages based on the recommended mortality assumptions.

	Probability of Living to Age				
	80	**85**	**90**	**95**	**100**
Female	86%	74%	56%	29%	9%
Male	80%	64%	42%	19%	5%

The recommended assumptions produce the following probabilities that a typical new teacher (for both female and male, this is age 23 with zero years of service) is still a member of the Retirement System at selected points in the future. For this illustration, we assume the entry date is July 1, 2020.

		Probability of Still Being Active		
	Age at Entry	*10 years later*	*20 years later*	*30 years later*
Female	23	41%	36%	35%
Male	23	40%	36%	34%

The current actuarial assumptions were adopted by the Retirement Board on October 29, 2015 and first used in the June 30, 2015 actuarial valuation. The valuation rate of interest assumption was lowered from 7.50% to 7.25% on October 26, 2017 and lowered to 7.10% on October 31, 2019. Additionally, on October 31, 2019, the assumed rate of COLA increase was lowered from 1.5% to 1.3%, and the mortality improvement scale was changed from MP-2014 to MP-2018. On October 29, 2020, the mortality improvement scale was changed to MP-2019. All other assumptions remain the same as those adopted in 2015.

A full actuarial review and revision of all assumptions is typically completed every five years, although if a change in a particular assumption were to be warranted sooner, we would not wait for the five years to elapse to make a change. Actual plan experience compared to expected experience is reviewed annually on both an annual and a five-year basis.

The five-year period ended last year (2020); however, the change of assumptions was postponed until 2021 due to the COVID pandemic and the desire to wait and gauge any initial pandemic impact before modifying the assumptions.

The average expected future working lifetime for the active population under the recommended assumptions is 12.56 (compared to 13.14 under the current assumptions). The normal rate is determined by spreading the outstanding liability over the expected future working lifetime, or more specifically over the present value of future salaries. An incremental decrease in this normal rate denominator will have the effect of increasing the normal rate. The main reason for this decrease in the expected future working lifetime is the new service retirement rates, which reflect the increasing rates of retirement at earlier ages.

The report which follows provides greater detail and descriptions of the graduation processes and resulting analyses that led to these recommended assumptions.

ACTUARIAL STANDARDS OF PRACTICE

Several Actuarial Standards of Practice (ASOP) were followed as required in the development of the actuarial assumptions. The economic assumptions, including the valuation rate of interest, were developed in accordance with ASOP No. 27 – *Selection of Economic Assumptions for Measuring Pension Obligations,* including the recent version of the standard effective for measurement dates on or after August 1, 2021. The demographic assumptions were developed in accordance with ASOP No. 35 – *Selection of Demographic and other Non-Economic Assumptions for Measuring Pension Obligations*, including the recent version of the standard effective for measurement dates on or after August 1, 2021.

Data credibility procedures were utilized as required by ASOP No. 25 –*Credibility Procedures,* both to develop assumptions that only used subject experience (NYSTRS experience) and to develop assumptions that used a blend of subject experience and published tables.

Also followed was ASOP No. 56 – *Modeling,* with respect to the various models used in the development of the assumptions.

The NYSTRS Office of the Actuary utilized ProVal, a widely used actuarial valuation software program leased from Winklevoss Technologies (WinTech), to review assumptions experience. We have audited the results produced by this model to a limited degree consistent with ASOP No. 56 and believe the software to be appropriate for the purposes for which it has been used.

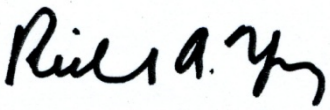
Additionally, the NYSTRS Office of the Actuary utilized the Cheiron Experience Study Tool, a tool developed by Cheiron to review experience, review graduation, and recommend updated assumptions. We have audited the results produced by this model to a limited degree consistent with ASOP No. 56 and believe the software to be appropriate for the purposes for which it has been used.

CERTIFICATION

This assumption study relies on member data provided by the participating employers to the Retirement System's administrative staff. The administrative and actuarial staff review this data for reasonability and completeness as well as reconcile it against prior data.

Future actuarial measurements such as the employer contribution rate may differ significantly from the measurements presented in this report due to such factors as: future plan experience that differs significantly from that predicted by the actuarial assumptions; changes in the actuarial assumptions or methods; and changes in plan provisions or applicable law.

The recommended assumptions have been developed in accordance with the relevant standards of practice prescribed by the Actuarial Standards Board and generally accepted actuarial principles and procedures. They are internally consistent and reasonably related to actual and anticipated future experience of the Retirement System. The undersigned are members of the American Academy of Actuaries and the Society of Actuaries and meet the qualification standards of the American Academy of Actuaries to render the actuarial opinion contained in this report.



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New York State Teachers' Retirement System
Office of the Actuary
October 19, 2021

INTRODUCTION

Every year the employer contribution rate for the New York State Teachers' Retirement System (NYSTRS) is determined by an actuarial valuation of the Retirement System's assets and liabilities. This annual actuarial valuation ensures a reasonable and systematic asset accumulation that will be sufficient to pay member benefits when due.

The Retirement System's liabilities represent a stream of expected future benefit payments to active members, inactive vested members who have not yet retired, and retired members. These benefit payments include payments on account of members' retirement, disability and/or death. The annual actuarial valuation utilizes several actuarial assumptions to estimate the future occurrence of these events as well as the present value of the expected future benefit payments. These assumptions are for the most part developed based upon the experience of NYSTRS's membership, except in cases where it's more appropriate to use a blend of NYSTRS experience and general population experience. In these instances, a modified standard table is used. The assumptions are revised periodically so that they more closely reflect recent member experience and expectations. Revised assumptions, which are very time-consuming to develop, are typically prepared every five years. There is no requirement to wait five years, however, to revise assumptions. If warranted, an assumption or subset of assumptions would be revised sooner.

The actuarial assumptions may be described as demographic or economic. The demographic assumptions consist of the mortality rates (active member, retired member and beneficiary, and disabled member), withdrawal rates, disability rates, and retirement rates. To some extent, withdrawal and retirement rates also have an economic component, but are based primarily on member demographics. Two of the economic assumptions, the valuation rate of interest and the salary scale, generally have the most significant impact upon the employer contribution rate. The third economic assumption, the projected increase in future retired member cost-of-living-adjustment (COLA) benefits, has a comparatively minor impact on the employer contribution rate due to the limitations on the COLA benefit provided.

Each year, member and investment experience are reviewed to determine how closely the actuarial assumptions reflect actual experience. This review consists of two parts: First, the experience for the most recent year is reviewed to determine if a yearly trend is apparent; second, the experience for the most recent five-year period is reviewed to analyze longer-term fluctuations in experience. This five-year experience forms the basis of the recommended assumptions in most cases. In some cases, for various reasons, a longer period of experience may be used. For the disability retirement rates, for example, a ten-year experience period was used because of the Retirement System's relatively limited incidence of disability, and, as a result, the inherent volatility of the subject experience.

Even with five or more years of experience, actual experience may still contain some fluctuations. This is especially true at very young and very old ages where member exposures may be limited. To further minimize these fluctuations, the experience rates are smoothed, using graduation techniques or limited fluctuation credibility theory in cases where relevant published tables were available or where the technique was deemed most appropriate. In either case, these smoothed rates form the basis for the recommendations.

The COVID-19 pandemic began in earnest in the United States in March 2020, resulting in widespread illness, hospitalizations, and death. This report includes early pandemic experience, but we could see further impacts on both demographic and economic assumptions in the future. If warranted, an assumption or subset of assumptions may be revised in the future to reflect pandemic experience.

DEMOGRAPHIC ASSUMPTIONS

MORTALITY[1]

Active Member Mortality

The active member mortality (AM) rates are the assumed rates of death for active members prior to retirement. These rates vary by gender and age. Active members have significantly lower mortality than retired members. As expected, older active members tend to die at a higher rate than younger active members and the general shape of plan experience is an increasing exponential pattern for both males and females. Due to the relatively small amount of data for active members, there is more volatility and less credibility with plan experience. As a result, more emphasis was placed on published data in determining this assumption.

The current AM rates were adopted on October 29, 2015 and were based upon experience for the five-year period from July 1, 2009 through June 30, 2014.

Recent AM experience has generally been higher than expected. The mortality experience for the five-year period from July 1, 2015 through June 30, 2020 has shown that the current assumptions on the total population are generally understating the actual number of deaths for male active members by approximately 13% and for female active members by approximately 44%. Based upon this experience, it is appropriate to review the current AM assumption and a recommended revision is warranted.

The recommended rates are based upon AM experience during the five-year period from July 1, 2015 through June 30, 2020. To reduce random fluctuations in the data and improve the predictive ability of the assumption, limited fluctuation credibility theory was used in conjunction with the Society of Actuaries published mortality table PubT-2010 active teachers[2] to develop the proposed AM assumption. Society of Actuaries mortality improvement scale MP-2020 will be incorporated into this assumption for all valuations. The recommended AM tables are salary-weighted, as opposed to headcount-weighted, a distinction that is described in the section on Healthy Annuitant Mortality (HAM). Appendix A summarizes the proposed AM mortality rates, the current AM rates, and the experience from the five-year experience study.

Like the general shape of the raw rates, the proposed and current AM assumptions have an increasing exponential pattern for both males and females. However, the proposed AM assumption is less optimistic about mortality compared with the current assumption. For both females and males, less optimism is justified since the overall Active-to-Expected ("A/E") ratios of the proposed assumption are better when compared with those metrics for the current assumption.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed active mortality rate assumption would have decreased this employer contribution rate by approximately 0.04%, resulting in the rate decreasing to 9.76%.

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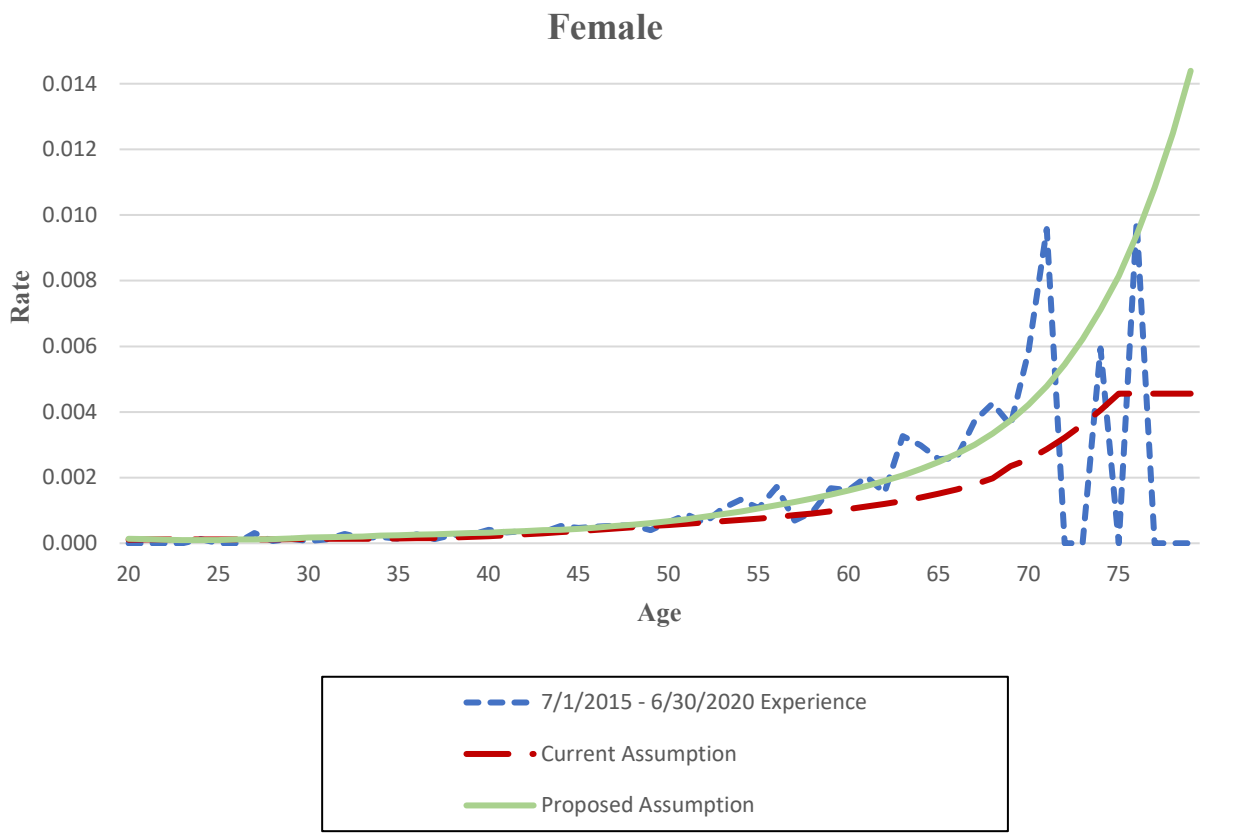
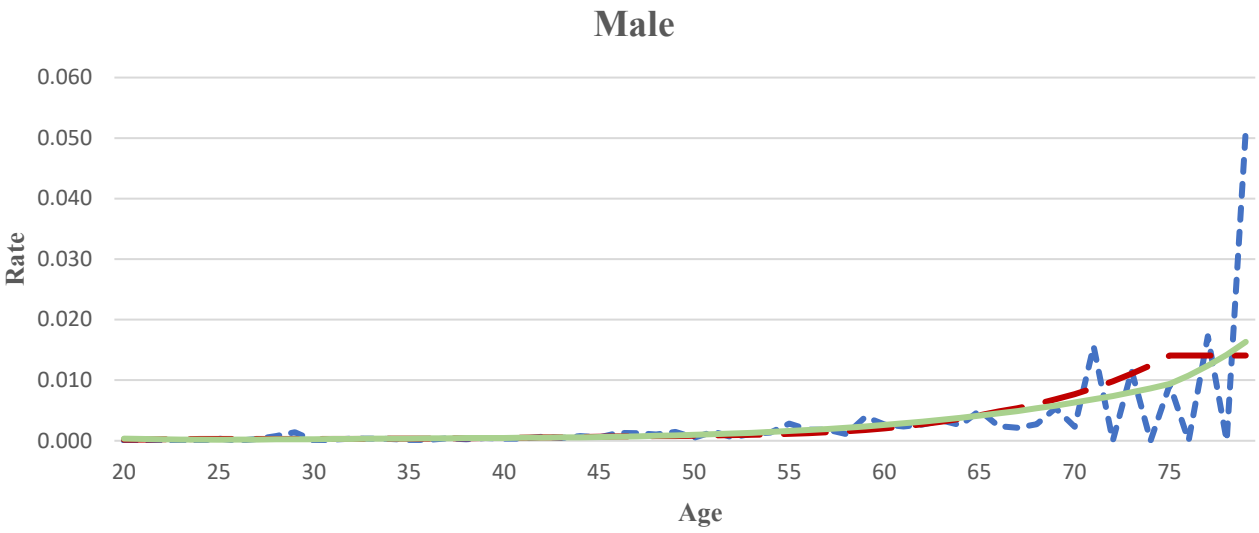
[1] For valuation purposes, all mortality assumptions, including active member mortality, use the base rates developed using limited fluctuation credibility theory along with the relevant data from Pub-2010 and the mortality improvement scale MP-2020.

[2] Pub-2010 active teachers' rates were projected to June 30, 2018 – the middle of the five-year study period – using MP-2020 and used to develop the proposed assumption.

Active Member Mortality





Healthy Annuitant Mortality

The healthy annuitant mortality (HAM) rates are the assumed rates of death for service and deferred retired members, i.e., all retirees except those who retired for disability. The HAM rates vary by gender and age. As expected, older retirees tend to die at a much higher rate than younger retirees, and the general shape of plan experience is an increasing exponential pattern for both males and females. Because of the relatively large amount of data for healthy annuitants, there is less volatility and more credibility with plan experience. As a result, more emphasis can be placed on the plan experience rather than a published table in determining this assumption.

The current HAM rates were adopted on October 29, 2015 and were based upon experience for the five-year period from July 1, 2009 through June 30, 2014.

Recent HAM experience has generally been close to expected for both males and females. The mortality experience for service and deferred retired members for the five-year period from July 1, 2015 through June 30, 2020 has shown that the current valuation assumptions are overstating the actual number of deaths by approximately 2.9% for males and 4.9% for females.

The recommended base table rates are based upon HAM experience during the five-year period from July 1, 2015 through June 30, 2020. To reduce random fluctuations in the data and improve the predictive ability of the assumption, limited fluctuation credibility theory was used in conjunction with PubT-2010 for retired teachers to develop the proposed HAM assumption. The data was parsed into three groups to best fit the published table to the data. For males the data was broken down into the following age ranges: 55-74, 75-95, and 96-119. For females the data was broken down into the following age ranges: 55-74, 75-89, 90-119. To better fit our data, a multiplier was determined for each age range using LFCT and the appropriate Pub-2010 mortality rates, which are projected to the middle of our study period, were shifted up or down in order to thread through plan experience. In addition, MP-2020 was used to project the Pub-2010 table to June 30, 2018 – the middle of the five-year study period. Until plan experience necessitates a change of this mortality assumption, Scale MP-2020 will be incorporated into this assumption for all valuations.

The proposed HAM rates are amounts-weighted, as opposed to prior years' tables which were headcount-weighted. Amounts-weighted means that the plan experience was weighted by retirement benefit amounts, reflecting the concept that it is the cessation of the benefit payment stream that is being valued. It is the consensus of the actuarial profession and our consultant Cheiron that an amounts-weighted table is preferable.

Our HAM assumption consists of two components - a base table and a mortality improvement scale. The base table was developed through a blend of member experience and published tables, as described later in this section. The Society of Actuaries (SOA) mortality improvement scale MP-2020 will be incorporated into this assumption. A mortality improvement scale quantifies the incremental improvement in future mortality that is expected to occur. The Mortality Improvement Scale MP-2020 was developed by the SOA using data from the Social Security Administration for years 1950-2015 and the Centers for Disease Control and Prevention, the U.S. Census Bureau, and the Centers for Medicare and Medicaid Services for years 2016-2018. Considering the recent release of Scale MP-2020 and given that our current HAM assumption is overpredicting deaths for males and females, it is appropriate to review the current HAM assumption and a recommended revision is warranted.

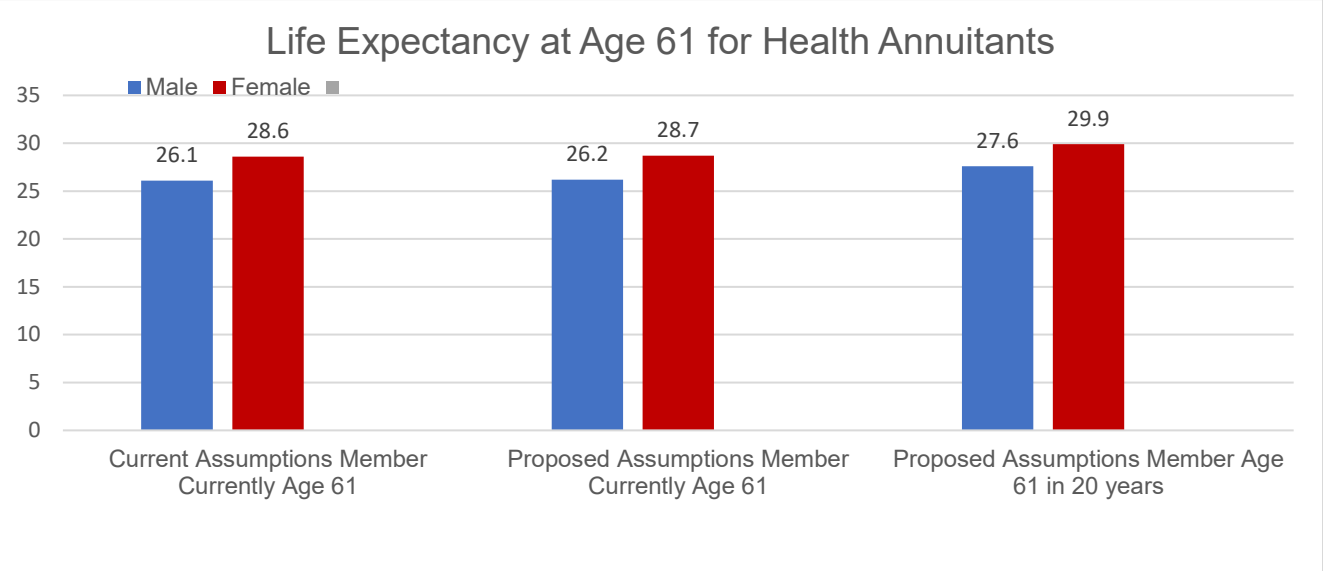
<u>Considering Future Mortality Improvement</u>

It is widely recognized that later generations generally enjoy greater longevity than earlier ones and that with continued advancements in medicine and technology it is likely that those in future generations will continue to live longer than their predecessors. To account for this future mortality improvement, an assumption can be made as to the amount, or rate, of improvement that is to be applied to the current mortality rates. These mortality improvement rates are then applied in such a way to reflect the idea that younger plan participants will be subject to mortality improvement for a longer period.

This can be illustrated with an example. The age 60 female mortality rate from the proposed base table is 0.2642%. This tells us that, when used in the 6/30/2020 valuation, we would expect 2,642 out of every 1,000,000 age 60 healthy female annuitants to expire over the following year[3]. But what is the mortality rate for healthy female annuitants who will be age 60 ten years from now? The mortality improvement scale tells us that the age 60 mortality rate is expected to improve on average at a rate of 0.9% per year. Applying ten years of mortality improvement[4] results in a future age 60 mortality rate in which we would expect there to be 2,414 deaths out of every 1,000,000 annuitants, which is an overall improvement of approximately 8.6%.

The effect of applying mortality improvement in this manner (known as *generational* mortality improvement) is an increase in plan liabilities as members are expected to live longer and thus receive more benefits. However, if no adjustment is made for assumed future mortality improvement, we would risk understating plan liabilities which could lead to an underfunding of plan benefits.

The chart below provides a comparison of life expectancy for healthy annuitants who are currently age 61 (NYSTRS' average retirement age) based on the current and the proposed assumptions, and who will be age 61 in 20 years based on the proposed assumptions.



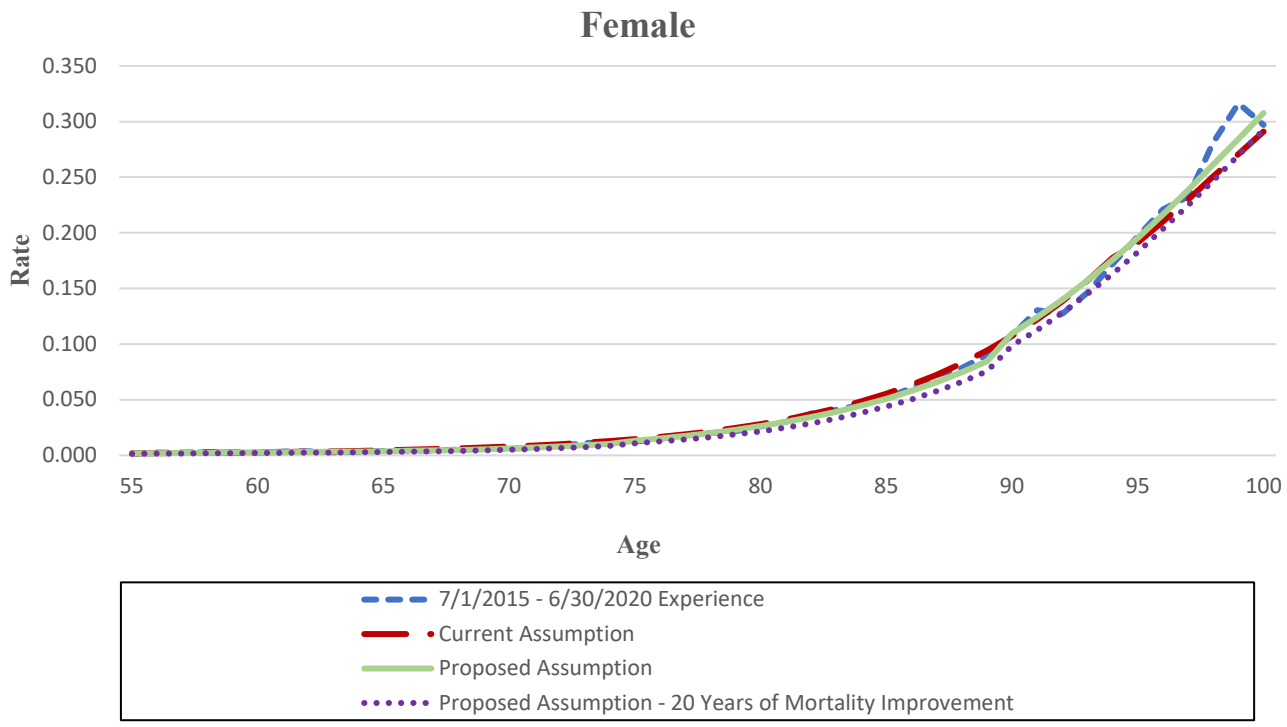
The current assumption includes Scale MP-2019 while the proposed assumption includes Scale MP-2020. The proposed assumption is more optimistic about future longevity compared to the current assumption. However, since MP-2020 is less optimistic about future longevity improvement compared to MP-2019, the life expectancy of a male or female healthy annuitant who is currently age 61 is only slightly better under the proposed assumption compared with the current assumption.

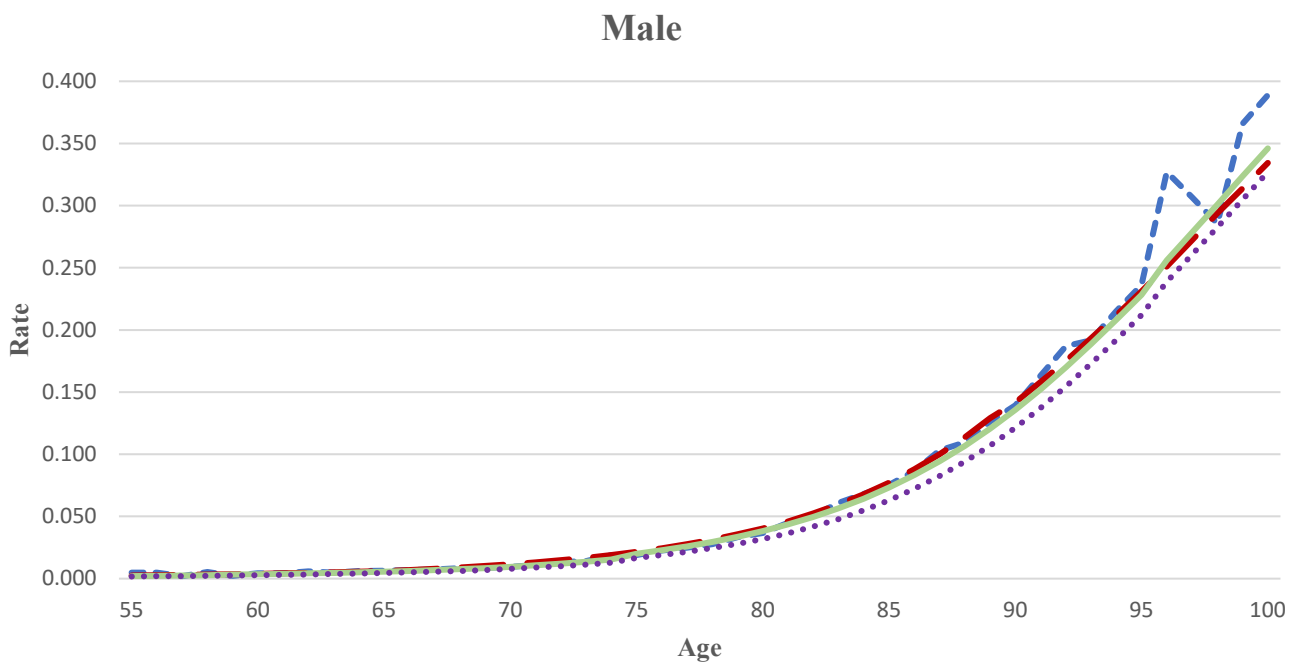
[3] 0.2642% x 1,000,000 = 2,642 lives
[4] See Appendix B for details behind this calculation.

Appendix A summarizes the proposed HAM rates, the current HAM rates, and the experience from the five-year experience study.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed healthy annuitant mortality assumptions (base table along with MP-2020 projected on a generational basis) would have increased this employer contribution rate by approximately 0.46%, resulting in the rate increasing to 10.26%.

Healthy Annuitant Mortality





Disabled Annuitant Mortality

The disabled annuitant mortality (DAM) rates are the assumed rates of death for members who retire on account of a disability. These rates vary by gender and age. As expected, older disabled annuitant members tend to die at a higher rate than younger disabled annuitant members and the general shape of plan experience is an increasing exponential pattern for both males and females. Because of the relatively small amount of data for disabled annuitants, there is more volatility and less credibility with plan experience. As a result, more emphasis is placed on the published data in determining this assumption.

The current DAM rates were adopted on October 29, 2015 and were based upon experience for the five-year period from July 1, 2004 through June 30, 2014.

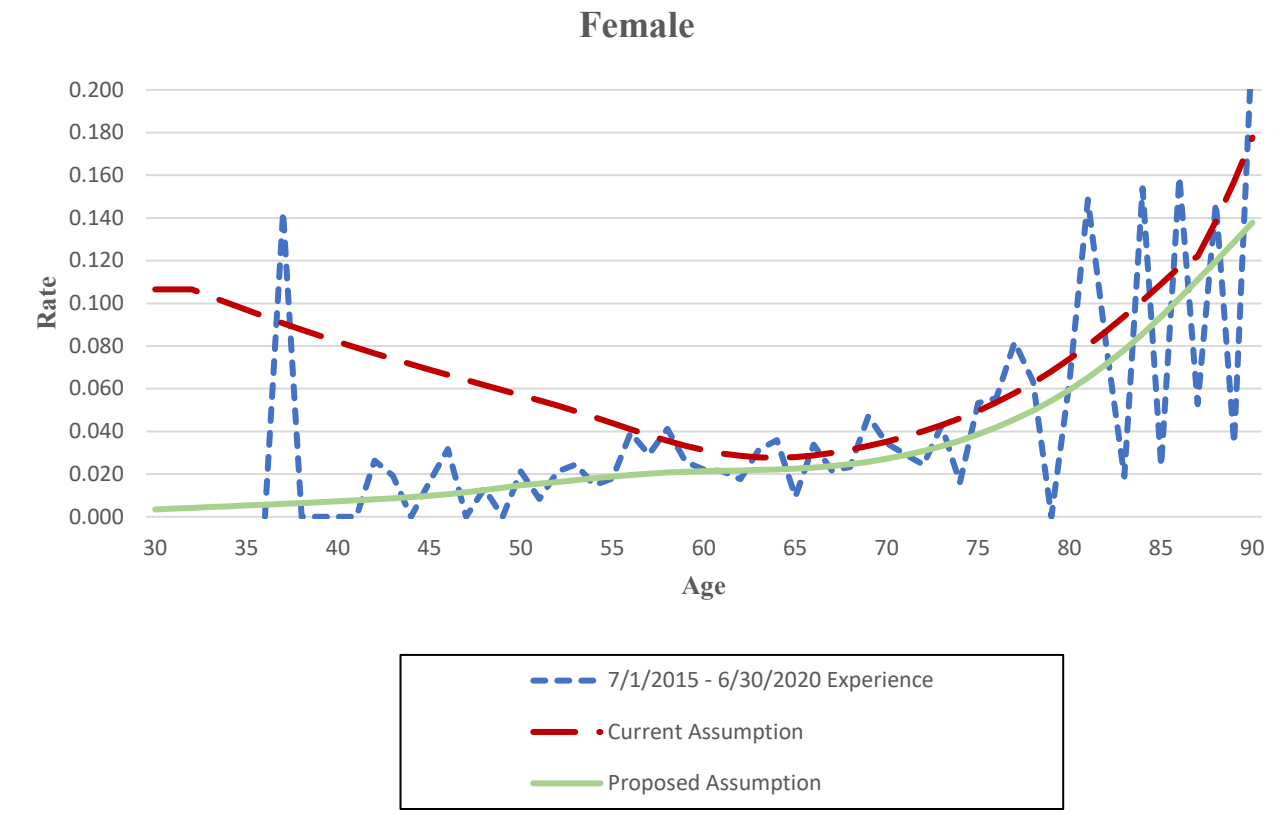
Recent DAM experience has generally been lower than expected. The mortality experience for the five-year period from July 1, 2015 through June 30, 2020 has shown that the current assumption is overstating the actual number of deaths for male disabled annuitants by approximately 20.7% and for female disabled annuitants by approximately 26.8%. Based upon this experience, it is appropriate to review the current DAM assumption and a recommended revision is warranted.

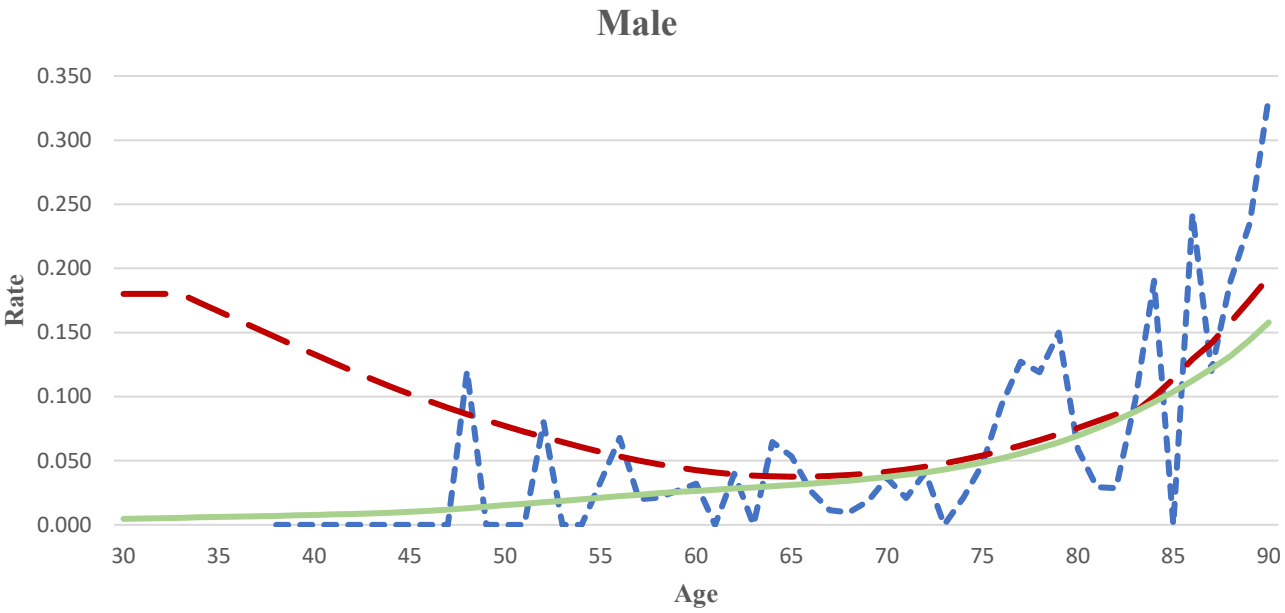
The recommended rates are based upon DAM experience during the five-year period from July 1, 2015 through June 30, 2020. To reduce random fluctuations in the data and improve the predictive ability of the assumption, limited fluctuation credibility theory was used in conjunction with Pub-2010 for disabled retirees who were formally teachers to develop the 2020 proposed DAM assumption. In addition, MP-2020 was used to project the Pub-2010 table to June 30, 2018 – the middle of the five-year study period. Until plan experience necessitates a change of this mortality assumption, Scale MP-2020 will be incorporated into this assumption for all valuations.

Like the general shape of the raw rates, the proposed and current DAM assumptions have an increasing exponential pattern for both males and females. The proposed DAM assumption is more optimistic than the current DAM assumption for both males and females since the prior assumption was overstating the actual number of deaths for both genders. As described in the section on HAM, the proposed DAM table is amounts-weighted, as opposed to the prior years' tables which were headcount-weighted.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed disabled annuitant mortality rate assumption would have increased this employer contribution rate by approximately 0.09%, resulting in the rate increasing to 9.89%.

Disabled Annuitant Mortality





Survivor and Beneficiary Mortality

The survivor and beneficiary mortality (SBM) rates are the assumed rates of death for beneficiaries. These rates vary by gender and age. As expected, older beneficiaries tend to die at a higher rate than younger beneficiaries and the general shape of the plan experience is an increasing exponential pattern for both males and females. Because of the relatively small amount of data for beneficiaries, there is more volatility and less credibility with plan experience. As a result, more emphasis was placed on the published data in determining this assumption using the limited fluctuation credibility theory technique.

The current SBM rates are equal to the HAM table that was adopted on October 29, 2015 and is based upon experience for the five-year period from July 1, 2009 through June 30, 2014. A change was made with this study to develop a separate mortality table for beneficiaries. The beneficiary experience was reviewed, and the mortality table based on the general population was the best fit for the data.

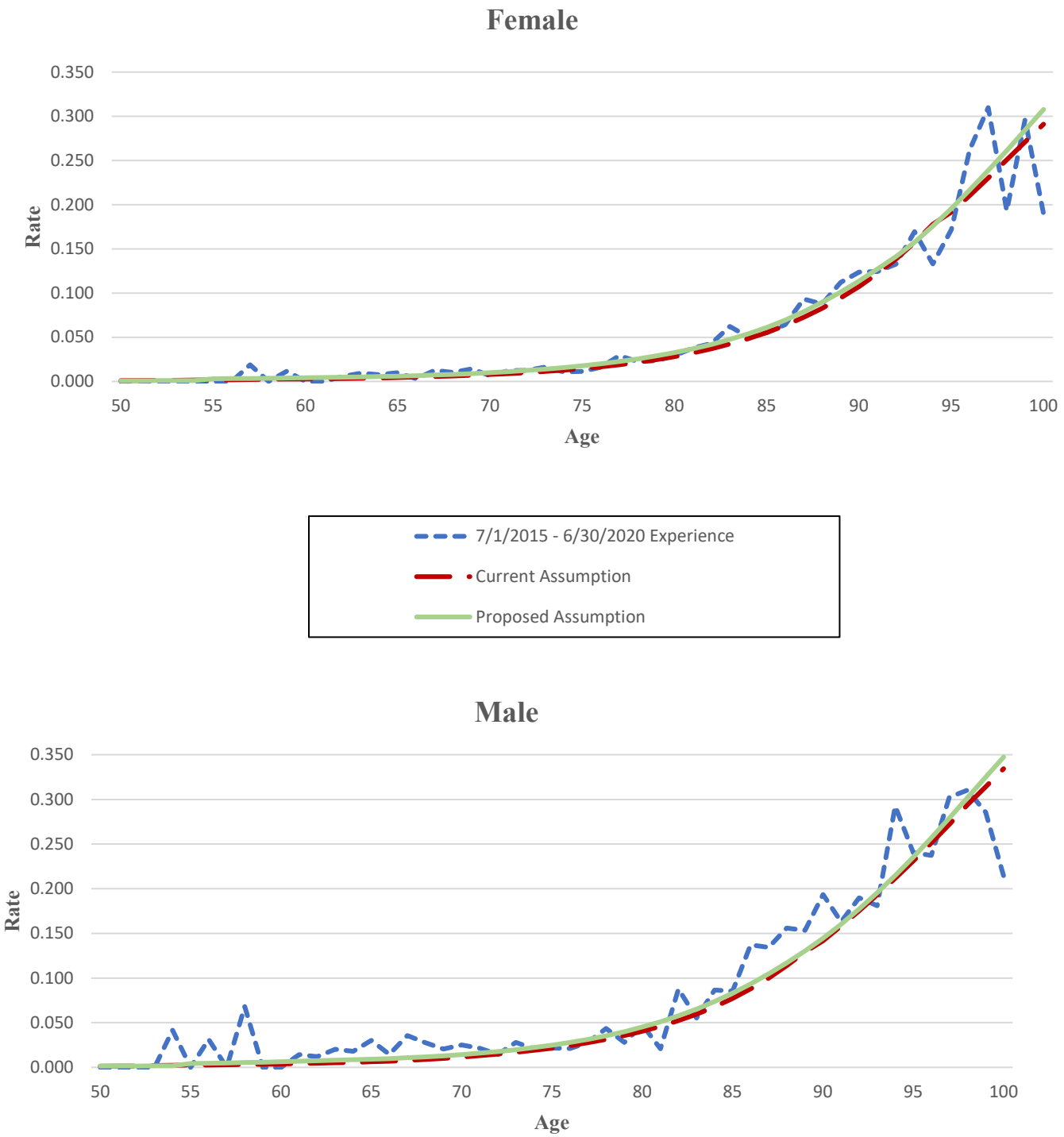
Recent SBM has generally been higher than expected. The mortality experience for the five-year period from July 1, 2015 through June 30, 2020 has shown that the current assumptions are understating the actual number of deaths for male beneficiaries by approximately 23.5% and for female beneficiaries by approximately 7.8%. Based on this experience, it is appropriate to review the current SBM assumption and a recommended revision is warranted.

The recommended rates are based upon SBM experience during the five-year period from July 1, 2015 through June 30, 2020. To reduce random fluctuations in the data and improve the predictive ability of the assumption, limited fluctuation credibility theory was used in conjunction with PubG-2010 general table for above-median incomes to develop the 2020 proposed SBM assumption. In addition, MP-2020 was used to project the Pub-2010 table to June 30, 2018 – the middle of the five-year study period. Until plan experience necessitates a change of this mortality assumption, Scale MP-2020 will be incorporated into this assumption for all valuations.

Like the general shape of the raw rates, the proposed and current SBM assumptions have an increasing exponential pattern for both males and females. The proposed SBM assumption is less optimistic than the current SBM assumption for both males and females. Less optimism is justified since the current rates are under-predicting the number of beneficiary deaths. As described in the section on HAM, the SBM tables are amounts-weighted, as opposed to headcount-weighted.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed survivor and beneficiary mortality rate assumption would have decreased this employer contribution rate by approximately 0.15%, resulting in the rate decreasing to 9.65%.

Survivor and Beneficiary Mortality



Service Retirement

Service retirement rates are the assumed rates of service retirement for all active members. These current rates vary by gender, age, and tier. *Unreduced retirement:* All Tier 1 members, Tier 2 – 4 members who are at least age 62, or at least age 55 with 30 years of service, Tier 5 members at least age 62, or at least age 57 with 30 years of service, and Tier 6 members at least age 63, are not subject to early retirement reductions. *Reduced retirement:* Tier 2 – 4 members age 55 through 61 with less than 30 years of service, Tier 5 members age 55 and 56 (regardless of length of service) or age 57 through 61 with less than 30 years of service, as well as Tier 6 members age 55 through 62 (regardless of length of service), are subject to early retirement reductions.

The current service retirement rates were adopted October 29, 2015 and were based upon experience for the five-year period from July 1, 2009 through June 30, 2014.

The experience for the five-year period from July 1, 2015 through June 30, 2020 was used to develop the service retirement rates. For the five-year period the exposure and actual service retirements include only Tier 1-4 members. Tier 5 and 6 are excluded from the analysis due to their very limited number of actual retirements. Based upon this experience, and a recommendation from our consultant Cheiron, we analyzed the service retirement rates according to our different benefit provisions and recommend the service retirement rates be structured in a different manner than the current rates, which focus on eligibility for an unreduced or a reduced benefit. The proposed retirement rates were constructed with three different tables based upon three groups by years of service: a group with at least 5 and less than 20 years of service, a group with at least 20 and less than 30 years of service, and a group with at least 30 years of service. The current service retirement rates structure in some cases overestimated the number of retirements for those with lower years of service but higher ages and in some cases underestimated the number of retirements for those with higher years of service but younger ages. The new service retirement rate structure provides a better fit with our retirement experience and will allow us to better predict the number of retirements going forward. The new service retirement rates also vary by age and gender.

The recommended rates are based on experience during the observed five-year period. The recent experience shows that overall, more members are retiring than expected and that members are retiring at younger ages. Indeed, the total number of retirements has increased in each of the last five fiscal years. A Moving Weighted Average graduation was performed on the raw rates in order to develop the proposed rates. Due to the limited number of retirements of Tier 5 and 6 members, the recommended service retirement rates will be applied to Tier 5 and 6 members as well, with the expectation that separate Tier 5 and 6 service retirement rates will be developed in the future as experience unfolds.

The weighted average retirement age for the active population under the recommended rates is 60.56 (compared to 61.61 under the current rates).

Appendix A summarizes the recommended service retirement rates and the results of the five-year experience study.

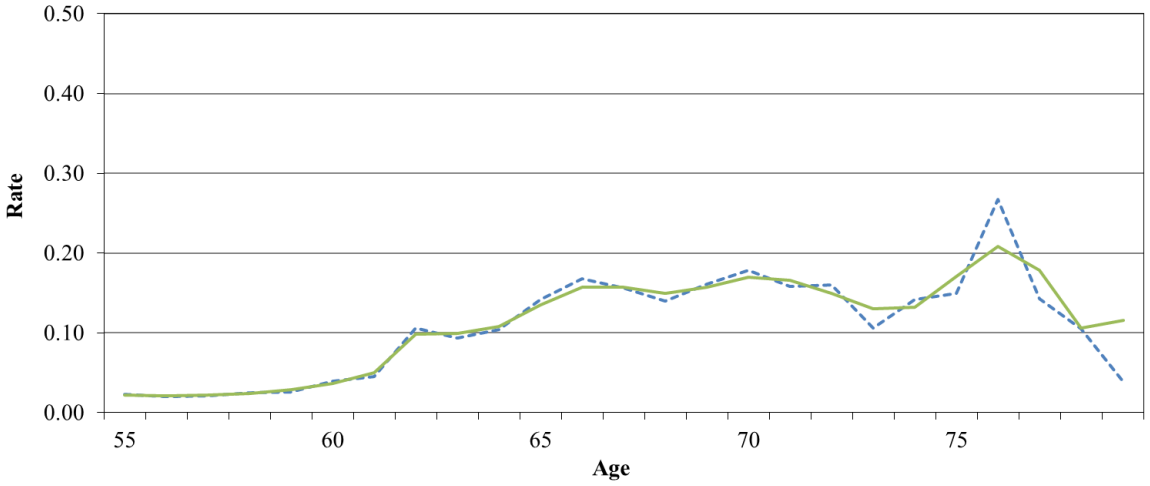
Summary

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed service retirement rate assumption would have increased this employer contribution rate by approximately 1.28%, resulting in the rate increasing to 11.08%.

Service Retirement

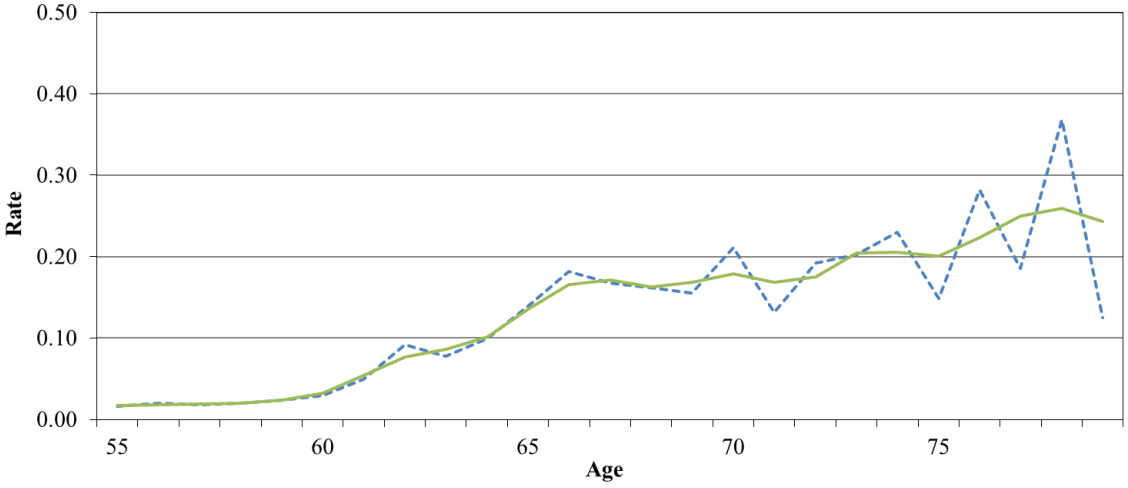
Female

5 ≤ Service < 20



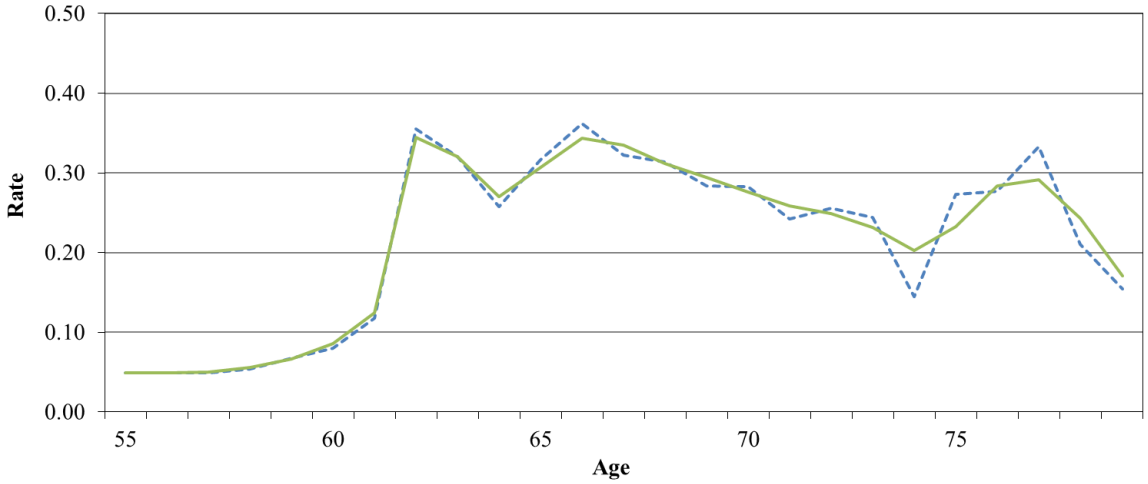
Male

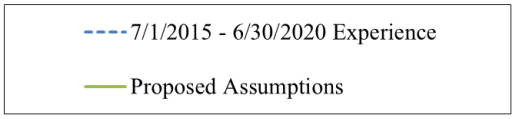
5 ≤ Service < 20



Female

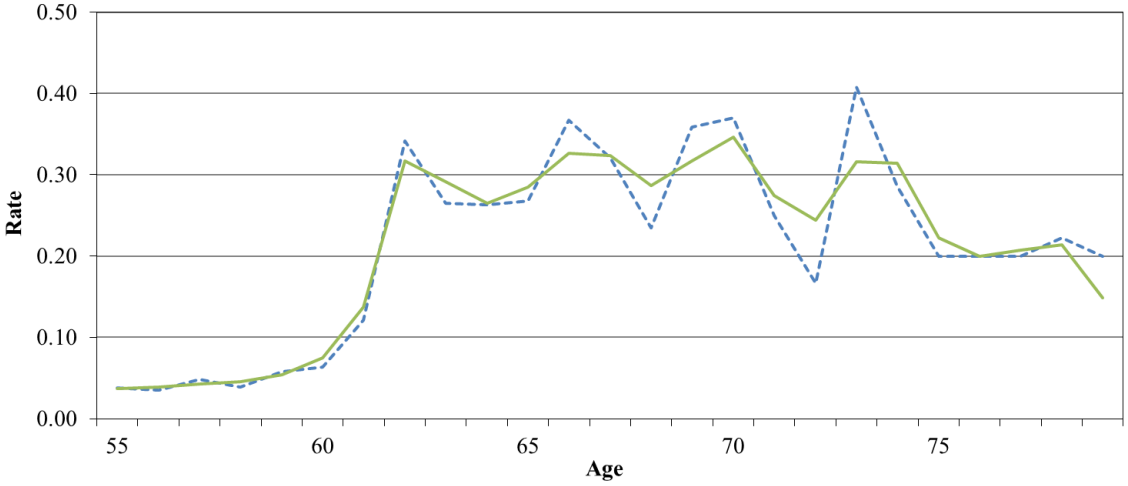
20 ≤ Service < 30





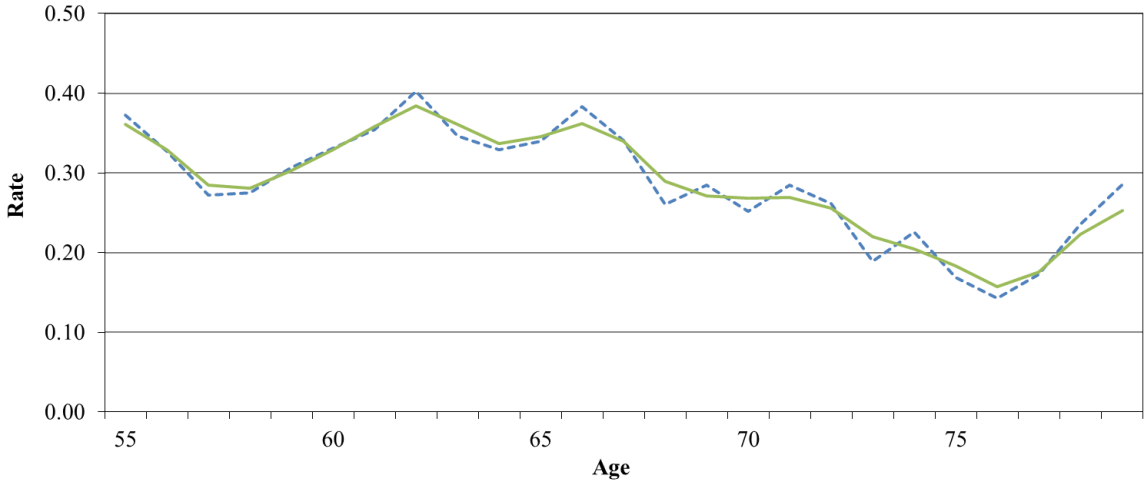
Male

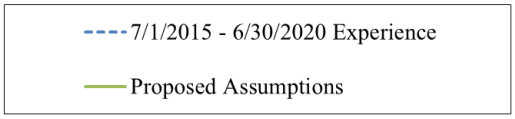
20 ≤ Service < 30



Female

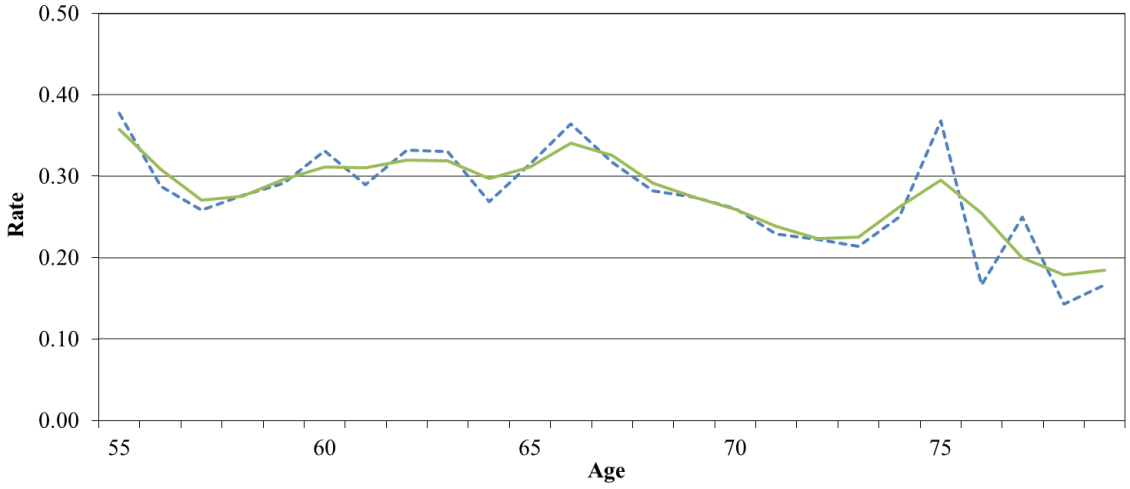
30 ≤ Service





Male

30 ≤ Service



Disability Retirement

Disability retirement rates are the assumed rates of retirement on account of disability. These rates vary by gender and age and are generally increasing.

The current disability rates were adopted on October 29, 2015, were based upon experience for the ten-year period from July 1, 2004 through June 30, 2014 and were developed for ages 30 through 54.

Due to relatively limited disability experience data, a ten-year period from July 1, 2010 to June 30, 2020 was studied. Over this ten-year period, the actual incidence of disability for females and males was higher than expected at most ages. Total disability retirements for females were approximately 135% of expected. Over the same period, total disability retirements for males were approximately 112% of expected. Due to the availability of more recent disability retirement experience, it is appropriate to review the current disability assumptions and a recommended revision is warranted.

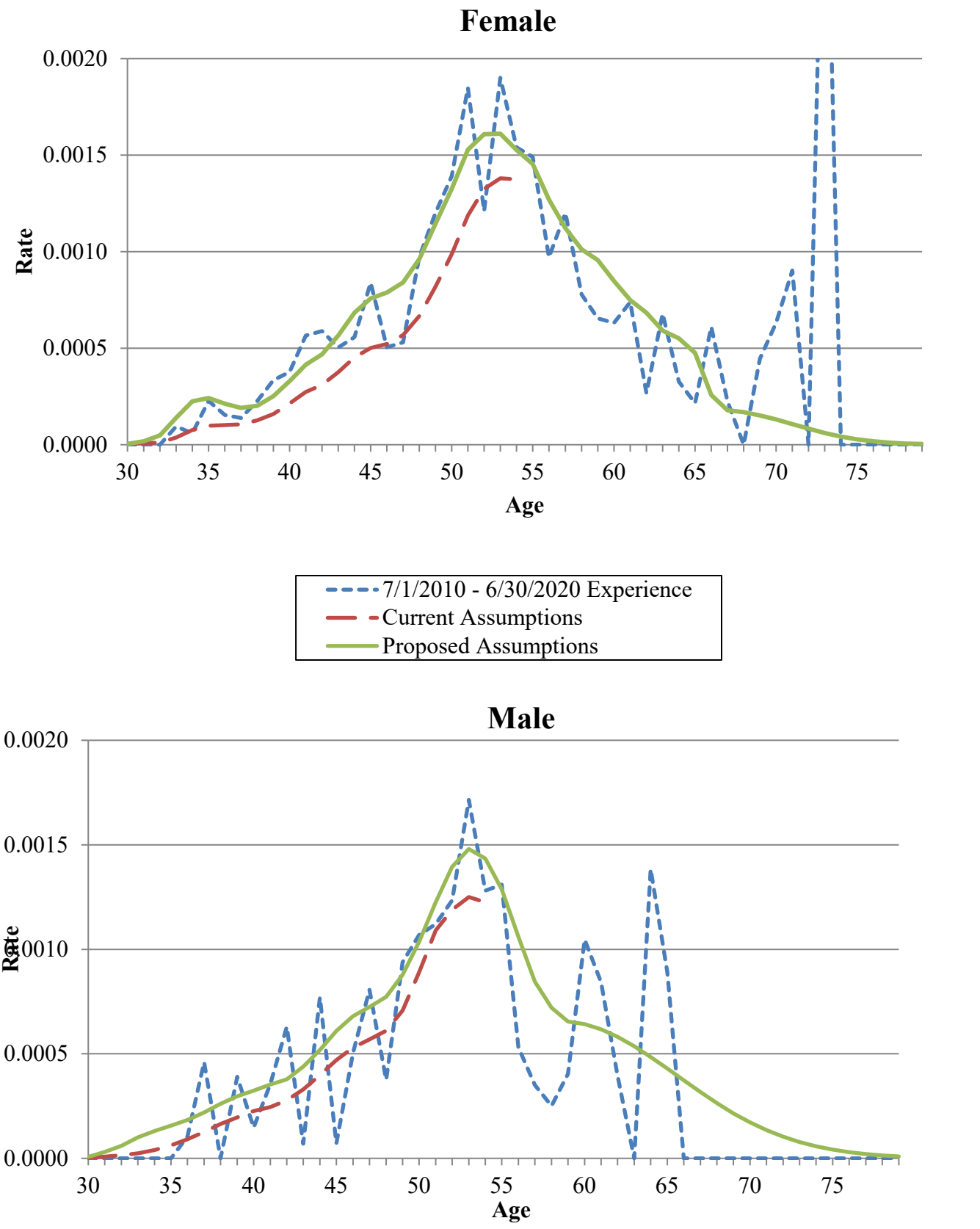
The recommended rates for 2021 are based on disability retirement experience during the ten-year period from July 1, 2010 through June 30, 2020. Limited Fluctuation Credibility Theory (LFCT) was performed on the raw rates from age 30 through age 79, using our current table in the place of a published table. The criteria for disability retirement eligibility varies greatly between retirement systems, with many systems having in statute, or in practice, a much lower bar than NYSTRS has (disabled from any future gainful employment). Because of this, we were not able to find an established disability table that bore a reasonable resemblance to our experience and thus used the current table as the standard tables in this LFCT analysis.

Appendix A summarizes the recommended disability retirement rates, the current rates and the results of the ten-year experience study.

The recommended disability retirement rates for females and males are higher than the current rates at most ages. Additionally, the table was extended out to age 79 as the experience showed that the System has more than a nominal number of disability retirements that occur after age 54.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed disability retirement rate assumptions would have decreased the employer contribution rate by .04%, resulting in the rate decreasing to 9.76%.

Disability Retirement



WITHDRAWAL

The withdrawal rates are the assumed rates of termination of employment from all causes other than death, disability, or retirement. The current withdrawal rates are ten-year select and ultimate tables that vary by gender, age, and years of service. However, unlike the current ones, the proposed withdrawal rates will vary by gender and years of service only, and no longer be select and ultimate, in order to reduce unneeded complexity. The current 22-table withdrawal rates assumption will be reduced to two tables. In general, members with short service tend to withdraw at a higher rate than members with longer service. After seventeen years of service, the withdrawal rates tend to stabilize near zero and the impact of additional service on the rates is negligible.

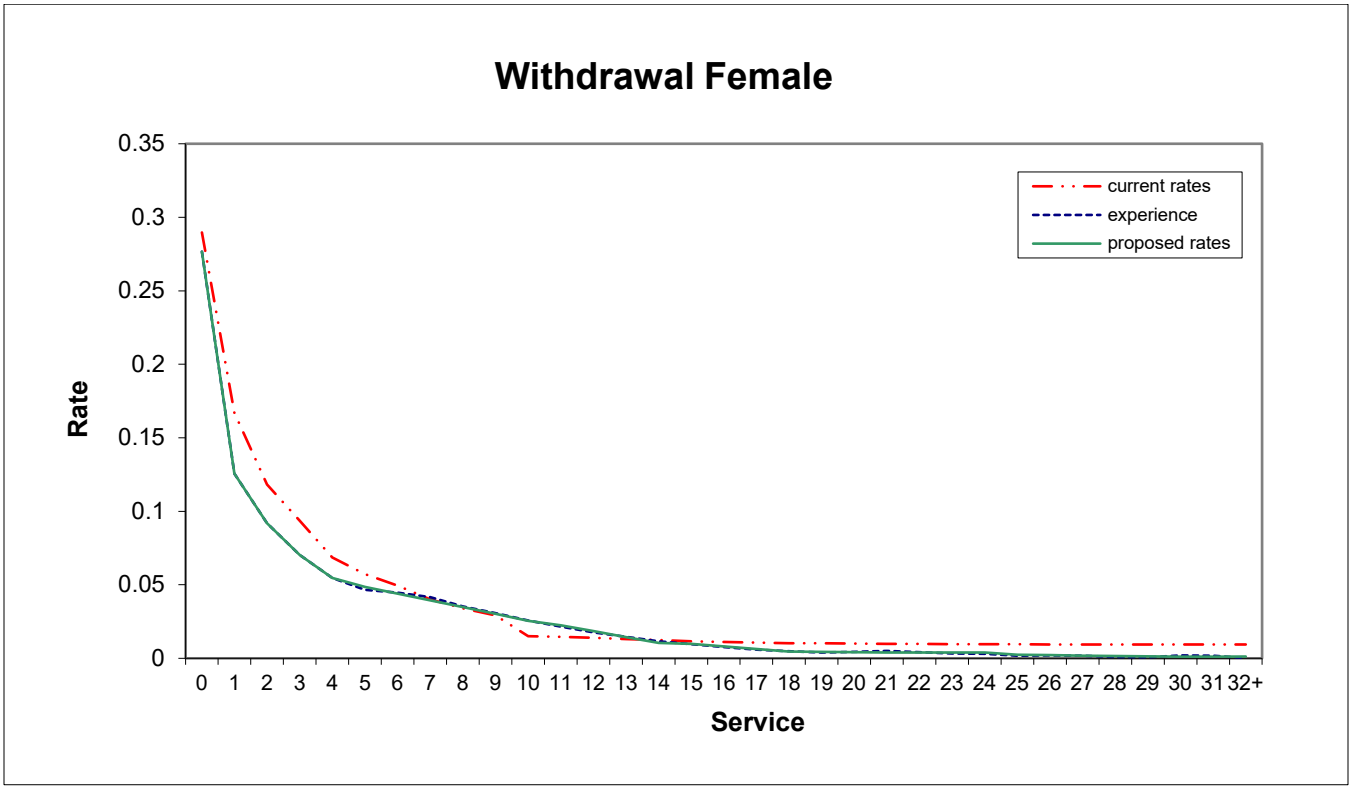
The current withdrawal rates were adopted on October 29, 2015 and were based upon member experience for the five-year period from July 1, 2009 through June 30, 2014.

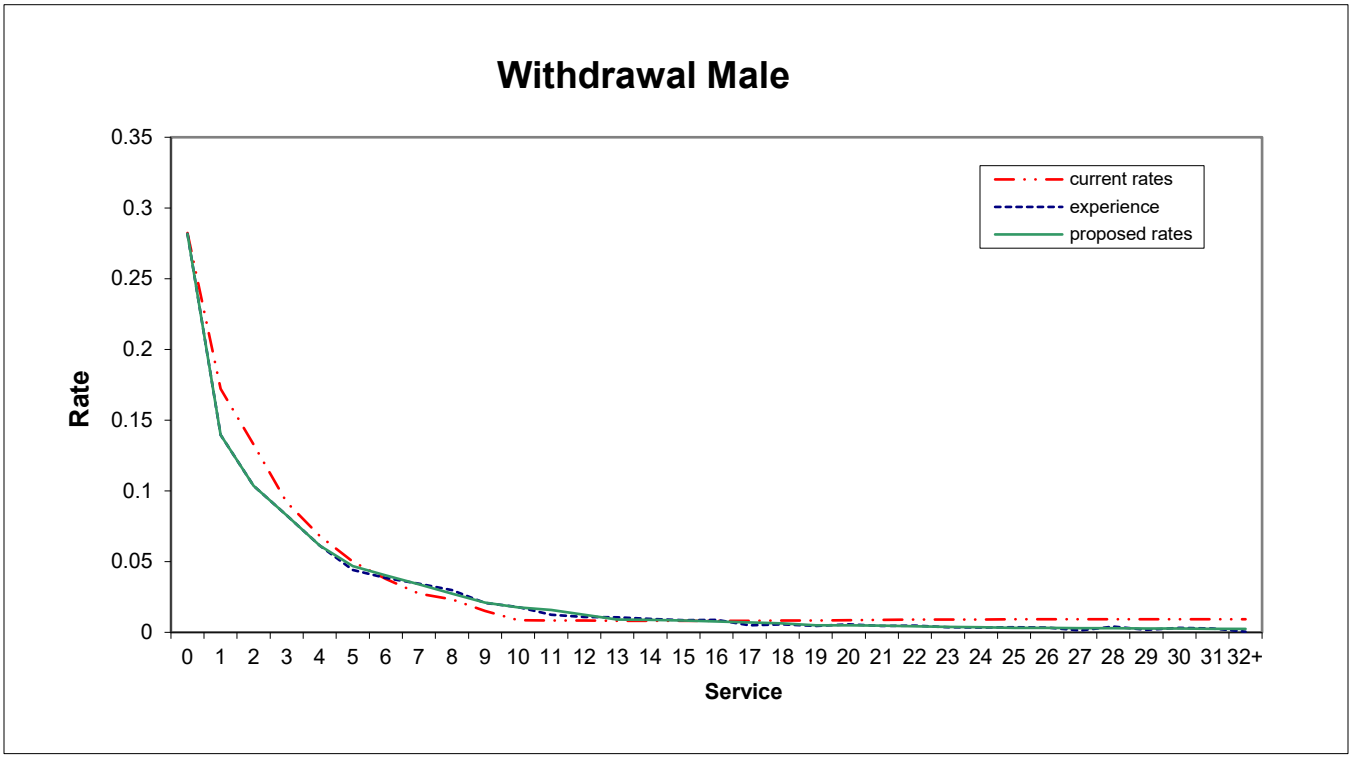
Recent withdrawal experience has generally been lower than expected for the five-year period from July 1, 2015 through June 30, 2020. Specifically, actual withdrawals of male members were over 3% fewer than expected. Similarly, actual withdrawals of female members were over 12% fewer than expected. Based upon this experience, it is appropriate to review the current withdrawal assumptions and a recommended revision is warranted.

The recommended rates are based upon withdrawal experience during the five-year period from July 1, 2015 through June 30, 2020. To reduce random fluctuations, the rates were graduated, or smoothed. and the data was grouped into quinquennial service groups. The rate for the quinquennial midpoint was set directly from the experience. The recommended withdrawal rates at individual points of service were then linearly interpolated from the midpoint rates. Actual rates were developed for the first five years of experience. Appendix A summarizes the recommended withdrawal rates, the current rates, and the results of the five-year experience study.

The recommended withdrawal rates are lower than the current rates for most years of service. The overall withdrawal rates typically decrease with increasing service.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed withdrawal rate assumptions would have increased this employer contribution rate by approximately 0.40%, resulting in the rate increasing to 10.20%.


Withdrawal Female
Rate
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32+
Service
current rates
experience
proposed rates


Withdrawal Male
Rate
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32+
Service
current rates
experience
proposed rates

ECONOMIC ASSUMPTIONS

SALARY SCALE

The salary scale is the assumed annual rate of increase in compensation. Cost-of-living, merit and productivity increases are included in these rates. The percentage increases are greater during the earlier years of employment (when salaries are lower and therefore increments represent a larger percentage) and decline as service increases.

The current salary scale rates were adopted on October 29, 2015 and were based upon salary experience for members who were full-time (nine months of service) for at least two consecutive years during the five-year period from July 1, 2009 through June 30, 2014. The current salary scale is duration-based and unisex. The rates vary by years of service and are independent of a member's gender.

Actual salary increases for active members of the System are based on their years of service with a participating employer. Thus, the use of a duration-based salary scale, without respect to age and gender, provides a better representation of the method used by participating employers in calculating salary increases for active members.

Recent salary experience has been slightly higher than expected. The five-year experience study for the years 2016 through 2020 for salary increases produced an actual-to-expected ratio of 1.004 for active members. The current salary scale rates were developed using salary experience during the five-year period from July 1, 2009 through June 30, 2014. Due to the availability of more recent salary experience, it is appropriate to review the salary scale and a recommended revision is warranted.

Salary scale rates were developed using salary experience for members who were full-time (nine months of service) for at least two consecutive years during the five-year period from July 1, 2015 through June 30, 2020. Additionally, those members with less than a year of service were included in this analysis by using their contract amount instead of earnings to develop the salary scale rate at duration 0. To reduce random fluctuations, the rates were graduated, or smoothed, using the Whittaker-Henderson method. These proposed salary scale rates were higher than the current salary scale rates at all durations.

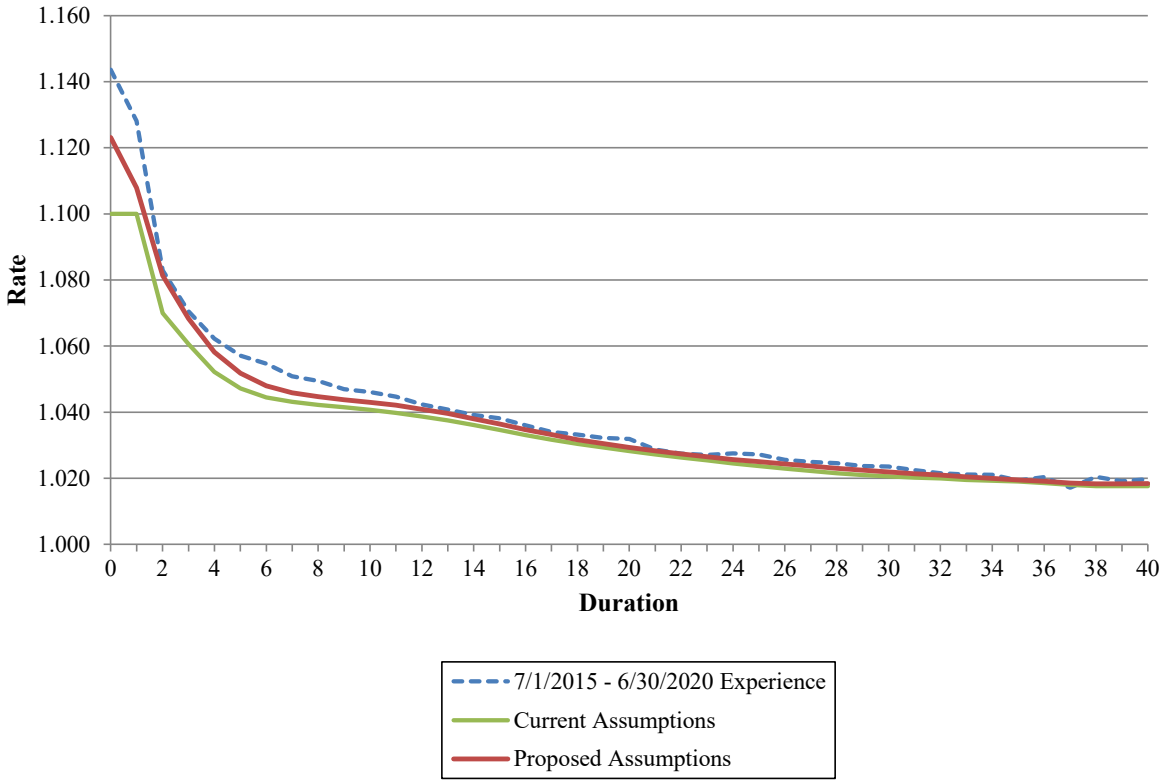
Raises provided to teachers in the years following the global financial crisis in 2008-09 were often very low or non-existent due to the extreme budget difficulties experienced by many school districts during those years. Additionally, many teachers voluntarily gave up whatever raises had been negotiated to help their employers during this difficult period. None of these conditions existed during the five-year period July 1, 2015 through June 30, 2020, so teacher raises during this period were generally much higher.

Going forward there is still much uncertainty with respect to COVID and how it will impact our economy and future state and school district budgets. Therefore, it seems unlikely that the raises granted during the 2015-2020 period – in part higher to make up for the five-year period that preceded it – will continue. Therefore, the recommended rates were developed using a 50/50 blend of the proposed salary scale rates and the current salary scale rates. This effectively makes the new salary scale a product of the last ten years' worth of salary experience, rather than the last five years. Appendix A summarizes the recommended salary scale along with the results of the five-year experience study.

The geometric average annual increase of the recommended salary scale is approximately 3.67%. The current salary scale has a geometric average annual increase of 3.29%. Going forward, salary experience will be monitored closely to ensure the salary scale rates continue to effectively predict salary experience.

Based upon the current assumptions, the employer contribution rate applied to the 2021-2022 salaries and collected in 2022-2023 is 9.80%. The proposed salary scale rate assumptions would have increased this employer contribution rate by approximately 0.45%, resulting in the rate increasing to 10.25%.

Salary Scale



VALUATION RATE OF INTEREST

The Valuation Rate of Interest Assumption

The valuation rate of interest, or discount rate, is used to measure the present value of expected future plan payments calculated within the actuarial valuation. The valuation rate of interest is used to calculate the actuarial valuation results, including the employer contribution rate (ECR). It is the single most impactful actuarial assumption and has the largest impact on the actuarial valuation results, including the ECR. Even a small change in this assumption will lead to a significant change in the ECR. Lowering the interest rate assumption has the effect of increasing plan liabilities, and ultimately increasing the ECR. Lowering this assumption implies that the System expects to earn less money on its investments in the future and will therefore require higher contributions.

When an actuary is determining the contribution to an ongoing public pension plan, they typically use a valuation interest rate that reflects the long-term projected investment return from the pension plan's assets. ASOP No. 27 – *Selection of Economic Assumptions for Measuring Pension Obligations* states in Section 3.9(a) with respect to contribution budgeting, "the actuary may use a discount rate that reflects the anticipated investment return from the pension fund."

Many factors are taken into account in the development of this assumption, in particular the plan's asset allocation, and anticipated long-term rates of return for each asset class invested in. Investment projections from investment advisors may also be considered, although ASOP No. 27, Section 3.5.6, makes clear that this assumption should ultimately reflect the actuary's judgement, and is not required nor expected to be set equal to that of a particular investment advisor or advisors.

The history of the NYSTRS valuation rate of interest assumption since 1980 is as follows:

NYSTRS History of the Valuation Rate of Interest Assumption

Fiscal Year	Return Assumption
1980	4.50%
1981 – 1984	6.75%
1985 – 1987	7.25%
1988 – 2014	8.00%
2015 – 2016	7.50%
2017 – 2018	7.25%
2019 – 2020	7.10%

The System's current valuation rate of interest assumption is 7.10% per annum. **A decrease in the valuation rate of interest assumption to 6.95% is recommended at this time.**

Asset Allocation

The System's current asset allocation, approved by the Retirement Board at its meeting on July 28, 2021, is provided below. This allocation is set by the Retirement Board and reviewed annually. Asset allocation changes, if any, are typically of an incremental nature and not large in scale.

Asset Class	*Allocation Target Percentage*	*Permitted Range*
Domestic Equity	33.0%	29.0% – 37.0%
International Equity	16.0%	12.0% – 20.0%
Global Equity	4.0%	0.0% – 8.0%
Private Equity	8.0%	3.0% – 13.0%
Real Estate	11.0%	6.0% – 16.0%
Total Equity	**72.0%**	
Private Debt	2.0%	0.5% – 5.0%
Domestic Fixed Income	16.0%	12.0% – 20.0%
High Yield Bonds	1.0%	0.0% – 3.0%
Global Bonds	2.0%	0.0% – 4.0%
Real Estate Debt	6.0%	2.0% – 10.0%
Cash Equivalents	1.0%	0.0% – 4.0%
Total Fixed Income	**28.0%**	

Historical Rates of Return

The System's historical annualized rates of return, net of expenses, for periods ending on June 30, 2021, are provided in the table below.

NYSTRS Historical Annualized Rates of Return through June 30, 2021	
Return Period	Annualized Rate of Return based on Market Value of Assets (net of expenses)
1 year	29.0%
3 years	12.7
5 years	11.9
10 years	10.1
15 years	8.1
20 years	7.8
25 years	8.5
30 years	9.2

Expected Returns

The System's investment consultant, Callan Associates, annually provides their long-term expected rates of return and standard deviations, by asset class and for the total fund. These projected returns represent their current expectations over both a 20-year and 30-year time horizon. Combined, along with corresponding asset class correlations, the expected annual rate of return for the total portfolio using a 20-year horizon is 7.48% on an arithmetic basis and 6.76% on a geometric basis. Using a 30-year horizon, the expected annual rate of return for the total portfolio is 8.01% on an arithmetic basis and 7.32% on a geometric basis (see the Callan projections included in Appendix C). For purposes of the valuation rate of interest assumption, the consensus is that the geometric return is the more appropriate choice.

Additionally, stochastic simulation projections were performed for the System by Cheiron, an actuarial consulting firm. In the stochastic simulation modeling, over five-thousand different future investment outcomes were generated based on the System's specific asset allocation. In one simulation set, the Callan capital market assumption projections were used, while in another simulation set the Horizon Actuarial Survey capital market assumption projections were used. Horizon annually surveys investment consultants and provides data with respect to the average of all their investment return expectations by asset class. For the 2021 Horizon survey, 16 different investment consultants provided long-term (20-year) investment return forecasts. Cheiron's 2021 Stochastic Investment Return Projections Report is included in Appendix C.

- The stochastic simulation run using Callan's 20-year projection capital market assumptions produced a return set with a distribution that had a 50th percentile return of 6.7% in 20 years. The returns' 25th to 75th percentile range was 4.7% to 8.7%.

- The stochastic simulation run using Callan's 30-year projection capital market assumptions produced a return set with a distribution that had a 50th percentile return of 7.2% in 20 years. The returns' 25th to 75th percentile range was 5.2% to 9.2%.

- The stochastic simulation run using the Horizon Survey's 20-year projection capital market assumptions produced a return set with a distribution that had a 50th percentile return of 6.7% in 20 years. The returns' 25th to 75th percentile range was 4.9% to 8.6%.

Valuation Interest Rate Conclusion

Based on this stochastic analysis, as well as the static long-term projections, we recommend a valuation interest rate assumption of **6.95%**. Note that 6.95% is the mid-point of the 50th percentile returns of the 20-year and 30-year projections and is very reasonable considering the distribution of the projected returns produced by the various stochastic simulations.

The Callan static 20-year projected geometric return for our asset allocation is 6.76%, while their 30-year projected return for our asset allocation is 7.32%. A return assumption close to the mid-point between these two projections is reasonable and appropriate.

The development of this assumption, as well as the assumption itself, conform to the requirements of ASOP No. 27.

We will review the valuation rate of interest assumption annually to determine if a further decrease is warranted in future years, based upon future capital market projections. Changing this assumption every year is not recommended, however, as it would introduce unneeded volatility into the determination of the ECR.

Other Retirement Systems

The trend across the country has been the lowering of investment return assumptions. The National Association of State Retirement Administrators (NASRA) maintains a public fund database providing data on 130 of the state and large city/county/municipal public retirement systems. According to the February 2021 NASRA Issue Brief on the subject, 78% of survey participants have lowered their assumed rate of return since 2017, and 96% have lowered their assumed rate of return at least once since 2010. The bar graph below from August 2021 shows the distribution of investment return assumptions used by the survey respondents.

Figure 1: NASRA Investment Return Assumption Survey as of August 2021

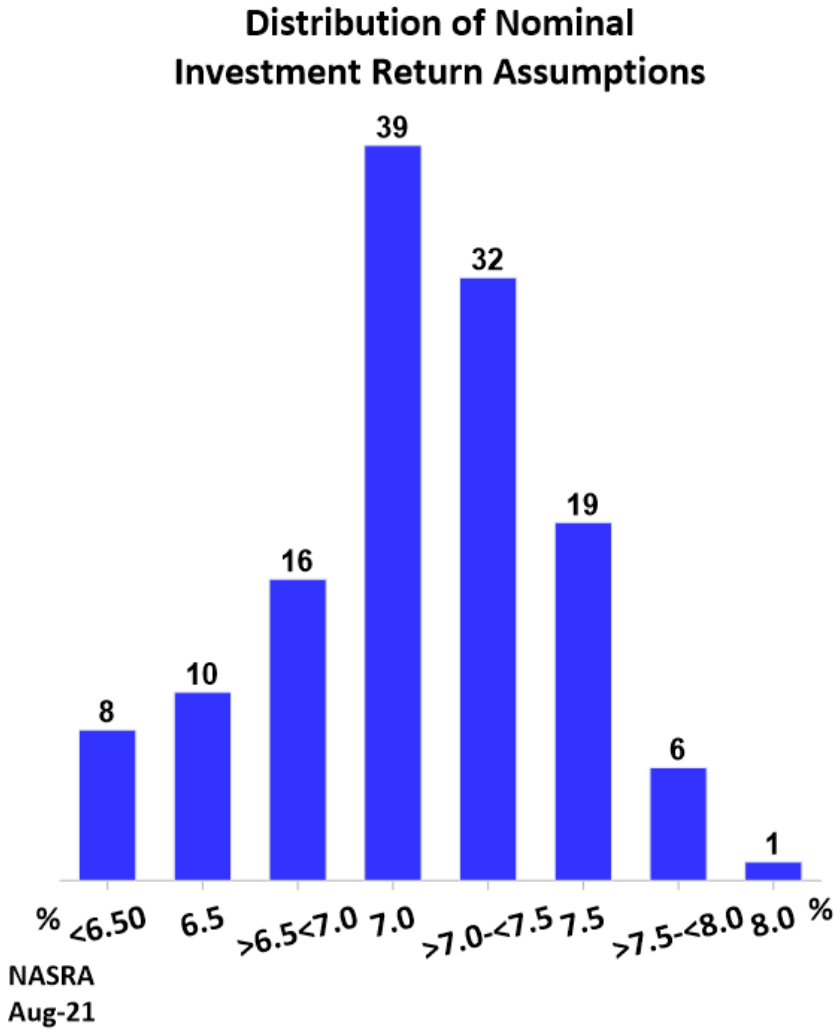
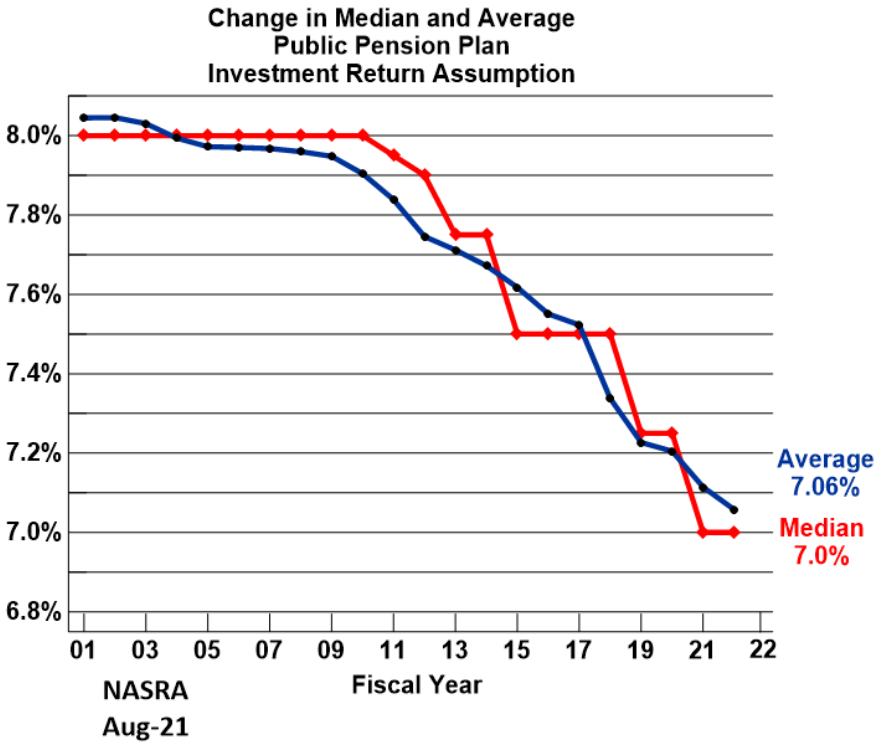


Figure 2: NASRA Investment Return Assumption Survey as of August 2021



Since the NASRA August 2021 Survey was released, some other retirement systems have announced rate decreases. Locally, the New York State and Local Retirement System has recently lowered their return assumption to 5.9%. The New York City Retirement Systems currently have a valuation rate of interest assumption of 7.0%.

With an assumption of 6.95%, NYSTRS is near both the median and average assumption in comparison with its peers across the industry.

CPI/COLA Increase Assumption

The valuation rate of interest assumption can be thought of as the sum of two components: a cost-of-living, or inflationary component, and a real rate of return component. **It is recommended that the inflation assumption be increased from the current rate of 2.20% to 2.40%.**

The actual annualized Consumer Price Index (CPI) [5] increases for the periods ending March 31, 2021 are displayed below.

Period	*Annualized CPI Increase*
5 years	2.15%
10 years	1.71%
20 years	2.06%

[5] CPI as measured by CPI-U, U.S. city average, 1982-84=100, as developed by the U.S. Dept. of Labor, Bureau of Labor Statistics

30 years	2.27%
Since 1913 (first available year)	3.13%

The Social Security OASDI Trustees' Report prepared by the Office of the Chief Actuary of the Social Security Administration released in 2021 contains a best-estimate long-term inflation assumption of 2.4%. Callan Associates long-term inflation assumption is 2.0%. The average of the Horizon Survey's long-term inflation forecasts is 2.2%, with investment consultants' projections ranging from a low of 1.8% to a high of 2.9%. The August 2021 Survey of Consumer Expectations by the Federal Reserve Bank of New York shows that short- and medium-term inflation expectations rose to new series highs of 5.2% and 4.0%, respectively. Given these projections and the recent uptick in inflation, it is appropriate to raise the inflation assumption.

The estimated rate of future increases in the CPI plays a role in the actuarial valuation with respect to projecting future retired member cost-of-living-adjustment (COLA) benefits. This benefit is provided in accordance with Chapter 125 of the Laws of 2000 and was first paid in September 2001. It is increased annually every September. The COLA is provided to eligible retired members (generally age 62 and retired for five years; or retired for five years under a disability retirement) and is equal to 50% of the annual increase in the CPI applied to the first $18,000 of annual benefit. The COLA percentage each year cannot exceed 3.0% nor be less than 1.0%.

The bounded nature of the COLA increase implies that annual CPI increases greater than 6.0% or less than 2.0% are not counted. A review of "bounded-CPI" data (i.e., annual historical increases greater than 6.0% or less than 2.0% are fixed at 6.0% or 2.0%, respectively) for the periods ending March 31, 2021 provides the following:

Period	***Annualized Bounded-CPI Increase***
5 years	2.27%
10 years	2.20%
20 years	2.46%
30 years	2.57%
Since 1913 (first available year)	3.29%

The chart below details the COLA percentages provided since the program's inception in 2001. The average increase over the 21-year period was 1.27% and the average increase over the last 5 years was 1.16%.

Year	**COLA %**	**Year**	**COLA %**	**Year**	**COLA %**	**Year**	**COLA %**	**Year**	**COLA %**
2001	1.5%	**2006**	1.7%	**2011**	1.4%	**2016**	1.0%	2021	1.4%
2002	1.0%	**2007**	1.4%	**2012**	1.4%	**2017**	1.0%		
2003	1.6%	**2008**	2.0%	**2013**	1.0%	**2018**	1.2%		
2004	1.0%	**2009**	1.0%	**2014**	1.0%	**2019**	1.2%		
2005	1.6%	**2010**	1.2%	**2015**	1.0%	**2020**	1.0%		

It is recommended that our "bounded-CPI" increase percentage assumption be maintained at the current rate of 2.6%. This will maintain the future projected COLA assumed rate of 1.3%.

ACTUARIAL VALUE OF ASSETS METHOD

NYSTRS uses an actuarial value of assets (AVA) method, or asset smoothing method, to calculate a value of assets to use in the actuarial valuation. The reason for using a smoothing method is to reduce annual fluctuations in the employer contribution rate (ECR) due to short-term volatility in the market value of assets (MVA) that can occur due to volatility in the capital markets. This is a common practice in the industry and utilized by most every other retirement system.

The AVA method currently used by NYSTRS is a five-year smoothing method that recognizes the difference between the actual return and the expected return based upon the valuation rate of interest assumption for each fiscal year, at the rate of 20% per year. Five years is a common length period for asset smoothing and is considered to strike an appropriate balance between providing lower ECR fluctuations and allowing the ECR to react sufficiently as needed to actual asset values.

Without asset smoothing, the ECR could and likely would fluctuate to a much greater degree on a year-to-year basis.

There is no change recommended to the AVA method at this time.

APPENDIX A: Recommended Actuarial Assumptions

Active Member Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
20	564	0	0.000108	0	-	0.000132	0	-
21	1,011	0	0.000112	0	-	0.000124	0	-
22	2,211	0	0.000112	0	-	0.000105	0	-
23	5,707	0	0.000112	1	0.0000	0.000096	1	0.0000
24	8,127	1	0.000112	1	1.0000	0.000099	1	1.0000
25	10,032	0	0.000112	1	0.0000	0.000101	1	0.0000
26	11,789	0	0.000112	1	0.0000	0.000114	1	0.0000
27	12,926	4	0.000112	1	4.0000	0.000116	1	4.0000
28	14,069	1	0.000119	2	0.5000	0.000131	2	0.5000
29	14,880	2	0.000124	2	1.0000	0.000145	2	1.0000
30	15,700	1	0.000129	2	0.5000	0.000171	3	0.3333
31	16,800	2	0.000132	2	1.0000	0.000185	3	0.6667
32	17,775	5	0.000135	2	2.5000	0.000197	4	1.2500
33	18,753	3	0.000137	3	1.0000	0.000209	4	0.7500
34	20,106	4	0.000140	3	1.3333	0.000232	5	0.8000
35	21,259	3	0.000144	3	1.0000	0.000240	5	0.6000
36	22,222	6	0.000151	3	2.0000	0.000259	6	1.0000
37	23,047	3	0.000160	4	0.7500	0.000277	6	0.5000
38	23,783	6	0.000174	4	1.5000	0.000291	7	0.8571
39	24,091	6	0.000191	5	1.2000	0.000316	8	0.7500
40	24,313	10	0.000213	5	2.0000	0.000326	8	1.2500
41	24,416	8	0.000239	6	1.3333	0.000347	8	1.0000
42	24,307	9	0.000269	7	1.2857	0.000366	9	1.0000
43	24,132	8	0.000302	7	1.1429	0.000395	10	0.8000
44	24,853	13	0.000338	8	1.6250	0.000413	10	1.3000
45	25,662	12	0.000374	10	1.2000	0.000442	11	1.0909
46	25,856	13	0.000412	11	1.1818	0.000482	12	1.0833
47	25,974	14	0.000450	12	1.1667	0.000523	14	1.0000
48	25,714	14	0.000487	13	1.0769	0.000568	15	0.9333
49	24,823	10	0.000523	13	0.7692	0.000616	15	0.6667
50	23,482	15	0.000559	13	1.1538	0.000668	16	0.9375
51	22,736	20	0.000595	14	1.4286	0.000733	17	1.1765
52	22,577	14	0.000632	14	1.0000	0.000811	18	0.7778
53	22,601	24	0.000671	15	1.6000	0.000884	20	1.2000
54	22,652	30	0.000711	16	1.8750	0.000968	22	1.3636

Active Member Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
55	22,471	24	0.000755	17	1.4118	0.001063	24	1.0000
56	20,371	35	0.000802	16	2.1875	0.001156	24	1.4583
57	18,896	13	0.000854	16	0.8125	0.001255	24	0.5417
58	17,871	17	0.000911	16	1.0625	0.001369	24	0.7083
59	16,679	28	0.000973	16	1.7500	0.001485	25	1.1200
60	15,419	25	0.001042	16	1.5625	0.001611	25	1.0000
61	14,296	29	0.001117	16	1.8125	0.001748	25	1.1600
62	12,950	20	0.001199	16	1.2500	0.001902	25	0.8000
63	9,800	32	0.001291	13	2.4615	0.002066	20	1.6000
64	7,710	23	0.001393	11	2.0909	0.002259	17	1.3529
65	6,233	16	0.001509	9	1.7778	0.002472	15	1.0667
66	4,635	12	0.001642	8	1.5000	0.002719	13	0.9231
67	3,216	12	0.001797	6	2.0000	0.003002	10	1.2000
68	2,347	10	0.001981	5	2.0000	0.003342	8	1.2500
69	1,669	6	0.002350	4	1.5000	0.003748	6	1.0000
70	1,196	7	0.002550	3	2.3333	0.004225	5	1.4000
71	836	8	0.002864	2	4.0000	0.004789	4	2.0000
72	598	0	0.003217	2	0.0000	0.005454	3	0.0000
73	435	0	0.003613	2	0.0000	0.006216	3	0.0000
74	337	2	0.004058	1	2.0000	0.007116	2	1.0000
75	260	0	0.004558	1	0.0000	0.008144	2	0.0000
76	204	2	0.004558	1	2.0000	0.009388	2	1.0000
77	157	0	0.004558	1	0.0000	0.010829	2	0.0000
78	111	0	0.004558	1	0.0000	0.012490	1	0.0000
79	81	0	0.004558	0	-	0.014393	1	0.0000
Total	**827,728**	**582**		**0** **403**	**1.4442**		**575**	**1.0122**

Active Member Mortality Rates

Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
20	186	0	0.000189	0	-	0.000326	0	-
21	303	0	0.000212	0	-	0.000292	0	-
22	535	0	0.000233	0	-	0.000249	0	-
23	1,482	0	0.000258	0	-	0.000215	0	-
24	2,377	0	0.000281	1	0.0000	0.000189	0	-
25	2,987	1	0.000286	1	1.0000	0.000173	1	1.0000
26	3,427	0	0.000286	1	0.0000	0.000189	1	0.0000
27	3,681	1	0.000287	1	1.0000	0.000206	1	1.0000
28	3,962	3	0.000288	1	3.0000	0.000223	1	3.0000
29	4,287	6	0.000290	1	6.0000	0.000252	1	6.0000
30	4,596	0	0.000293	1	0.0000	0.000269	1	0.0000
31	4,974	1	0.000298	1	1.0000	0.000298	1	1.0000
32	5,386	2	0.000305	2	1.0000	0.000314	2	1.0000
33	5,949	2	0.000314	2	1.0000	0.000340	2	1.0000
34	6,336	2	0.000326	2	1.0000	0.000353	2	1.0000
35	6,902	1	0.000342	2	0.5000	0.000376	3	0.3333
36	7,406	1	0.000361	3	0.3333	0.000396	3	0.3333
37	7,837	3	0.000384	3	1.0000	0.000412	3	1.0000
38	8,155	2	0.000410	3	0.6667	0.000438	4	0.5000
39	8,460	4	0.000441	4	1.0000	0.000448	4	1.0000
40	8,637	3	0.000474	4	0.7500	0.000467	4	0.7500
41	8,796	3	0.000510	4	0.7500	0.000494	4	0.7500
42	8,740	6	0.000548	5	1.2000	0.000518	5	1.2000
43	8,758	4	0.000586	5	0.8000	0.000550	5	0.8000
44	8,912	7	0.000624	6	1.1667	0.000582	5	1.4000
45	9,039	5	0.000661	6	0.8333	0.000633	6	0.8333
46	9,081	12	0.000697	6	2.0000	0.000683	6	2.0000
47	8,954	11	0.000732	7	1.5714	0.000743	7	1.5714
48	8,733	9	0.000765	7	1.2857	0.000816	7	1.2857
49	8,243	12	0.000800	7	1.7143	0.000891	7	1.7143
50	7,747	4	0.000836	6	0.6667	0.000988	8	0.5000
51	7,314	11	0.000876	6	1.8333	0.001090	8	1.3750
52	7,092	4	0.000923	7	0.5714	0.001197	8	0.5000
53	6,844	8	0.000979	7	1.1429	0.001327	9	0.8889
54	6,616	9	0.001050	7	1.2857	0.001463	10	0.9000

Active Member Mortality Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
55	6,311	18	0.001139	7	2.5714	0.001605	10	1.8000
56	5,387	10	0.001251	7	1.4286	0.001769	10	1.0000
57	4,898	9	0.001391	7	1.2857	0.001948	10	0.9000
58	4,475	5	0.001565	7	0.7143	0.002146	10	0.5000
59	4,077	16	0.001779	7	2.2857	0.002363	10	1.6000
60	3,737	10	0.002039	8	1.2500	0.002605	10	1.0000
61	3,381	8	0.002349	8	1.0000	0.002875	10	0.8000
62	2,972	8	0.002716	8	1.0000	0.003162	9	0.8889
63	2,363	8	0.003143	7	1.1429	0.003461	8	1.0000
64	1,958	5	0.003636	7	0.7143	0.003789	7	0.7143
65	1,594	8	0.004197	7	1.1429	0.004146	7	1.1429
66	1,244	3	0.004828	6	0.5000	0.004515	6	0.5000
67	927	2	0.005370	5	0.4000	0.004918	5	0.4000
68	735	2	0.006058	4	0.5000	0.005349	4	0.5000
69	557	3	0.006834	4	0.7500	0.005822	3	1.0000
70	430	1	0.007709	3	0.3333	0.006313	3	0.3333
71	320	5	0.008696	3	1.6667	0.006838	2	2.5000
72	236	0	0.009810	2	0.0000	0.007406	2	0.0000
73	173	2	0.011066	2	1.0000	0.008017	1	2.0000
74	134	0	0.012483	2	0.0000	0.008674	1	0.0000
75	108	1	0.014082	2	0.5000	0.009408	1	1.0000
76	85	0	0.014082	1	0.0000	0.010787	1	0.0000
77	58	1	0.014082	1	1.0000	0.012380	1	1.0000
78	49	0	0.014082	1	0.0000	0.014221	1	0.0000
79	39	2	0.014082	1	2.0000	0.016338	1	2.0000
Total	**259,147**	**266**		**236**	**1.1271**		**269**	**0.9888**

Healthy Annuitant Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
55	657	1	0.001805	1	1.0000	0.001763	1	1.0000
56	3,274	8	0.001980	6	1.3333	0.001932	6	1.3333
57	4,831	12	0.002172	10	1.2000	0.002104	10	1.2000
58	6,044	19	0.002382	14	1.3571	0.002284	14	1.3571
59	7,205	17	0.002613	19	0.8947	0.002461	18	0.9444
60	8,555	22	0.002866	25	0.8800	0.002642	23	0.9565
61	10,325	36	0.003053	32	1.1250	0.002833	29	1.2414
62	12,580	44	0.003298	41	1.0732	0.003026	38	1.1579
63	17,046	45	0.003604	61	0.7377	0.003239	55	0.8182
64	20,714	67	0.003976	82	0.8171	0.003476	72	0.9306
65	23,798	93	0.004417	105	0.8857	0.003756	89	1.0449
66	26,786	115	0.004931	132	0.8712	0.004075	109	1.0550
67	29,070	128	0.005524	161	0.7950	0.004460	130	0.9846
68	30,674	157	0.006203	190	0.8263	0.004926	151	1.0397
69	30,585	187	0.006979	213	0.8779	0.005489	168	1.1131
70	29,064	172	0.007864	229	0.7511	0.006169	179	0.9609
71	26,922	194	0.008874	239	0.8117	0.006976	188	1.0319
72	24,900	208	0.010029	250	0.8320	0.007929	197	1.0558
73	22,150	243	0.011349	251	0.9681	0.009050	200	1.2150
74	19,724	225	0.012863	254	0.8858	0.010362	204	1.1029
75	18,059	223	0.014602	264	0.8447	0.013227	239	0.9331
76	16,332	244	0.016603	271	0.9004	0.015184	248	0.9839
77	14,364	258	0.018909	272	0.9485	0.017425	250	1.0320
78	12,598	252	0.021567	272	0.9265	0.019982	252	1.0000
79	11,315	245	0.024631	279	0.8781	0.022903	259	0.9459
80	10,382	272	0.028162	292	0.9315	0.026219	272	1.0000
81	9,666	290	0.032228	312	0.9295	0.029999	290	1.0000
82	8,938	337	0.036904	330	1.0212	0.034278	306	1.1013
83	8,316	338	0.042268	352	0.9602	0.039141	325	1.0400
84	7,874	358	0.048410	381	0.9396	0.044654	352	1.0170
85	7,493	389	0.055421	415	0.9373	0.050874	381	1.0210
86	7,084	428	0.063404	449	0.9532	0.057876	410	1.0439
87	6,677	483	0.072465	484	0.9979	0.065733	439	1.1002
88	6,055	474	0.082724	501	0.9461	0.074568	452	1.0487
89	5,423	489	0.094308	511	0.9569	0.084462	458	1.0677

Healthy Annuitant Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
90	4,740	511	0.107360	509	1.0039	0.109847	521	0.9808
91	4,006	523	0.122037	489	1.0695	0.124150	497	1.0523
92	3,259	415	0.138518	451	0.9202	0.139945	456	0.9101
93	2,702	395	0.157000	424	0.9316	0.157256	425	0.9294
94	2,235	385	0.177701	397	0.9698	0.175838	393	0.9796
95	1,762	347	0.191477	337	1.0297	0.195482	344	1.0087
96	1,379	305	0.210235	290	1.0517	0.216617	299	1.0201
97	1,053	245	0.229998	242	1.0124	0.238632	251	0.9761
98	775	218	0.250723	194	1.1237	0.261262	202	1.0792
99	550	174	0.270858	149	1.1678	0.284370	156	1.1154
100	367	109	0.291040	107	1.0187	0.307717	113	0.9646
101	245	84	0.311444	76	1.1053	0.331284	81	1.0370
102	157	52	0.331900	52	1.0000	0.355062	56	0.9286
103	91	42	0.352232	32	1.3125	0.378941	34	1.2353
104	49	20	0.372273	18	1.1111	0.402553	20	1.0000
105	31	14	0.391860	12	1.1667	0.425814	13	1.0769
106	22	9	0.410849	9	1.0000	0.448404	10	0.9000
107	12	7	0.429112	5	1.4000	0.470342	6	1.1667
108	5	4	0.446544	2	2.0000	0.491432	2	2.0000
109	1	0	0.463061	0	-	0.511431	1	0.0000
110	1	0	0.478604	0	-	0.530405	1	0.0000
111	1	1	1.000000	1	1.0000	0.548187	1	1.0000
112	0	0	1.000000	0	-	0.557992	0	-
113	0	0	1.000000	0	-	0.558942	0	-
114	0	0	1.000000	0	-	0.559950	0	-
115	0	0	1.000000	0	-	0.560902	0	-
116	0	0	1.000000	0	-	0.560959	0	-
117	0	0	1.000000	0	-	0.561015	0	-
118	0	0	1.000000	0	-	0.561015	0	-
119	0	0	1.000000	0	-	0.561015	0	-
120	0	0	1.000000	0	-	1.000000	0	-
Total	**528,923**	**10,933**		**11,496**	**0.9510**		**10,696**	**1.0222**

Healthy Annuitant Mortality Rates

Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
55	208	1	0.002522	1	1.0000	0.002062	0	-
56	1,049	5	0.002753	3	1.6667	0.002298	2	2.5000
57	1,506	3	0.003004	5	0.6000	0.002558	4	0.7500
58	1,875	10	0.003279	6	1.6667	0.002850	5	2.0000
59	2,289	5	0.003579	8	0.6250	0.003160	7	0.7143
60	2,729	12	0.003906	11	1.0909	0.003492	10	1.2000
61	3,255	14	0.004264	14	1.0000	0.003850	13	1.0769
62	3,887	23	0.004654	18	1.2778	0.004238	16	1.4375
63	5,095	25	0.005050	26	0.9615	0.004643	24	1.0417
64	6,404	39	0.005564	36	1.0833	0.005097	33	1.1818
65	7,673	49	0.006204	48	1.0208	0.005594	43	1.1395
66	9,049	62	0.006976	63	0.9841	0.006160	56	1.1071
67	10,630	80	0.007886	84	0.9524	0.006809	72	1.1111
68	12,456	106	0.008942	111	0.9550	0.007562	94	1.1277
69	13,654	120	0.010151	139	0.8633	0.008430	115	1.0435
70	13,965	132	0.011524	161	0.8199	0.009446	132	1.0000
71	13,989	155	0.013074	183	0.8470	0.010632	149	1.0403
72	13,708	184	0.014821	203	0.9064	0.012012	165	1.1152
73	12,628	179	0.016788	212	0.8443	0.013614	172	1.0407
74	11,241	212	0.019009	214	0.9907	0.015459	174	1.2184
75	10,415	197	0.021524	224	0.8795	0.020078	209	0.9426
76	9,475	213	0.024380	231	0.9221	0.022872	217	0.9816
77	8,504	212	0.027633	235	0.9021	0.026050	222	0.9550
78	7,499	207	0.031346	235	0.8809	0.029647	222	0.9324
79	6,968	232	0.035590	248	0.9355	0.033736	235	0.9872
80	6,521	239	0.040445	264	0.9053	0.038367	250	0.9560
81	6,282	283	0.045997	289	0.9792	0.043643	274	1.0328
82	5,902	298	0.052342	309	0.9644	0.049675	293	1.0171
83	5,766	351	0.059585	344	1.0203	0.056541	326	1.0767
84	5,395	368	0.067844	366	1.0055	0.064371	347	1.0605
85	4,996	377	0.077246	386	0.9767	0.073241	366	1.0301
86	4,487	388	0.087929	395	0.9823	0.083220	373	1.0402
87	3,922	405	0.100040	392	1.0332	0.094351	370	1.0946
88	3,357	368	0.113741	382	0.9634	0.106789	358	1.0279
89	2,840	359	0.129208	367	0.9782	0.120557	342	1.0497

Healthy Annuitant Mortality Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
90	2,388	333	0.141713	338	0.9852	0.135736	324	1.0278
91	1,934	316	0.158130	306	1.0327	0.152258	294	1.0748
92	1,518	284	0.175288	266	1.0677	0.169997	258	1.1008
93	1,127	216	0.193131	218	0.9908	0.188712	213	1.0141
94	823	177	0.211674	174	1.0172	0.208207	171	1.0351
95	542	128	0.230976	125	1.0240	0.228238	124	1.0323
96	367	120	0.251106	92	1.3043	0.256135	94	1.2766
97	212	65	0.272113	58	1.1207	0.278405	59	1.1017
98	133	38	0.293848	39	0.9744	0.300930	40	0.9500
99	82	30	0.313988	26	1.1538	0.323597	27	1.1111
100	54	21	0.334365	18	1.1667	0.346058	19	1.1053
101	29	9	0.354599	10	0.9000	0.368382	11	0.8182
102	17	5	0.374524	6	0.8333	0.390636	7	0.7143
103	7	3	0.393982	3	1.0000	0.412527	3	1.0000
104	3	1	0.412831	1	1.0000	0.433960	1	1.0000
105	3	2	0.430946	1	2.0000	0.454672	1	2.0000
106	1	0	0.448227	0	-	0.474623	0	-
107	1	1	0.464592	0	-	0.493810	0	-
108	0	0	0.479987	0	-	0.511957	0	-
109	0	0	0.494376	0	-	0.529320	0	-
110	0	0	0.500000	0	-	0.530405	0	-
111	0	0	1.000000	0	-	0.548187	0	-
112	0	0	1.000000	0	-	0.557992	0	-
113	0	0	1.000000	0	-	0.558942	0	-
114	0	0	1.000000	0	-	0.559950	0	-
115	0	0	1.000000	0	-	0.560902	0	-
116	0	0	1.000000	0	-	0.560959	0	-
117	0	0	1.000000	0	-	0.561015	0	-
118	0	0	1.000000	0	-	0.561015	0	-
119	0	0	1.000000	0	-	0.561015	0	-
120	0	0	1.000000	0	-	1.000000	0	-
Total	**248,860**	**7,662**		**7,894**	**0.9706**		**7,336**	**1.0444**

Disabled Annuitant Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
30	0	0	0.106487	0	-	0.003422	0	-
31	0	0	0.106487	0	-	0.003769	0	-
32	0	0	0.106487	0	-	0.004129	0	-
33	0	0	0.103280	0	-	0.004505	0	-
34	0	0	0.100083	0	-	0.004881	0	-
35	0	0	0.096905	0	-	0.005259	0	-
36	3	0	0.093763	0	-	0.005634	0	-
37	7	1	0.090676	1	1.0000	0.006015	0	-
38	7	0	0.087665	1	0.0000	0.006401	0	-
39	11	0	0.084746	1	0.0000	0.006802	0	-
40	20	0	0.081925	2	0.0000	0.007219	0	-
41	28	0	0.079198	2	0.0000	0.007660	0	-
42	38	1	0.076550	3	0.3333	0.008131	0	-
43	52	1	0.073965	4	0.2500	0.008652	0	-
44	52	0	0.071430	4	0.0000	0.009236	0	-
45	61	1	0.068936	4	0.2500	0.009899	1	1.0000
46	63	2	0.066480	4	0.5000	0.010640	1	2.0000
47	67	0	0.064061	4	0.0000	0.011491	1	0.0000
48	75	1	0.061677	5	0.2000	0.012463	1	1.0000
49	85	0	0.059314	5	0.0000	0.013571	1	0.0000
50	94	2	0.056949	5	0.4000	0.014803	1	2.0000
51	120	1	0.054543	7	0.1429	0.015537	2	0.5000
52	141	3	0.052046	7	0.4286	0.016336	2	1.5000
53	163	4	0.049422	8	0.5000	0.017181	3	1.3333
54	204	3	0.046664	10	0.3000	0.018046	4	0.7500
55	223	4	0.043813	10	0.4000	0.018866	4	1.0000
56	229	9	0.040949	9	1.0000	0.019608	4	2.2500
57	240	7	0.038174	9	0.7778	0.020231	5	1.4000
58	267	11	0.035582	10	1.1000	0.020721	6	1.8333
59	272	7	0.033251	9	0.7778	0.021082	6	1.1667

Disabled Annuitant Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
60	271	6	0.031256	8	0.7500	0.021350	6	1.0000
61	281	6	0.029665	8	0.7500	0.021532	6	1.0000
62	283	5	0.028522	8	0.6250	0.021709	6	0.8333
63	288	9	0.027851	8	1.1250	0.021906	6	1.5000
64	306	11	0.027664	8	1.3750	0.022166	7	1.5714
65	322	3	0.027957	9	0.3333	0.022529	7	0.4286
66	355	12	0.028701	10	1.2000	0.023039	8	1.5000
67	370	8	0.029851	11	0.7273	0.023732	9	0.8889
68	386	9	0.031348	12	0.7500	0.024639	10	0.9000
69	360	17	0.033140	12	1.4167	0.025784	9	1.8889
70	319	11	0.035196	11	1.0000	0.027188	9	1.2222
71	273	8	0.037505	10	0.8000	0.028858	8	1.0000
72	246	6	0.040079	10	0.6000	0.030823	8	0.7500
73	210	9	0.042938	9	1.0000	0.033071	7	1.2857
74	187	3	0.046105	9	0.3333	0.035661	7	0.4286
75	169	9	0.049628	8	1.1250	0.038596	7	1.2857
76	144	8	0.053557	8	1.0000	0.041899	6	1.3333
77	110	9	0.057934	6	1.5000	0.045616	5	1.8000
78	95	6	0.062794	6	1.0000	0.049768	5	1.2000
79	74	0	0.068155	5	0.0000	0.054392	4	0.0000
80	78	5	0.074002	6	0.8333	0.059522	5	1.0000
81	74	11	0.080289	6	1.8333	0.065190	5	2.2000
82	62	5	0.086960	5	1.0000	0.071412	4	1.2500
83	53	1	0.093972	5	0.2000	0.078249	4	0.2500
84	52	8	0.101322	5	1.6000	0.085710	4	2.0000
85	42	1	0.109018	5	0.2000	0.093862	4	0.2500
86	44	7	0.117066	5	1.4000	0.102354	5	1.4000
87	38	2	0.122037	5	0.4000	0.111003	4	0.5000
88	34	5	0.138518	5	1.0000	0.119794	4	1.2500
89	29	1	0.157000	5	0.2000	0.128685	4	0.2500

Disabled Annuitant Mortality Rates
Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
90	31	7	0.177701	6	1.1667	0.137873	4	1.7500
91	24	2	0.191477	5	0.4000	0.147449	4	0.5000
92	21	6	0.210235	4	1.5000	0.157607	3	2.0000
93	15	2	0.229998	3	0.6667	0.168645	3	0.6667
94	14	0	0.250723	4	0.0000	0.180687	3	0.0000
95	12	0	0.270858	3	0.0000	0.195482	2	0.0000
96	14	3	0.291040	4	0.7500	0.216617	3	1.0000
97	12	2	0.311444	4	0.5000	0.238632	3	0.6667
98	9	0	0.331900	3	0.0000	0.261262	2	0.0000
99	8	5	0.352232	3	1.6667	0.284370	2	2.5000
100	3	0	0.372273	1	0.0000	0.307717	1	0.0000
101	1	1	0.391860	0	-	0.331284	0	-
102	0	0	0.410849	0	-	0.355062	0	-
103	0	0	0.429112	0	-	0.378941	0	-
104	0	0	0.446544	0	-	0.402553	0	-
105	0	0	0.463061	0	-	0.425814	0	-
106	0	0	0.478604	0	-	0.448404	0	-
107	0	0	0.478604	0	-	0.470342	0	-
108	0	0	0.478604	0	-	0.491432	0	-
109	0	0	0.478604	0	-	0.511431	0	-
110	0	0	0.478604	0	-	0.530405	0	-
111	0	0	1.000000	0	-	0.548187	0	-
112	0	0	1.000000	0	-	0.557992	0	-
113	0	0	1.000000	0	-	0.558942	0	-
114	0	0	1.000000	0	-	0.559950	0	-
115	0	0	1.000000	0	-	0.560902	0	-
116	0	0	1.000000	0	-	0.560959	0	-
117	0	0	1.000000	0	-	0.561015	0	-
118	0	0	1.000000	0	-	0.561015	0	-
119	0	0	1.000000	0	-	0.561015	0	-
120	0	0	1.000000	0	-	1.000000	0	-
Total	**8,241**	**287**		**392**	**0.7321**		**255**	**1.1255**

Disabled Annuitant Mortality Rates

Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
30	0	0	0.180013	0	-	0.004652	0	-
31	0	0	0.180013	0	-	0.004963	0	-
32	0	0	0.180013	0	-	0.005272	0	-
33	0	0	0.180013	0	-	0.005569	0	-
34	0	0	0.173269	0	-	0.005877	0	-
35	0	0	0.166522	0	-	0.006163	0	-
36	0	0	0.159773	0	-	0.006456	0	-
37	0	0	0.153024	0	-	0.006751	0	-
38	1	0	0.146284	0	-	0.007059	0	-
39	2	0	0.139576	0	-	0.007371	0	-
40	1	0	0.132936	0	-	0.007705	0	-
41	2	0	0.126401	0	-	0.008073	0	-
42	4	0	0.120012	0	-	0.008491	0	-
43	10	0	0.113802	1	0.0000	0.008966	0	-
44	11	0	0.107801	1	0.0000	0.009542	0	-
45	16	0	0.102029	2	0.0000	0.010203	0	-
46	18	0	0.096503	2	0.0000	0.010984	0	-
47	17	0	0.091236	2	0.0000	0.011887	0	-
48	25	3	0.086231	2	1.5000	0.012917	0	-
49	22	0	0.081479	2	0.0000	0.014064	0	-
50	18	0	0.076958	1	0.0000	0.015343	0	-
51	18	0	0.072640	1	0.0000	0.016424	0	-
52	25	2	0.068494	2	1.0000	0.017566	0	-
53	27	0	0.064498	2	0.0000	0.018749	1	0.0000
54	49	0	0.060638	3	0.0000	0.019960	1	0.0000
55	59	2	0.056938	3	0.6667	0.021172	1	2.0000
56	59	4	0.053442	3	1.3333	0.022361	1	4.0000
57	50	1	0.050216	3	0.3333	0.023488	1	1.0000
58	47	1	0.047308	2	0.5000	0.024557	1	1.0000
59	38	1	0.044759	2	0.5000	0.025566	1	1.0000

Disabled Annuitant Mortality Rates

Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
60	31	1	0.042595	1	1.0000	0.026516	1	1.0000
61	42	0	0.040829	2	0.0000	0.027415	1	0.0000
62	50	2	0.039455	2	1.0000	0.028313	1	2.0000
63	49	0	0.038461	2	0.0000	0.029236	1	0.0000
64	62	4	0.037830	2	2.0000	0.030182	2	2.0000
65	75	4	0.037550	3	1.3333	0.031154	2	2.0000
66	76	2	0.037620	3	0.6667	0.032187	2	1.0000
67	87	1	0.038040	3	0.3333	0.033281	3	0.3333
68	103	1	0.038798	4	0.2500	0.034485	4	0.2500
69	109	2	0.039890	4	0.5000	0.035810	4	0.5000
70	109	4	0.041328	5	0.8000	0.037301	4	1.0000
71	96	2	0.043137	4	0.5000	0.039017	4	0.5000
72	98	4	0.045337	4	1.0000	0.040985	4	1.0000
73	99	0	0.047925	5	0.0000	0.043225	4	0.0000
74	95	2	0.050890	5	0.4000	0.045778	4	0.5000
75	84	4	0.054216	5	0.8000	0.048700	4	1.0000
76	75	7	0.057882	4	1.7500	0.051973	4	1.7500
77	55	7	0.061871	3	2.3333	0.055667	3	2.3333
78	42	5	0.066162	3	1.6667	0.059793	3	1.6667
79	40	6	0.070742	3	2.0000	0.064417	3	2.0000
80	34	2	0.075602	3	0.6667	0.069552	2	1.0000
81	34	1	0.080733	3	0.3333	0.075256	3	0.3333
82	35	1	0.086134	3	0.3333	0.081539	3	0.3333
83	31	3	0.087929	3	1.0000	0.088386	3	1.0000
84	21	4	0.100040	2	2.0000	0.095845	2	2.0000
85	25	0	0.113741	3	0.0000	0.103866	3	0.0000
86	33	8	0.129208	4	2.0000	0.112482	4	2.0000
87	25	3	0.141713	4	0.7500	0.121693	3	1.0000
88	21	4	0.158130	3	1.3333	0.131659	3	1.3333
89	17	4	0.175288	3	1.3333	0.144125	2	2.0000

Disabled Annuitant Mortality Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
90	12	4	0.193131	2	2.0000	0.157863	2	2.0000
91	4	1	0.211674	1	1.0000	0.171906	1	1.0000
92	3	1	0.230976	1	1.0000	0.186069	1	1.0000
93	4	0	0.251106	1	0.0000	0.200252	1	0.0000
94	4	1	0.272113	1	1.0000	0.214573	1	1.0000
95	2	0	0.293848	1	0.0000	0.229208	0	-
96	3	1	0.313988	1	1.0000	0.256135	1	1.0000
97	1	1	0.334365	0	-	0.278405	0	-
98	0	0	0.354599	0	-	0.300930	0	-
99	0	0	0.374524	0	-	0.323597	0	-
100	0	0	0.393982	0	-	0.346058	0	-
101	0	0	0.412831	0	-	0.368382	0	-
102	0	0	0.430946	0	-	0.390636	0	-
103	0	0	0.448227	0	-	0.412527	0	-
104	0	0	0.464592	0	-	0.433960	0	-
105	0	0	0.479987	0	-	0.454672	0	-
106	0	0	0.494376	0	-	0.474623	0	-
107	0	0	0.500000	0	-	0.493810	0	-
108	0	0	0.500000	0	-	0.511957	0	-
109	0	0	0.500000	0	-	0.529320	0	-
110	0	0	0.500000	0	-	0.530405	0	-
111	0	0	1.000000	0	-	0.548187	0	-
112	0	0	1.000000	0	-	0.557992	0	-
113	0	0	1.000000	0	-	0.558942	0	-
114	0	0	1.000000	0	-	0.559950	0	-
115	0	0	1.000000	0	-	0.560902	0	-
116	0	0	1.000000	0	-	0.560959	0	-
117	0	0	1.000000	0	-	0.561015	0	-
118	0	0	1.000000	0	-	0.561015	0	-
119	0	0	1.000000	0	-	0.561015	0	-
120	0	0	1.000000	0	-	1.000000	0	-
Total	**2,305**	**111**		**140**	**0.7929**		**100**	**1.1100**

Survivor and Beneficiary Mortality Rates

Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
1	0	0	0.000361	0	-	0.000145	0	-
2	0	0	0.000236	0	-	0.000145	0	-
3	0	0	0.000176	0	-	0.000145	0	-
4	0	0	0.000132	0	-	0.000145	0	-
5	0	0	0.000119	0	-	0.000145	0	-
6	0	0	0.000110	0	-	0.000145	0	-
7	0	0	0.000102	0	-	0.000145	0	-
8	0	0	0.000094	0	-	0.000145	0	-
9	0	0	0.000087	0	-	0.000145	0	-
10	0	0	0.000082	0	-	0.000145	0	-
11	0	0	0.000084	0	-	0.000145	0	-
12	0	0	0.000097	0	-	0.000145	0	-
13	0	0	0.000110	0	-	0.000145	0	-
14	0	0	0.000121	0	-	0.000145	0	-
15	0	0	0.000132	0	-	0.000145	0	-
16	0	0	0.000142	0	-	0.000145	0	-
17	0	0	0.000150	0	-	0.000145	0	-
18	0	0	0.000144	0	-	0.000145	0	-
19	0	0	0.000148	0	-	0.000145	0	-
20	0	0	0.000148	0	-	0.000134	0	-
21	0	0	0.000148	0	-	0.000125	0	-
22	1	0	0.000148	0	-	0.000116	0	-
23	1	0	0.000152	0	-	0.000106	0	-
24	2	0	0.000155	0	-	0.000097	0	-
25	3	0	0.000158	0	-	0.000099	0	-
26	3	1	0.000164	0	-	0.000114	0	-
27	2	0	0.000171	0	-	0.000128	0	-
28	2	1	0.000179	0	-	0.000144	0	-
29	3	0	0.000189	0	-	0.000160	0	-
30	5	1	0.000199	0	-	0.000175	0	-
31	10	0	0.000211	0	-	0.000204	0	-
32	8	0	0.000223	0	-	0.000218	0	-
33	6	0	0.000236	0	-	0.000244	0	-
34	4	0	0.000249	0	-	0.000255	0	-

Survivor and Beneficiary Mortality Rates
Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
35	4	0	0.000262	0	-	0.000279	0	-
36	2	0	0.000275	0	-	0.000300	0	-
37	3	0	0.000291	0	-	0.000317	0	-
38	3	0	0.000310	0	-	0.000346	0	-
39	3	0	0.000334	0	-	0.000360	0	-
40	7	0	0.000362	0	-	0.000383	0	-
41	9	0	0.000396	0	-	0.000405	0	-
42	9	0	0.000436	0	-	0.000425	0	-
43	9	1	0.000484	0	-	0.000456	0	-
44	11	0	0.000539	0	-	0.000487	0	-
45	16	0	0.000601	0	-	0.000518	0	-
46	16	2	0.000671	0	-	0.000552	0	-
47	14	0	0.000747	0	-	0.000597	0	-
48	20	0	0.000829	0	-	0.000647	0	-
49	20	0	0.000916	0	-	0.000699	0	-
50	22	0	0.001008	0	-	0.000767	0	-
51	27	0	0.001104	0	-	0.000839	0	-
52	34	0	0.001203	0	-	0.000916	0	-
53	34	0	0.001419	0	-	0.001017	0	-
54	38	0	0.001645	0	-	0.001111	0	-
55	44	0	0.001805	0	-	0.003011	0	-
56	50	0	0.001980	0	-	0.003214	0	-
57	53	1	0.002172	0	-	0.003415	0	-
58	62	0	0.002382	0	-	0.003623	0	-
59	86	1	0.002613	0	-	0.003842	0	-
60	120	0	0.002866	0	-	0.004095	0	-
61	152	0	0.003053	0	-	0.004376	1	0.0000
62	180	1	0.003298	1	1.0000	0.004709	1	1.0000
63	216	2	0.003604	1	2.0000	0.005081	1	2.0000
64	265	2	0.003976	1	2.0000	0.005515	1	2.0000
65	306	3	0.004417	1	3.0000	0.006007	2	1.5000
66	340	1	0.004931	2	0.5000	0.006574	2	0.5000
67	399	5	0.005524	2	2.5000	0.007228	3	1.6667
68	493	5	0.006203	3	1.6667	0.007991	4	1.2500
69	561	8	0.006979	4	2.0000	0.008882	5	1.6000

Survivor and Beneficiary Mortality Rates
Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
70	627	4	0.007864	5	0.8000	0.009913	6	0.6667
71	661	8	0.008874	6	1.3333	0.011099	7	1.1429
72	714	9	0.010029	7	1.2857	0.012469	9	1.0000
73	736	12	0.011349	8	1.5000	0.014025	10	1.2000
74	740	8	0.012863	10	0.8000	0.015798	12	0.6667
75	802	9	0.014602	12	0.7500	0.017811	14	0.6429
76	881	14	0.016603	15	0.9333	0.020084	18	0.7778
77	861	25	0.018909	16	1.5625	0.022658	20	1.2500
78	845	19	0.021567	18	1.0556	0.025572	22	0.8636
79	852	20	0.024631	21	0.9524	0.028889	25	0.8000
80	861	25	0.028162	24	1.0417	0.032661	28	0.8929
81	872	33	0.032228	28	1.1786	0.036972	32	1.0313
82	863	37	0.036904	32	1.1563	0.041889	36	1.0278
83	821	51	0.042268	35	1.4571	0.047505	39	1.3077
84	798	40	0.048410	39	1.0256	0.053910	43	0.9302
85	795	44	0.055421	44	1.0000	0.061218	49	0.8980
86	793	51	0.063404	50	1.0200	0.069540	55	0.9273
87	762	71	0.072465	55	1.2909	0.078933	60	1.1833
88	766	67	0.082724	63	1.0635	0.089461	69	0.9710
89	742	83	0.094308	70	1.1857	0.101045	75	1.1067
90	662	82	0.107360	71	1.1549	0.113634	75	1.0933
91	612	76	0.122037	75	1.0133	0.127095	78	0.9744
92	550	73	0.138518	76	0.9605	0.141336	78	0.9359
93	478	81	0.157000	75	1.0800	0.157256	75	1.0800
94	421	56	0.177701	75	0.7467	0.175838	74	0.7568
95	361	62	0.191477	69	0.8986	0.195482	71	0.8732
96	271	71	0.210235	57	1.2456	0.216617	59	1.2034
97	184	57	0.229998	42	1.3571	0.238632	44	1.2955
98	114	22	0.250723	29	0.7586	0.261262	30	0.7333
99	81	24	0.270858	22	1.0909	0.284370	23	1.0435
100	58	11	0.291040	17	0.6471	0.307717	18	0.6111
101	43	10	0.311444	13	0.7692	0.331284	14	0.7143
102	34	14	0.331900	11	1.2727	0.355062	12	1.1667
103	19	9	0.352232	7	1.2857	0.378941	7	1.2857
104	10	2	0.372273	4	0.5000	0.402553	4	0.5000

Survivor and Beneficiary Mortality Rates
Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
105	8	3	0.391860	3	1.0000	0.425814	3	1.0000
106	4	1	0.410849	2	0.5000	0.448404	2	0.5000
107	3	1	0.429112	1	1.0000	0.470342	1	1.0000
108	4	2	0.446544	2	1.0000	0.491432	2	1.0000
109	2	1	0.463061	1	1.0000	0.511431	1	1.0000
110	1	0	0.478604	0	-	0.530405	1	0.0000
111	1	0	1.000000	1	0.0000	0.548187	1	0.0000
112	1	0	1.000000	1	0.0000	0.557992	1	0.0000
113	0	0	1.000000	0	-	0.558942	0	-
114	0	0	1.000000	0	-	0.559950	0	-
115	0	0	1.000000	0	-	0.560902	0	-
116	0	0	1.000000	0	-	0.560959	0	-
117	0	0	1.000000	0	-	0.561015	0	-
118	0	0	1.000000	0	-	0.561015	0	-
119	0	0	1.000000	0	-	0.561015	0	-
120	0	0	1.000000	0	-	1.000000	0	-
Total	**23,392**	**1,323**		**1,227**	**1.0782**		**1,323**	**1.0000**

Survivor and Beneficiary Mortality Rates

Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
1	0	0	0.000410	0	-	0.000403	0	-
2	0	0	0.000277	0	-	0.000403	0	-
3	0	0	0.000230	0	-	0.000403	0	-
4	0	0	0.000179	0	-	0.000403	0	-
5	0	0	0.000157	0	-	0.000403	0	-
6	0	0	0.000141	0	-	0.000403	0	-
7	0	0	0.000124	0	-	0.000403	0	-
8	0	0	0.000105	0	-	0.000403	0	-
9	0	0	0.000085	0	-	0.000403	0	-
10	0	0	0.000072	0	-	0.000403	0	-
11	0	0	0.000076	0	-	0.000403	0	-
12	0	0	0.000113	0	-	0.000403	0	-
13	0	0	0.000149	0	-	0.000403	0	-
14	0	0	0.000183	0	-	0.000403	0	-
15	0	0	0.000218	0	-	0.000403	0	-
16	0	0	0.000253	0	-	0.000403	0	-
17	0	0	0.000290	0	-	0.000403	0	-
18	0	0	0.000256	0	-	0.000403	0	-
19	0	0	0.000288	0	-	0.000403	0	-
20	1	0	0.000317	0	-	0.000403	0	-
21	1	0	0.000351	0	-	0.000387	0	-
22	2	1	0.000381	0	-	0.000360	0	-
23	1	0	0.000397	0	-	0.000333	0	-
24	4	0	0.000403	0	-	0.000306	0	-
25	4	0	0.000378	0	-	0.000302	0	-
26	4	0	0.000361	0	-	0.000338	0	-
27	5	0	0.000351	0	-	0.000360	0	-
28	6	0	0.000347	0	-	0.000383	0	-
29	4	0	0.000348	0	-	0.000420	0	-
30	8	0	0.000353	0	-	0.000442	0	-
31	11	0	0.000361	0	-	0.000479	0	-
32	9	0	0.000372	0	-	0.000498	0	-
33	9	0	0.000384	0	-	0.000530	0	-
34	9	0	0.000397	0	-	0.000559	0	-

Survivor and Beneficiary Mortality Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
35	8	0	0.000408	0	-	0.000599	0	-
36	6	0	0.000418	0	-	0.000621	0	-
37	3	0	0.000430	0	-	0.000651	0	-
38	6	0	0.000445	0	-	0.000677	0	-
39	8	0	0.000464	0	-	0.000712	0	-
40	10	0	0.000490	0	-	0.000740	0	-
41	9	0	0.000524	0	-	0.000764	0	-
42	10	0	0.000566	0	-	0.000798	0	-
43	10	0	0.000619	0	-	0.000841	0	-
44	9	0	0.000684	0	-	0.000883	0	-
45	8	0	0.000760	0	-	0.000935	0	-
46	9	0	0.000849	0	-	0.001001	0	-
47	9	0	0.000949	0	-	0.001068	0	-
48	7	0	0.001060	0	-	0.001151	0	-
49	7	0	0.001183	0	-	0.001237	0	-
50	10	0	0.001316	0	-	0.001339	0	-
51	10	0	0.001461	0	-	0.001459	0	-
52	18	0	0.001618	0	-	0.001585	0	-
53	18	0	0.001951	0	-	0.001729	0	-
54	24	1	0.002311	0	-	0.001890	0	-
55	24	0	0.002522	0	-	0.004211	0	-
56	32	1	0.002753	0	-	0.004591	0	-
57	37	0	0.003004	0	-	0.004992	0	-
58	44	3	0.003279	0	-	0.005427	0	-
59	46	0	0.003579	0	-	0.005881	0	-
60	57	0	0.003906	0	-	0.006353	0	-
61	70	1	0.004264	0	-	0.006847	0	-
62	83	1	0.004654	0	-	0.007355	1	1.0000
63	99	2	0.005050	0	-	0.007893	1	2.0000
64	112	2	0.005564	1	2.0000	0.008469	1	2.0000
65	132	4	0.006204	1	4.0000	0.009119	1	4.0000
66	137	2	0.006976	1	2.0000	0.009879	1	2.0000
67	169	6	0.007886	1	6.0000	0.010764	2	3.0000
68	218	6	0.008942	2	3.0000	0.011791	3	2.0000
69	245	5	0.010151	2	2.5000	0.012977	3	1.6667

Survivor and Beneficiary Mortality Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
70	279	7	0.011524	3	2.3333	0.014348	4	1.7500
71	279	6	0.013074	4	1.5000	0.015914	4	1.5000
72	274	4	0.014821	4	1.0000	0.017714	5	0.8000
73	250	7	0.016788	4	1.7500	0.019770	5	1.4000
74	239	5	0.019009	5	1.0000	0.022137	5	1.0000
75	231	5	0.021524	5	1.0000	0.024837	6	0.8333
76	237	5	0.024380	6	0.8333	0.027914	7	0.7143
77	215	6	0.027633	6	1.0000	0.031432	7	0.8571
78	207	9	0.031346	6	1.5000	0.035426	7	1.2857
79	179	5	0.035590	6	0.8333	0.039971	7	0.7143
80	189	9	0.040445	8	1.1250	0.045158	9	1.0000
81	193	4	0.045997	9	0.4444	0.051057	10	0.4000
82	217	19	0.052342	11	1.7273	0.057759	13	1.4615
83	217	12	0.059585	13	0.9231	0.065291	14	0.8571
84	231	20	0.067844	16	1.2500	0.073728	17	1.1765
85	234	20	0.077246	18	1.1111	0.083113	19	1.0526
86	226	31	0.087929	20	1.5500	0.093445	21	1.4762
87	216	29	0.100040	22	1.3182	0.104717	23	1.2609
88	186	29	0.113741	21	1.3810	0.117043	22	1.3182
89	163	25	0.129208	21	1.1905	0.130367	21	1.1905
90	155	30	0.141713	22	1.3636	0.144705	22	1.3636
91	141	23	0.158130	22	1.0455	0.160306	23	1.0000
92	137	26	0.175288	24	1.0833	0.177295	24	1.0833
93	127	23	0.193131	25	0.9200	0.195554	25	0.9200
94	106	31	0.211674	22	1.4091	0.214933	23	1.3478
95	79	19	0.230976	18	1.0556	0.235173	19	1.0000
96	59	14	0.251106	15	0.9333	0.256846	15	0.9333
97	43	13	0.272113	12	1.0833	0.279223	12	1.0833
98	29	9	0.293848	9	1.0000	0.301941	9	1.0000
99	21	6	0.313988	7	0.8571	0.324803	7	0.8571
100	14	3	0.334365	5	0.6000	0.347403	5	0.6000
101	15	7	0.354599	5	1.4000	0.369814	6	1.1667
102	9	4	0.374524	3	1.3333	0.392154	4	1.0000
103	4	2	0.393982	2	1.0000	0.414131	2	1.0000
104	2	1	0.412831	1	1.0000	0.435647	1	1.0000

Survivor and Beneficiary Mortality Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
105	2	1	0.430946	1	-	0.456440	1	1.0000
106	1	0	0.448227	0	-	0.476468	0	-
107	1	0	0.464592	0	-	0.495730	0	-
108	1	1	0.479987	0	-	0.513947	1	1.0000
109	0	0	0.494376	0	-	0.531378	0	-
110	0	0	0.500000	0	-	0.545110	0	-
111	0	0	1.000000	0	-	0.548187	0	-
112	0	0	1.000000	0	-	0.557992	0	-
113	0	0	1.000000	0	-	0.558942	0	-
114	0	0	1.000000	0	-	0.559950	0	-
115	0	0	1.000000	0	-	0.560902	0	-
116	0	0	1.000000	0	-	0.560959	0	-
117	0	0	1.000000	0	-	0.561015	0	-
118	0	0	1.000000	0	-	0.561015	0	-
119	0	0	1.000000	0	-	0.561015	0	-
120	0	0	1.000000	0	-	1.000000	0	-
Total	**7,190**	**505**		**409**	**1.2347**		**438**	**1.1530**

Service Retirement Rates*

With at Least 5 Years of Service and Less Than 20 Years of Service
Female**

			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected
55	8,939	206	0.022034	197	1.0457
56	8,581	171	0.020920	180	0.9500
57	8,173	169	0.021583	176	0.9602
58	7,692	195	0.024243	186	1.0484
59	7,008	182	0.028714	201	0.9055
60	6,223	243	0.036747	229	1.0611
61	5,555	251	0.049865	277	0.9061
62	4,831	512	0.098737	477	1.0734
63	3,852	360	0.099499	383	0.9399
64	3,043	318	0.108244	329	0.9666
65	2,386	338	0.134619	321	1.0530
66	1,723	290	0.157206	271	1.0701
67	1,197	187	0.157651	189	0.9894
68	856	120	0.149321	128	0.9375
69	627	101	0.157048	98	1.0306
70	437	78	0.169309	74	1.0541
71	265	42	0.166236	44	0.9545
72	194	31	0.149874	29	1.0690
73	141	15	0.130584	18	0.8333
74	106	15	0.131818	14	1.0714
75	87	13	0.170940	15	0.8667
76	71	19	0.208633	15	1.2667
77	49	7	0.178744	9	0.7778
78	38	4	0.105960	4	1.0000
79	26	1	0.115385	3	0.3333
80+	68	13	1.000000	68	0.1912
Total	**72,168**	**3,881**		**3,935**	**0.9863**

* Experience is based on Tiers 1-4 due to the limited number of retirements for Tiers 5 and 6.

** Current numbers are missing due to the set up of the new service retirement rates structure.

Service Retirement Rates*

With at Least 20 Years of Service and Less Than 30 Years of Service
Female**

Age	Exposure	Actual Experience	Proposed Rate	Proposed Expected	Ratio of Actual to Expected
55	7,234	355	0.048946	354	1.0028
56	6,494	316	0.048932	318	0.9937
57	6,039	298	0.050278	304	0.9803
58	5,852	316	0.055984	328	0.9634
59	5,728	384	0.066847	383	1.0026
60	5,640	450	0.085816	484	0.9298
61	5,576	656	0.124821	696	0.9425
62	5,420	1,926	0.344649	1,868	1.0310
63	3,868	1,239	0.320354	1,239	1.0000
64	2,998	771	0.270180	810	0.9519
65	2,451	775	0.306632	752	1.0306
66	1,825	661	0.343562	627	1.0542
67	1,213	391	0.335230	407	0.9607
68	847	266	0.312155	264	1.0076
69	540	153	0.294658	159	0.9623
70	357	101	0.276159	99	1.0202
71	256	62	0.258438	66	0.9394
72	168	43	0.248951	42	1.0238
73	123	30	0.231388	28	1.0714
74	83	12	0.202817	17	0.7059
75	66	18	0.232824	15	1.2000
76	47	13	0.283422	13	1.0000
77	27	9	0.291667	8	1.1250
78	19	4	0.243590	5	0.8000
79	13	2	0.170732	2	1.0000
80+	37	6	1.000000	37	0.1622
Total	**62,921**	**9,257**		**9,325**	**0.9927**

* Experience is based on Tiers 1-4 due to the limited number of retirements for Tiers 5 and 6.

** Current numbers are missing due to the set up of the new service retirement rates structure.

Service Retirement Rates*

With at Least 30 Years of Service
Female**

Age	Exposure	Actual Experience	Proposed Rate	Proposed Expected	Proposed Ratio of Actual to Expected
55	4,289	1,598	0.360457	1,546	1.0336
56	3,526	1,152	0.328854	1,160	0.9931
57	3,021	821	0.285005	861	0.9535
58	2,815	773	0.281178	792	0.9760
59	2,591	794	0.303384	786	1.0102
60	2,376	786	0.329377	783	1.0038
61	2,093	742	0.358157	750	0.9893
62	1,817	731	0.383599	697	1.0488
63	1,364	472	0.361017	492	0.9593
64	1,078	355	0.336647	363	0.9780
65	906	308	0.345155	313	0.9840
66	691	265	0.361702	250	1.0600
67	485	165	0.339678	165	1.0000
68	388	101	0.289690	112	0.9018
69	320	91	0.270671	87	1.0460
70	254	64	0.268173	68	0.9412
71	190	54	0.269377	51	1.0588
72	153	40	0.255354	39	1.0256
73	111	21	0.220085	24	0.8750
74	93	21	0.204420	19	1.1053
75	65	11	0.182796	12	0.9167
76	56	8	0.157205	9	0.8889
77	52	9	0.175258	9	1.0000
78	34	8	0.222973	8	1.0000
79	28	8	0.253012	7	1.1429
80+	76	18	1.000000	76	0.2368
Total	**28,872**	**9,416**		**9,479**	**0.9934**

* Experience is based on Tiers 1-4 due to the limited number of retirements for Tiers 5 and 6.

* Current numbers are missing due to the set up of the new service retirement rates structure.

Service Retirement Rates*

With at Least 5 Years of Service and Less Than 20 Years of Service
Male**

			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected
55	1,720	27	0.016895	29	0.9310
56	1,532	30	0.018138	28	1.0714
57	1,391	25	0.018949	26	0.9615
58	1,280	26	0.020392	26	1.0000
59	1,198	28	0.023948	29	0.9655
60	1,126	33	0.032544	37	0.8919
61	1,067	53	0.053559	57	0.9298
62	941	86	0.076575	72	1.1944
63	812	63	0.086291	70	0.9000
64	703	70	0.101429	71	0.9859
65	582	81	0.135241	79	1.0253
66	440	80	0.165359	73	1.0959
67	322	54	0.171258	55	0.9818
68	259	42	0.162524	42	1.0000
69	206	32	0.168459	35	0.9143
70	166	35	0.178411	30	1.1667
71	129	17	0.168561	22	0.7727
72	104	20	0.175182	18	1.1111
73	74	15	0.204473	15	1.0000
74	61	14	0.205761	13	1.0769
75	47	7	0.201031	9	0.7778
76	39	11	0.223684	9	1.2222
77	27	5	0.250000	7	0.7143
78	19	7	0.259259	5	1.4000
79	16	2	0.243243	4	0.5000
80+	60	16	1.000000	60	0.2667
Total	**14,321**	**879**		**921**	**0.9544**

* Experience is based on Tiers 1-4 due to the limited number of retirements for Tiers 5 and 6.

** Current numbers are missing due to the set up of the new service retirement rates structure.

Service Retirement Rates*

With at Least 20 Years of Service and Less Than 30 Years of Service
Male**

			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected
55	2,497	94	0.036912	92	1.0217
56	2,131	75	0.038733	83	0.9036
57	1,890	91	0.042465	80	1.1375
58	1,601	62	0.045650	73	0.8493
59	1,414	82	0.053792	76	1.0789
60	1,241	79	0.074850	93	0.8495
61	1,114	135	0.137343	153	0.8824
62	977	334	0.317298	310	1.0774
63	661	175	0.291193	192	0.9115
64	517	136	0.264522	137	0.9927
65	388	104	0.284814	111	0.9369
66	294	108	0.326565	96	1.1250
67	206	66	0.323741	67	0.9851
68	128	30	0.287004	37	0.8108
69	92	33	0.316940	29	1.1379
70	54	20	0.345833	19	1.0526
71	40	10	0.274390	11	0.9091
72	30	5	0.244094	7	0.7143
73	27	11	0.316327	9	1.2222
74	14	4	0.314286	4	1.0000
75	15	3	0.222222	3	1.0000
76	10	2	0.200000	2	1.0000
77	5	1	0.206897	1	1.0000
78	9	2	0.214286	2	1.0000
79	5	1	0.148148	1	1.0000
80+	8	0	1.000000	8	-
Total	**15,368**	**1,663**		**1,696**	**0.9805**

* Experience is based on Tiers 1-4 due to the limited number of retirements for Tiers 5 and 6.

** Current numbers are missing due to the set up of the new service retirement rates structure.

Service Retirement Rates*

With at Least 30 Years of Service
Male**

Age	Exposure	Actual Experience	Proposed Rate	Proposed Expected	Ratio of Actual to Expected
55	1,581	597	0.357369	565	1.0566
56	1,266	364	0.308100	390	0.9333
57	1,171	303	0.270702	317	0.9558
58	1,150	318	0.275266	317	1.0032
59	1,041	303	0.296323	308	0.9838
60	956	317	0.311082	297	1.0673
61	837	242	0.310642	260	0.9308
62	734	244	0.319459	234	1.0427
63	578	191	0.319013	184	1.0380
64	461	124	0.297225	137	0.9051
65	374	118	0.311052	116	1.0172
66	302	110	0.340284	103	1.0680
67	221	70	0.325405	72	0.9722
68	181	51	0.291372	53	0.9623
69	124	34	0.274286	34	1.0000
70	96	25	0.259067	25	1.0000
71	70	16	0.238434	17	0.9412
72	45	10	0.223404	10	1.0000
73	28	6	0.224806	6	1.0000
74	28	7	0.262136	7	1.0000
75	19	7	0.294872	6	1.1667
76	12	2	0.254902	3	0.6667
77	8	2	0.200000	2	1.0000
78	7	1	0.178571	1	1.0000
79	6	1	0.184615	1	1.0000
80+	46	9	1.000000	46	0.1957
Total	**11,342**	**3,472**		**3,511**	**0.9889**

* Experience is based on Tiers 1-4 due to the limited number of retirements for Tiers 5 and 6.

** Current numbers are missing due to the set up of the new service retirement rates structure.

Disability Retirement Rates

Female

			Current*			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
30	60	0	0.000005	0	-	0.000004	0	-
31	240	0	0.000008	0	-	0.000018	0	-
32	3,910	0	0.000010	0	-	0.000048	0	-
33	10,567	1	0.000037	0	-	0.000140	1	1.0000
34	17,001	1	0.000076	1	1.0000	0.000225	4	0.2500
35	22,024	5	0.000098	2	2.5000	0.000242	5	1.0000
36	25,964	4	0.000102	3	1.3333	0.000212	6	0.6667
37	28,911	4	0.000105	3	1.3333	0.000191	6	0.6667
38	31,054	7	0.000126	4	1.7500	0.000202	6	1.1667
39	32,900	11	0.000159	5	2.2000	0.000252	8	1.3750
40	34,542	13	0.000214	7	1.8571	0.000330	11	1.1818
41	35,370	20	0.000274	10	2.0000	0.000415	15	1.3333
42	35,693	21	0.000310	11	1.9091	0.000468	17	1.2353
43	35,785	18	0.000376	13	1.3846	0.000566	20	0.9000
44	35,880	20	0.000452	16	1.2500	0.000684	25	0.8000
45	35,746	30	0.000501	18	1.6667	0.000758	27	1.1111
46	35,637	18	0.000522	19	0.9474	0.000788	28	0.6429
47	35,866	19	0.000568	20	0.9500	0.000841	30	0.6333
48	36,022	35	0.000666	24	1.4583	0.000961	35	1.0000
49	35,807	43	0.000818	29	1.4828	0.001145	41	1.0488
50	35,232	49	0.000986	35	1.4000	0.001325	47	1.0426
51	35,182	65	0.001187	42	1.5476	0.001528	54	1.2037
52	35,540	43	0.001325	47	0.9149	0.001608	57	0.7544
53	36,307	69	0.001380	50	1.3800	0.001611	58	1.1897
54	37,006	57	0.001375	51	1.1176	0.001527	57	1.0000
55	37,567	56				0.001454	55	1.0182
56	35,024	34				0.001270	44	0.7727
57	33,313	40				0.001121	37	1.0811
58	32,107	25				0.001012	32	0.7813
59	30,547	20				0.000956	29	0.6897
60	28,499	18				0.000848	24	0.7500
61	25,716	19				0.000749	19	1.0000
62	22,449	6				0.000684	15	0.4000
63	16,220	11				0.000591	10	1.1000
64	12,217	4				0.000551	7	0.5714

Disability Retirement Rates
Female

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
65	9,295	2				0.000476	4	0.5000
66	6,554	4				0.000258	2	2.0000
67	4,443	1				0.000178	1	1.0000
68	3,129	0				0.000169	1	0.0000
69	2,245	1				0.000152	0	-
70	1,585	1				0.000131	0	-
71	1,108	1				0.000107	0	-
72	768	0				0.000083	0	-
73	568	2				0.000060	0	-
74	427	0				0.000042	0	-
75	326	0				0.000028	0	-
76	254	0				0.000018	0	-
77	188	0				0.000011	0	-
78	144	0				0.000006	0	-
79	103	0				0.000004	0	-
Total	**1,013,042**	**798**		**410 ***	**1.3488 ***		**838**	**0.9523**

* Current results correspond to the current assumptions structure from age 30 through age 54

Disability Retirement Rates
Male

			Current*			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
30	21	0	0.000003	0	-	0.000007	0	-
31	88	0	0.000008	0	-	0.000031	0	-
32	1,273	0	0.000015	0	-	0.000060	0	-
33	3,601	0	0.000024	0	-	0.000100	0	-
34	5,954	0	0.000040	0	-	0.000131	1	0.0000
35	7,960	0	0.000062	0	-	0.000156	1	0.0000
36	9,594	1	0.000091	1	1.0000	0.000183	2	0.5000
37	10,881	5	0.000126	1	5.0000	0.000220	2	2.5000
38	11,916	0	0.000164	2	0.0000	0.000261	3	0.0000
39	12,827	5	0.000196	3	1.6667	0.000297	4	1.2500
40	13,524	2	0.000226	3	0.6667	0.000324	4	0.5000
41	14,073	5	0.000245	3	1.6667	0.000353	5	1.0000
42	14,289	9	0.000278	4	2.2500	0.000378	5	1.8000
43	14,395	1	0.000330	5	0.2000	0.000439	6	0.1667
44	14,273	11	0.000398	6	1.8333	0.000519	7	1.5714
45	14,127	1	0.000470	7	0.1429	0.000610	9	0.1111
46	13,876	7	0.000530	7	1.0000	0.000680	9	0.7778
47	13,646	11	0.000569	8	1.3750	0.000724	10	1.1000
48	13,318	5	0.000611	8	0.6250	0.000772	10	0.5000
49	12,776	12	0.000707	9	1.3333	0.000878	11	1.0909
50	12,176	13	0.000889	11	1.1818	0.001035	13	1.0000
51	11,602	13	0.001091	13	1.0000	0.001225	14	0.9286
52	11,345	14	0.001190	14	1.0000	0.001395	16	0.8750
53	11,079	19	0.001250	14	1.3571	0.001480	16	1.1875
54	10,935	14	0.001225	13	1.0769	0.001435	16	0.8750
55	10,688	14				0.001287	14	1.0000
56	9,425	5				0.001060	10	0.5000
57	8,549	3				0.000845	7	0.4286
58	7,956	2				0.000721	6	0.3333
59	7,419	3				0.000655	5	0.6000
60	6,686	7				0.000642	4	1.7500
61	5,937	5				0.000617	4	1.2500
62	5,049	2				0.000581	3	0.6667
63	3,807	0				0.000536	2	0.0000
64	2,890	4				0.000485	1	4.0000

Disability Retirement Rates
Male

			Current			Proposed		
Age	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
65	2,246	2				0.000430	1	2.0000
66	1,677	0				0.000373	1	0.0000
67	1,178	0				0.000317	0	-
68	830	0				0.000264	0	-
69	625	0				0.000215	0	-
70	449	0				0.000172	0	-
71	320	0				0.000135	0	-
72	245	0				0.000104	0	-
73	175	0				0.000078	0	-
74	125	0				0.000058	0	-
75	105	0				0.000042	0	-
76	86	0				0.000030	0	-
77	63	0				0.000021	0	-
78	49	0				0.000014	0	-
79	38	0				0.000009	0	-
Total	**336,166**	**195**		**132 ***	**1.1212 ***		**222**	**0.8784**

* Current results correspond to the current assumptions structure from age 30 through age 54

Withdrawal Rates
Male

			Current			Proposed		
Service	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
0	8,375	2,359	0.282347	2,365	0.9976	0.281672	2,359	1.0000
1	13,363	1,866	0.172097	2,300	0.8114	0.139639	1,866	1.0000
2	10,293	1,066	0.132807	1,367	0.7798	0.103566	1,066	1.0000
3	8,426	698	0.092137	776	0.8991	0.082839	698	1.0000
4	7,278	446	0.068191	496	0.8987	0.061281	446	1.0000
5	6,493	287	0.049906	324	0.8857	0.046733	303	0.9458
6	6,259	241	0.037728	236	1.0206	0.040304	252	0.9554
7	6,333	218	0.027449	174	1.2541	0.033875	215	1.0162
8	6,850	204	0.023209	159	1.2832	0.027446	188	1.0851
9	7,592	158	0.015074	114	1.3806	0.021017	160	0.9902
10	8,194	147	0.008480	69	2.1156	0.017586	144	1.0201
11	8,993	112	0.008394	75	1.4837	0.015753	142	0.7906
12	9,596	104	0.008295	80	1.3066	0.012379	119	0.8755
13	10,165	107	0.008212	83	1.2818	0.009004	92	1.1690
14	10,596	101	0.008161	86	1.1680	0.008712	92	1.0941
15	11,263	96	0.008128	92	1.0487	0.008419	95	1.0124
16	11,421	101	0.008139	93	1.0865	0.007735	88	1.1432
17	11,549	58	0.008193	95	0.6130	0.007052	81	0.7122
18	11,179	64	0.008308	93	0.6891	0.006368	71	0.8991
19	10,603	49	0.008465	90	0.5459	0.005078	54	0.9100
20	9,690	55	0.008646	84	0.6565	0.005000	48	1.1352
21	8,628	38	0.008826	76	0.4990	0.004633	40	0.9507
22	7,555	36	0.008977	68	0.5308	0.004265	32	1.1172
23	6,628	24	0.009079	60	0.3988	0.003897	26	0.9291
24	5,651	19	0.009139	52	0.3679	0.003530	20	0.9525
25	5,109	18	0.009176	47	0.3840	0.003162	16	1.1141
26	4,585	16	0.009200	42	0.3793	0.003058	14	1.1413
27	4,273	6	0.009216	39	0.1524	0.002953	13	0.4755
28	3,862	16	0.009225	36	0.4491	0.002848	11	1.4545
29	3,779	7	0.009226	35	0.2008	0.002744	10	0.6751
30	3,531	11	0.009227	33	0.3376	0.002639	9	1.1805
31	2,688	7	0.009227	25	0.2822	0.002534	7	1.0275
32+	2,055	1	0.009227	19	0.0527	0.002430	5	0.2003
Total	**252,855**	**8,736**		**9,783**	**0.8930**		**8,783**	**0.9947**

Female

			Current			Proposed		
Service	Exposure	Actual Experience	Rate	Expected	Ratio of Actual to Expected	Rate	Expected	Ratio of Actual to Expected
0	27,422	7,585	0.289658	7,943	0.9549	0.276603	7,585	1.0000
1	47,610	5,983	0.167067	7,954	0.7522	0.125667	5,983	1.0000
2	37,138	3,413	0.118299	4,393	0.7768	0.091900	3,413	1.0000
3	30,272	2,131	0.093614	2,834	0.7520	0.070395	2,131	1.0000
4	25,875	1,413	0.068642	1,776	0.7956	0.054609	1,413	1.0000
5	23,271	1,083	0.057331	1,334	0.8118	0.048608	1,131	0.9574
6	22,398	1,001	0.049333	1,105	0.9059	0.044007	986	1.0156
7	23,047	958	0.040158	926	1.0351	0.039406	908	1.0548
8	24,861	877	0.033889	843	1.0409	0.034805	865	1.0135
9	27,227	839	0.029148	794	1.0572	0.030204	822	1.0202
10	29,083	747	0.015077	438	1.7036	0.025604	745	1.0032
11	31,074	669	0.014525	451	1.4822	0.022445	697	0.9592
12	32,344	570	0.013870	449	1.2706	0.018454	597	0.9550
13	32,272	473	0.013127	424	1.1165	0.014464	467	1.0133
14	34,168	395	0.012349	422	0.9362	0.010474	358	1.1038
15	35,527	345	0.011640	414	0.8343	0.009808	348	0.9901
16	35,726	271	0.011035	394	0.6874	0.008100	289	0.9365
17	35,016	210	0.010588	371	0.5664	0.006392	224	0.9383
18	33,131	157	0.010337	342	0.4584	0.004683	155	1.0119
19	30,526	120	0.010156	310	0.3871	0.004300	131	0.9142
20	27,252	119	0.009997	272	0.4368	0.004251	116	1.0271
21	23,732	119	0.009862	234	0.5084	0.003896	92	1.2870
22	20,595	87	0.009749	201	0.4333	0.003883	80	1.0880
23	18,148	60	0.009660	175	0.3423	0.003869	70	0.8545
24	15,989	48	0.009588	153	0.3131	0.003856	62	0.7786
25	14,632	27	0.009525	139	0.1937	0.002475	36	0.7455
26	13,421	28	0.009472	127	0.2203	0.002156	29	0.9678
27	12,547	22	0.009433	118	0.1859	0.001836	23	0.9551
28	11,995	12	0.009413	113	0.1063	0.001516	18	0.6598
29	11,565	9	0.009411	109	0.0827	0.001230	14	0.6327
30	10,749	22	0.009409	101	0.2175	0.001223	13	1.6730
31	8,006	15	0.009409	75	0.1991	0.001217	10	1.5398
32+	5,912	1	0.009409	56	0.0180	0.001210	7	0.1398
Total	**812,531**	**29,809**		**35,791**	**0.8329**		**29,820**	**0.9996**

Salary Scale

Duration	Previous Year's Salaries (in thousands)	Current Year's Salaries (in thousands)	Proposed Rate	Proposed Expected Salaries (in thousands)	Ratio of Actual to Expected
0	5,856	6,715	1.1231	6,577	1.0210
1	1,106,366	1,248,135	1.1079	1,225,743	1.0183
2	1,410,942	1,527,894	1.0814	1,525,793	1.0014
3	1,385,646	1,483,408	1.0683	1,480,286	1.0021
4	1,325,886	1,408,376	1.0582	1,403,053	1.0038
5	1,280,870	1,354,019	1.0518	1,347,219	1.0050
6	1,295,475	1,366,351	1.0480	1,357,658	1.0064
7	1,405,570	1,477,023	1.0459	1,470,086	1.0047
8	1,620,955	1,701,096	1.0447	1,693,412	1.0045
9	1,920,283	2,010,459	1.0438	2,004,391	1.0030
10	2,217,111	2,319,348	1.0430	2,312,447	1.0030
11	2,561,647	2,676,117	1.0421	2,669,492	1.0025
12	2,862,667	2,983,951	1.0409	2,979,750	1.0014
13	3,148,032	3,276,354	1.0396	3,272,694	1.0011
14	3,405,932	3,539,201	1.0380	3,535,357	1.0011
15	3,718,969	3,860,783	1.0364	3,854,339	1.0017
16	3,906,079	4,046,796	1.0347	4,041,620	1.0013
17	3,997,175	4,133,192	1.0332	4,129,881	1.0008
18	3,920,981	4,051,386	1.0317	4,045,276	1.0015
19	3,744,784	3,865,311	1.0305	3,859,000	1.0016
20	3,340,369	3,446,903	1.0293	3,438,242	1.0025
21	2,990,078	3,075,840	1.0283	3,074,697	1.0004
22	2,655,869	2,728,748	1.0274	2,728,640	1.0000
23	2,357,989	2,421,793	1.0265	2,420,476	1.0005
24	2,065,794	2,122,666	1.0257	2,118,885	1.0018
25	1,884,933	1,936,228	1.0250	1,932,056	1.0022
26	1,732,511	1,776,860	1.0243	1,774,611	1.0013
27	1,634,046	1,674,828	1.0237	1,672,773	1.0012
28	1,553,208	1,591,364	1.0230	1,588,932	1.0015
29	1,493,700	1,529,121	1.0225	1,527,308	1.0012
30	1,137,953	1,164,721	1.0219	1,162,874	1.0016
31	882,044	901,873	1.0214	900,920	1.0011
32	659,343	673,562	1.0210	673,189	1.0006
33	459,973	469,711	1.0204	469,356	1.0008
34	331,772	338,753	1.0200	338,407	1.0010
35	238,524	243,137	1.0195	243,175	0.9998
36	172,843	176,360	1.0191	176,144	1.0012
37	135,489	137,816	1.0186	138,009	0.9986
38	101,346	103,420	1.0183	103,201	1.0021
39	71,078	72,437	1.0183	72,379	1.0008
40	50,832	51,836	1.0184	51,767	1.0013
Total	**72,190,920**	**74,973,892**		**74,820,115**	**1.0021**

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APPENDIX B: Mortality Improvement Illustration

Generational mortality improvement helps to account for the observation that younger individuals will enjoy greater longevity than their older counterparts. An illustration of the application of generational mortality improvement is shown below.

The mortality rate for a female annuitant who is age 60 in 2020 is expressed as:

$$q_{60}^{2020} = 0.002642$$

The mortality improvement rates from Scale MP-2020 for an age 60 female are as follows:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
0.04%	0.36%	0.66%	0.90%	1.07%	1.16%	1.19%	1.20%	1.21%	1.21%

This tells us that mortality for a 60-year-old female is expected to improve by 0.04% between calendar year 2020 and 2021. An *improvement* in mortality is expressed as a *reduction* in the actual mortality rate. Therefore, the mortality rate for a 60-year-old female in 2021 can be expressed as:

$$q_{60}^{2021} = q_{60}^{2020} \times (1 - 0.0004) = 0.002642 \times 0.9996 = 0.002641$$

Then, the mortality rate for a female annuitant who will be age 60 ten years from now is determined by the following:

$$\begin{aligned} q_{60}^{2030} = q_{60}^{2020} &\times (1 - 0.0004) \times (1 - 0.0036) \times (1 - 0.0066) \times (1 - .0090) \times (1 - .0107) \\ &\times (1 - .0116) \times (1 - .0119) \times (1 - .0120) \times (1 - .0121) \times (1 - .0121) \\ &= 0.002642 \times 0.9996 \times 0.9964 \times 0.9934 \times 0.9910 \times 0.9893 \times 0.9884 \times 0.9881 \\ &\times 0.9880 \times 0.9879 \times 0.9879 = \mathbf{0.002413} \end{aligned}$$

APPENDIX C: Additional Exhibits

CHEIRON

Classic Values, Innovative Advice

New York State Teachers' Retirement System

2021 Stochastic Investment Return Projections

August 2021

Capital Market Assumptions (CMAs)

- This analysis is based on CMAs from
  - Callan CMAs for 2021
  - Horizon Actuarial Services 2021 Survey of CMAs
- The study also uses the target asset allocation resulting from Callan's 2021 asset-liability study, as follows:

Asset Class	Target Allocation
Broad US Equity	33%
Global Ex-US Equity	16%
Global Equity	4%
Real Estate Equity	11%
Private Equity	8%
Private Credit	2%
Core US Fixed Income	16%
Global Fixed Income	2%
Real Estate Debt	6%
High Yield Bonds	1%
Cash Equivalents	1%

Assumed Rate of Investment Return

- The table below shows the probability of meeting or exceeding a given investment return based on Callan's 20-year horizon CMAs with a 30-year measurement period

Probabilities of Meeting Alternative Investment Return Assumptions						
Investment Return Assumption	6.67%	6.75%	7.00%	7.10%	7.25%	7.50%
Probability of Meeting or Exceeding the Assumption	50%	49%	45%	43%	41%	37%

- The table below shows the probability of meeting or exceeding a given investment return based on Callan's 30-year horizon CMAs with a 30-year measurement period

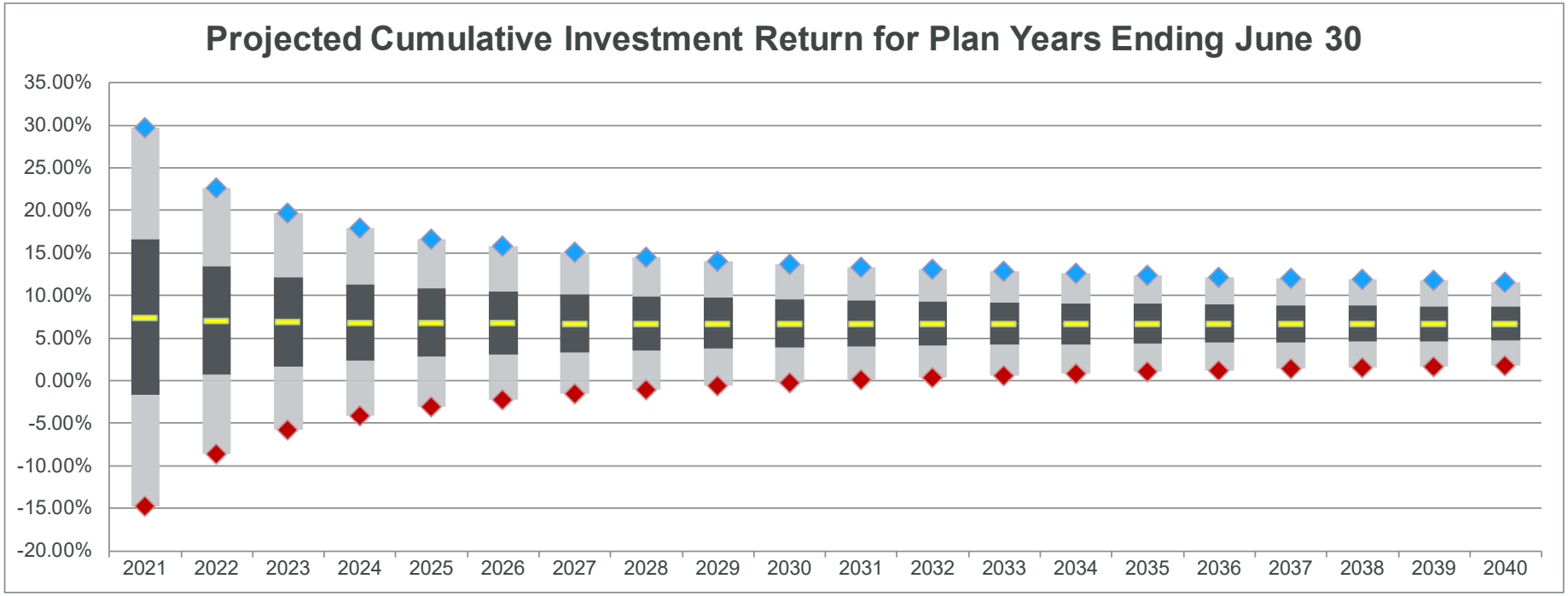
Probabilities of Meeting Alternative Investment Return Assumptions						
Investment Return Assumption	7.20%	6.75%	7.00%	7.10%	7.25%	7.50%
Probability of Meeting or Exceeding the Assumption	50%	57%	53%	52%	49%	45%

Assumed Rate of Investment Return

- The table below shows the probability of meeting or exceeding a given investment return based on Horizon's 20-year horizon CMAs with a 30-year measurement period

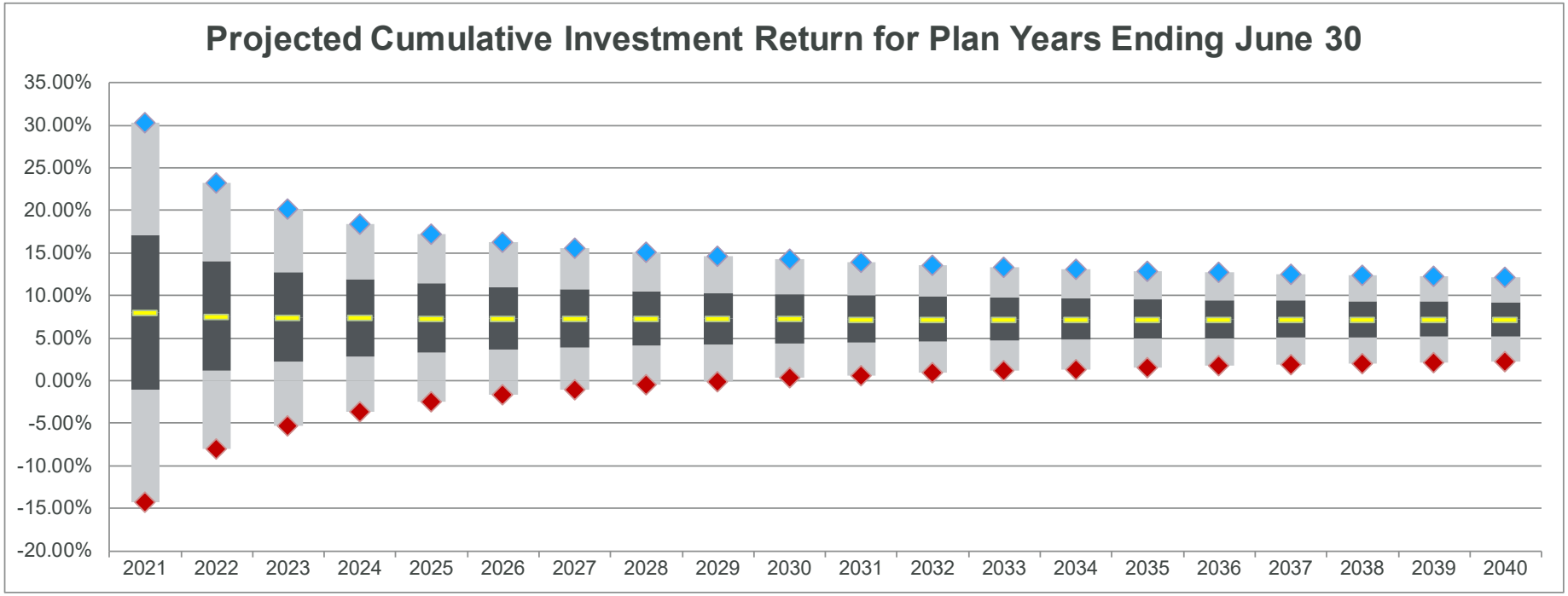
Probabilities of Meeting Alternative Investment Return Assumptions						
Investment Return Assumption	6.71%	6.75%	7.00%	7.10%	7.25%	7.50%
Probability of Meeting or Exceeding the Assumption	50%	49%	45%	43%	40%	36%

Investment Return – Callan 20-Yr CMAs



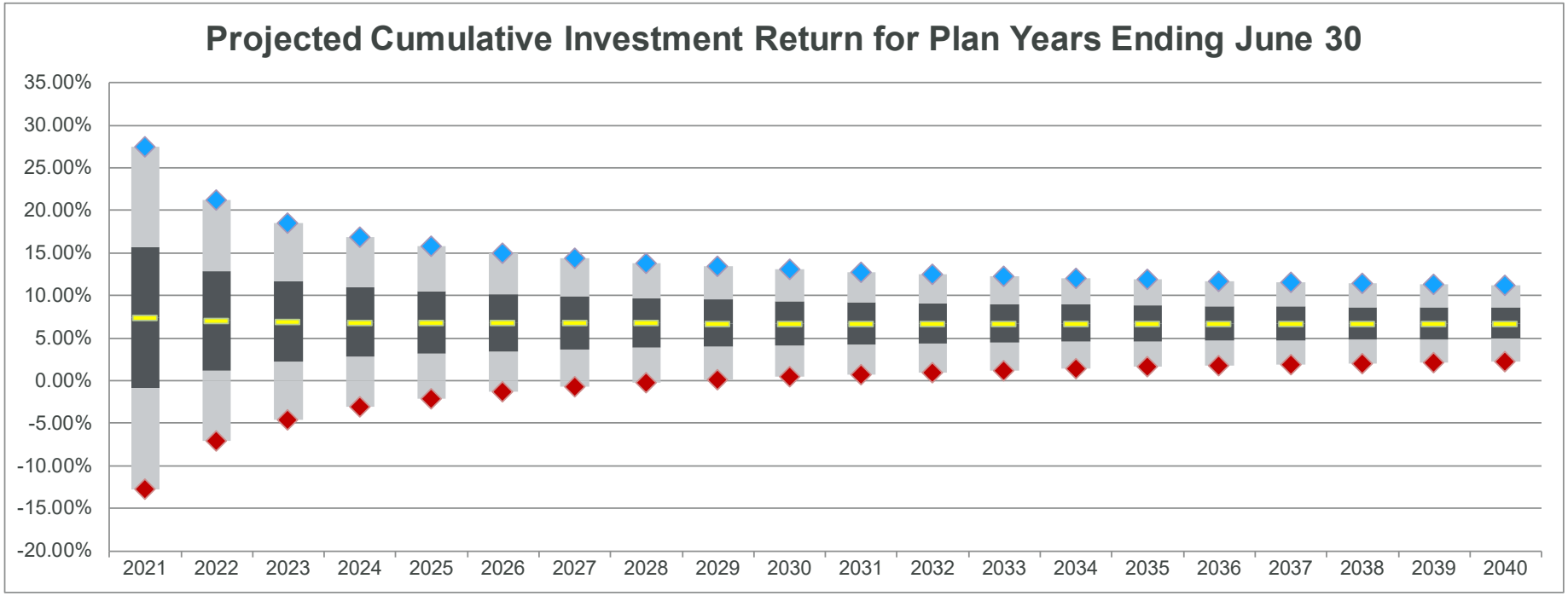
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
95%	29.7%	22.7%	19.7%	17.9%	16.7%	15.8%	15.1%	14.5%	14.1%	13.7%	13.3%	13.1%	12.8%	12.6%	12.4%	12.2%	12.0%	11.9%	11.7%	11.6%
75%	16.6%	13.5%	12.1%	11.4%	10.8%	10.5%	10.2%	9.9%	9.7%	9.6%	9.4%	9.3%	9.2%	9.1%	9.0%	8.9%	8.9%	8.8%	8.8%	8.7%
50%	7.5%	7.1%	6.9%	6.8%	6.8%	6.8%	6.8%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%
25%	-1.6%	0.6%	1.7%	2.3%	2.8%	3.1%	3.3%	3.6%	3.7%	3.9%	4.0%	4.1%	4.2%	4.3%	4.4%	4.4%	4.5%	4.6%	4.6%	4.7%
5%	-14.8%	-8.6%	-5.8%	-4.2%	-3.0%	-2.2%	-1.6%	-1.0%	-0.6%	-0.2%	0.1%	0.4%	0.6%	0.8%	1.0%	1.2%	1.4%	1.5%	1.6%	1.8%

Investment Return – Callan 30-Yr CMAs



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
95%	30.2%	23.2%	20.2%	18.4%	17.2%	16.3%	15.6%	15.1%	14.6%	14.2%	13.9%	13.6%	13.3%	13.1%	12.9%	12.7%	12.6%	12.4%	12.3%	12.1%
75%	17.1%	14.0%	12.7%	11.9%	11.4%	11.0%	10.7%	10.5%	10.3%	10.1%	10.0%	9.8%	9.7%	9.6%	9.6%	9.5%	9.4%	9.3%	9.3%	9.2%
50%	8.0%	7.6%	7.4%	7.4%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%
25%	-1.1%	1.2%	2.2%	2.9%	3.3%	3.6%	3.9%	4.1%	4.3%	4.4%	4.5%	4.6%	4.7%	4.8%	4.9%	5.0%	5.0%	5.1%	5.1%	5.2%
5%	-14.2%	-8.1%	-5.3%	-3.6%	-2.5%	-1.7%	-1.0%	-0.5%	-0.1%	0.3%	0.6%	0.9%	1.1%	1.3%	1.5%	1.7%	1.9%	2.0%	2.2%	2.3%

Investment Return – Horizon 20-Yr CMAs



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
95%	27.5%	21.2%	18.5%	16.8%	15.8%	15.0%	14.3%	13.8%	13.4%	13.1%	12.8%	12.5%	12.3%	12.1%	11.9%	11.7%	11.6%	11.4%	11.3%	11.2%
75%	15.6%	12.8%	11.7%	11.0%	10.5%	10.1%	9.9%	9.7%	9.5%	9.3%	9.2%	9.1%	9.0%	8.9%	8.8%	8.8%	8.7%	8.7%	8.6%	8.6%
50%	7.4%	7.0%	6.9%	6.9%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%
25%	-0.9%	1.2%	2.2%	2.8%	3.2%	3.5%	3.7%	3.9%	4.0%	4.2%	4.3%	4.4%	4.5%	4.6%	4.6%	4.7%	4.7%	4.8%	4.9%	4.9%
5%	-12.7%	-7.1%	-4.6%	-3.1%	-2.1%	-1.3%	-0.8%	-0.3%	0.1%	0.5%	0.7%	1.0%	1.2%	1.4%	1.6%	1.7%	1.9%	2.0%	2.2%	2.3%

2021 Callan CMAs and Target Allocation

Callan Asset Class (20 year Horizon)	Target Allocation	Arithmetic Return	Geometric Return	Standard Deviation
Broad US Equity[1]	33.0%	8.55%	7.20%	17.95%
Global Ex-US Equity[2]	16.0%	9.30%	7.40%	20.70%
Global Equity	4.0%	8.85%	7.45%	18.25%
Real Estate Equity[3]	11.0%	8.35%	7.20%	16.75%
Private Equity	8.0%	11.80%	8.30%	27.80%
Private Credit	2.0%	7.70%	6.85%	14.60%
Core US Fixed Income	16.0%	2.70%	2.65%	3.75%
Global Fixed Income[4]	2.0%	2.15%	2.15%	3.10%
Real Estate Debt[5]	6.0%	4.20%	4.15%	4.65%
High Yield Bonds	1.0%	5.50%	5.05%	10.75%
Cash Equivalents	1.0%	1.60%	1.60%	0.90%
Inflation	N/A	N/A	2.00%	1.50%
Total Portfolio	**N/A**	**7.48%**	**6.76%**	**13.53%**

1 Modeled as 80% large cap / 20% mid and small cap
2 Modeled as 75% non-US developed markets / 25% emerging markets
3 Modeled as 55% core real estate / 30% non-core real estate / 15% REITs
4 Modeled as 60% non-US developed market bonds / 40% core US fixed income
5 Modeled as 80% commercial mortgages / 20% private mezzanine debt

Source: Callan LLC

2021 Callan CMAs and Target Allocation

Callan Asset Class (30 year Horizon)	Target Allocation	Arithmetic Return	Geometric Return	Standard Deviation
Broad US Equity[1]	33.0%	8.95%	7.60%	17.95%
Global Ex-US Equity[2]	16.0%	9.75%	7.90%	20.70%
Global Equity	4.0%	9.30%	7.95%	18.25%
Real Estate Equity[3]	11.0%	8.65%	7.50%	16.75%
Private Equity	8.0%	12.20%	8.75%	27.80%
Private Credit	2.0%	8.10%	7.25%	14.60%
Core US Fixed Income	16.0%	3.50%	3.50%	3.75%
Global Fixed Income[4]	2.0%	2.95%	2.95%	3.10%
Real Estate Debt[5]	6.0%	5.50%	5.50%	4.65%
High Yield Bonds	1.0%	6.00%	5.55%	10.75%
Cash Equivalents	1.0%	2.00%	2.00%	0.90%
Inflation	N/A	N/A	2.00%	1.50%
Total Portfolio	**N/A**	**8.01%**	**7.32%**	**13.53%**

1 Modeled as 80% large cap / 20% mid and small cap
2 Modeled as 75% non-US developed markets / 25% emerging markets
3 Modeled as 55% core real estate / 30% non-core real estate / 15% REITs
4 Modeled as 60% non-US developed market bonds / 40% core US fixed income
5 Modeled as 80% commercial mortgages / 20% private mezzanine debt

Source: Callan LLC

2021 Callan CMAs – Correlations

Callan Asset Class	US EQ	Non US EQ	GL EQ	RE EQ	PE	PC	Core US FI	GL FI	RE Debt	HY	Cash
Broad US Equity	1.000										
Global Ex-US Equity	0.817	1.000									
Global Equity	0.955	0.951	1.000								
Real Estate Equity	0.798	0.783	0.830	1.000							
Private Equity	0.803	0.783	0.832	0.744	1.000						
Private Credit	0.735	0.720	0.763	0.667	0.680	1.000					
Core US Fixed Income	-0.104	-0.123	-0.118	-0.101	-0.190	-0.060	1.000				
Global Fixed Income	-0.138	-0.128	-0.138	-0.142	-0.092	-0.034	0.735	1.000			
Real Estate Debt	0.737	0.720	0.765	0.682	0.890	0.653	0.189	0.187	1.000		
High Yield Bonds	0.715	0.715	0.750	0.571	0.589	0.630	-0.004	-0.009	0.624	1.000	
Cash Equivalents	-0.064	-0.104	-0.088	-0.035	0.000	-0.060	0.150	0.072	0.061	-0.110	1.000

Source: Callan LLC

2021 Horizon CMAs and Target Allocation

Horizon Asset Class (20 year Horizon)	Target Allocation*	Arithmetic Return	Geometric Return	Standard Deviation
US Equity - Large Cap	28.0%	7.96%	6.65%	16.42%
US Equity - Small/Mid Cap	7.0%	9.01%	7.04%	20.17%
Non-US Equity – Developed	13.5%	8.79%	7.14%	18.32%
Non-US Equity – Emerging	4.5%	10.78%	7.81%	24.33%
US Corp Bonds – Core	22.8%	3.38%	3.23%	5.52%
US Corp Bonds - High Yield	1.0%	5.46%	4.98%	9.88%
Non-US Debt – Developed	1.2%	2.53%	2.25%	7.18%
US Treasuries	1.0%	1.91%	1.90%	1.30%
Real Estate	11.0%	7.65%	6.21%	17.62%
Private Equity	8.0%	12.27%	9.65%	22.25%
Private Debt	2.0%	7.52%	6.87%	11.42%
Total Portfolio	**N/A**	**7.38%**	**6.69%**	**12.23%**

* When possible, the target allocation in Callan's presentation was mapped to Horizon's asset classes following the notes to Callan's asset classes. Callan's 33% Broad US Equity is noted as 80% Large Cap (26.4%) and 20% Mid and Small Cap (6.6%). Callan's 16% Global Ex-US Equity is noted 75% Developed Markets (12%) and 25% Emerging Markets (4%). Callan's 2% Global Fixed Income is noted as 60% Non-US Developed Markets (1.2%) and 40% Core US Fixed Income (0.8%). Additionally, Callan's Global Equity was mapped to 50% US Equity and 50% Non-US Equity based on available information in the latest CAFR, and Callan's Real Estate Debt was mapped to US Corp Bonds - Core.

Source: Horizon Actuarial Services, LLC 2021 Survey of Capital Market Assumptions

2021 Horizon CMAs – Correlations

Horizon Asset Class	US LC	US SC	Non US Dev	Non US Emg	FI	HY	FI Dev	US Treas	RE	PE	P FI
US Eq – LC	1.00										
US Eq – SMC	0.90	1.00									
Non-US Eq – Developed	0.82	0.77	1.00								
Non-US Eq – Emerging	0.72	0.70	0.80	1.00							
US Core Bonds	0.19	0.15	0.20	0.18	1.00						
US High Yield	0.63	0.63	0.62	0.62	0.43	1.00					
Non-US Debt – Developed	0.15	0.10	0.30	0.26	0.55	0.24	1.00				
US Treasuries	-0.06	-0.06	-0.04	-0.03	0.12	-0.10	0.16	1.00			
Real Estate	0.60	0.62	0.55	0.49	0.28	0.52	0.24	-0.01	1.00		
Private Equity	0.74	0.74	0.69	0.61	0.10	0.51	0.11	-0.03	0.50	1.00	
Private Debt	0.54	0.55	0.54	0.52	0.26	0.71	0.15	-0.04	0.46	0.54	1.00

Source: Horizon Actuarial Services, LLC 2021 Survey of Capital Market Assumptions

Reliance

The purpose of this presentation is to present stochastic projections of investment returns for evaluating the valuation interest rate to the New York State Teachers' Retirement System (NYSTRS).

Future results may differ significantly from the current results presented in this presentation due to such factors as the following: changes in capital market assumptions; and changes in asset allocation.

In preparing this presentation, we relied on information (some oral and some written) supplied by NYSTRS. This information includes, but is not limited to, the asset allocation and the capital market assumptions. Investment return projections in this presentation were developed using R-Scan, our proprietary tool for developing stochastic projections. Annual investment returns are assumed to follow a normal distribution.

This presentation and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained herein. This presentation does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

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