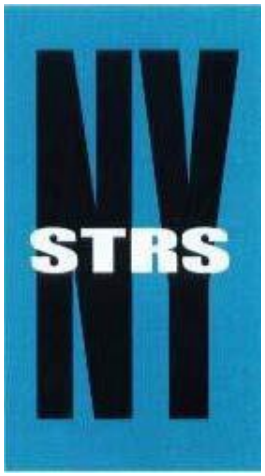
ACTUARIAL VALUATION REPORT

as of

JUNE 30, 2019



New York State Teachers' Reirement System

Office of the Actuary

July 21, 2020

NEW YORK STATE TEACHERS' RETIREMENT SYSTEM

Actuarial Valuation Report
as of June 30, 2019

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Actuarial Valuation Report
as of June 30, 2019

A. INTRODUCTION

This report presents to the New York State Teachers' Retirement System (NYSTRS or the Retirement System) Retirement Board the results of the annual actuarial valuation of assets and liabilities of the Retirement System as of June 30, 2019. The financial objective of NYSTRS is to properly fund the retirement and ancillary benefits of members in order to ensure sufficient assets are being accumulated in order to pay benefits as they become due. Employer contributions are made by participating employers in accordance with an actuarially determined employer contribution rate. The rate is determined by actuarial valuation made each June 30th. Members contribute in accordance with a fixed rate schedule as required by statute.

The purpose of this report is to summarize the determination of the Employer Contribution Rate which will be applied to member salaries earned during the July 1, 2020 to June 30, 2021 fiscal year and to review the funded status of the Retirement System. Use of the valuation results contained herein for purposes or by parties other than those stated above may not be appropriate.

B. EMPLOYER CONTRIBUTION RATE

The Employer Contribution Rate to be applied to member salaries for the July 1, 2020 to June 30, 2021 fiscal year and collected in the fiscal year ending June 30, 2022 consists of four components. These components may be described as follows:

The **Normal Rate** represents the annual cost of accruing active member benefits as well as actuarial gains and losses. The active member component includes the cost of benefits accruing on account of retirement, withdrawal, disability, death (except for the first $50,000 of death benefits which are funded by the group life insurance rate) and the cost-of-living benefit provided during retirement. The Normal Rate is calculated in accordance with the Aggregate Actuarial Cost Method.

The **Expense Rate** is a pay-as-you-go rate representing the administrative cost of the

Retirement System for the fiscal year July 1, 2021 to June 30, 2022 and is set during the budget process.

The **Group Life Insurance Rate** is, as we understand it, prescribed to be a pay-as-you-go rate representing the expected benefit payments of the first $50,000 of member death benefits for the fiscal year July 1, 2021 to June 30, 2022.

The **Excess Benefit Plan Rate** is a pay-as-you-go rate representing the Excess Benefit Fund's need for contributions to cover expected benefit payments in excess of the Internal Revenue Code Section 415 limits for the fiscal year July 1, 2021 to June 30, 2022.

The actuarially computed Employer Contribution Rate to be applied to the member salaries for the fiscal year ending June 30, 2021 is **9.53%**. The Employer Contribution Rates determined by the actuarial valuations as of June 30, 2019 and June 30, 2018 and the changes between the two are summarized below:

	As of 6/30/2019	As of 6/30/2018	Change
Normal Rate	9.14%	8.47%	0.67%
Expense Rate	0.26	0.26	0.00
Group Life Insurance Rate	0.13	0.13	0.00
Excess Benefit Plan Rate	0.00	0.00	0.00
Employer Contribution Rate	**9.53%**	**8.86%**	**0.67%**

The actuarial assumptions in use for the June 30, 2019 actuarial valuation were developed primarily based upon Retirement System experience and were adopted by the Retirement Board on October 29, 2015, October 26, 2017, and October 31, 2019. On October 29, 2015 the Retirement Board adopted new demographic and economic assumptions. On October 26, 2017 the Retirement Board lowered the valuation rate of interest assumption from 7.50% to 7.25%, and on October 31, 2019 the valuation rate of interest assumption was further lowered to 7.1%. The mortality improvement scale, projected COLA increase, and inflation assumptions were also revised and adopted by the Retirement Board on October 31, 2019. The Mortality Improvement Scale changed from MP-2014 to MP-2018. The projected COLA assumption was lowered from 1.5% to 1.3%. The Inflation assumption was lowered from 2.25% to 2.2%. In accordance with Sections 501, 508 and 517 of the Education Law, the

Retirement Board has the authority to adopt the actuarial assumptions as recommended by the Actuary.

As in most prior years, the actual employer contributions made by participating employers during the fiscal year ending June 30, 2019 were equal to the employer contributions determined in accordance with the applicable annual actuarial valuation.

C. GAIN/LOSS IN THE EMPLOYER CONTRIBUTION RATE

The Employer Contribution Rate of 9.53% represents a 67 basis point increase from the prior year's rate of 8.86%.

NORMAL RATE

The Normal Rate component of the Employer Contribution Rate of 9.14% represents a 67 basis point increase over the prior year's rate of 8.47%. This change may be broken down as follows:

Salary/Service:	This loss is due to salary and service data coming in higher than expected.	+0.36
Net Investment Loss:	The recognition of prior investment gains and losses over a five-year period in accordance with the asset valuation method resulted in a net investment loss.	+0.08
New Entrants:	New entrants join the Retirement System as Tier 6 members with a long-term expected normal rate of approximately 4.4% which results in downward pressure on the Normal Rate.	-0.07
Withdrawal:	Withdrawal experience produced a loss.	+0.02
Mortality:	Members are living slightly longer than expected and receiving benefits for a longer period.	+0.03
Retirement:	There were slightly more retirements than expected.	+0.07
Pension Payments:	Actual payments to retirees were less than expected.	-0.02
Cost of Living Adjustment:	The actual COLA increase of 1.2% was lower than the expected increase of 1.50%.	-0.06
Actuarial Assumption Changes:	Decrease in Normal Rate due to gain on assumption changes.	-0.01
Miscellaneous:	Decrease due to other sources of gain and loss (e.g. overlap, disability, valuation software change, etc.)	+0.27
TOTAL CHANGE IN THE NORMAL RATE		**0.67%**

OTHER COMPONENTS

The **Expense Rate** is set during the budget process. As of June 30, 2019, the expense rate remains at 0.26%.

The **Group Life Insurance Fund Rate** is unchanged from the previous year. Contributions collected have generally been more than sufficient to cover payments over the past several years, resulting in an accumulated Group Life Insurance Fund of approximately $335 million as of June 30, 2019. The Group Life Insurance Rate is being held constant, however, in anticipation of rising payouts in the future due to the growth in the number of retirees eligible for the post-retirement death benefit (Tiers 2 through 6) and the inactive member death benefit (Tiers 2 through 6).

The **Excess Benefit Plan Rate** remains equal to 0.00% this year. This rate represents the Excess Benefit Fund's need for contributions to cover retirement benefits paid in excess of the Internal Revenue Code Section 415 limits. These payments are made exclusively from the Excess Benefit Plan. This fund was established in accordance with the Excess Benefit Plan which received final IRS approval in August 2001. The fund has accumulated assets of approximately $3.6 million as of June 30, 2019. The rate has been set to 0.00% this year in order to utilize the existing fund balance.

D. EMPLOYER CONTRIBUTION RATE HISTORY

The following chart summarizes the Employer Contribution Rate for the last 20 years:

Salary Year	*Employer Contribution Rate*	*Salary Year*	*Employer Contribution Rate*
2001-2002	0.36%	2011-2012	11.11%
2002-2003	0.36	2012-2013	11.84
2003-2004	2.52	2013-2014	16.25
2004-2005	5.63	2014-2015	17.53
2005-2006	7.97	2015-2016	13.26
2006-2007	8.60	2016-2017	11.72
2007-2008	8.73	2017-2018	9.80
2008-2009	7.63	2018-2019	10.62
2009-2010	6.19	2019-2020	8.86
2010-2011	8.62	2020-2021	9.53

The complete Employer Contribution Rate history is presented in Appendix 15.

E. EMPLOYER CONTRIBUTION RATE CHANGE

The Employer Contribution Rate has increased this year from 8.86% to 9.53%, representing an increase of approximately 7.6% wholly attributable to the increase in the Normal Rate component which increased from 8.47% to 9.14%. The rate of return on the System's market value of assets for the fiscal year ending June 30, 2019 was 7.1%. The System's five-year market value rate of return now stands at 7.2%, a decrease from last year's 9.3%. The June 30, 2019 actuarial valuation showed a small loss on assets accounting for a portion of the increase in the employer contribution rate. This is the first actuarial loss on assets since June 30, 2016. The remainder of the change in the employer contribution rate is due to the net effect of other actuarial gains and losses as outlined earlier in this report.

The Normal Rate component of the Employer Contribution Rate is calculated in accordance with the Aggregate Actuarial Cost Method, as required by statute (New York State Education Law Section 517). Under the Aggregate Actuarial Cost Method gains and losses resulting from differences between actual and expected experience, as well as changes to assumptions or plan provisions, are not separately amortized but are spread as part of the normal cost calculation, over the expected future working lifetime of active members. The Aggregate Method is a reasonable and widely accepted actuarial cost method to use for ongoing plan funding purposes and is consistent with the System's goal of accumulating sufficient assets to pay benefits as they come due.

F. MEMBER DATA

The member data for the annual actuarial valuation was determined as of June 30, 2019.

	June 30, 2019	June 30, 2018
Active Members and Members not yet receving monthly benefits	263,517	264,590
Retired Members receiving monthly benefits	162,807	160,049
Beneficiaries receiving monthly benefits	6,396	6,236
Total	432,720	430,875

Compared with the previous year, the total number of members increased slightly. The number of active members decreased while the number of retired members increased.

The number of retirements increased from 6,416 during the 2017-2018 fiscal year to 6,890 during the 2018-2019 fiscal year. The number of retirements over each of the last ten years is as follows:

Fiscal Year	*Total Number of Retirements*	*Fiscal Year*	*Total Number of Retirements*
2009-2010	5,501	2014-2015	6,161
2010-2011*	8,423	2015-2016	6,245
2011-2012	6,033	2016-2017	6,396
2012-2013	6,330	2017-2018	6,416
2013-2014	6,547	2018-2019	6,890

*Denotes an early retirement incentive offered during that fiscal year.

Historical member statistics, including statistics specific to retired members, appear in the appendices to this report. Additional member statistics may also be found in the Retirement System's most recent Comprehensive Annual Financial Report (CAFR).

G. FUNDED STATUS

As of June 30, 2019, the actuarial value of plan assets, including GLIF assets, was equal to $120.6 billion. The accrued pension benefit liability calculated in accordance with the Entry Age Normal Cost Method, including GLIF liabilities, was equal to $121.0 billion. These two values produced a funded ratio of 99.6% as of June 30, 2019. If the market value of plan assets is used instead of the actuarial value of plan assets, the funded ratio as of June 30, 2019 would be equal to 101.2%.

For purposes of this funded ratio calculation, the plan liabilities have been calculated in accordance with the Entry Age Normal Cost Method as required by Governmental Accounting Standards Board (GASB) Statement No. 67. The Retirement System is funded in accordance with the Aggregate Cost Method. GASB Statement No. 67 requires that the Entry Age Normal Cost Method be used to calculate the accrued liability for purposes of presenting the funded ratio calculation for all plans, regardless of the cost method being used for funding purposes. Both Aggregate and Entry Age Normal are appropriate contribution allocation procedures for purposes of ongoing plan funding and are widely accepted actuarial cost methods.

The funded ratios provided here are an appropriate measurement of the System's funded status. While the funded ratios will fluctuate from year to year, a funded ratio of 100% is desirable and indicative of a well-funded System. The primary reason for this healthy funded ratio is that the Retirement System has collected the actuarially required contribution annually from employers. The significance of this cannot be overstated. It does not, however, imply that future contributions will

not be required. The funded status measurement provided here is not appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the System's benefit obligations such as in a plan termination situation.

A history of the Retirement System's funded status is provided in Appendix 4 of this report.

H. ACTUARIAL EXPERIENCE

Each year the Office of the Actuary completes an experience study in order to regularly monitor the reasonableness and appropriateness of the actuarial assumptions used in the actuarial valuation. Changes are recommended when warranted. Assumptions are typically revised every five years. These assumptions are used to estimate the probability a member will cease teaching due to retirement, withdrawal, disability, or death. In addition, the assumptions are used to estimate future salary increases, future investment earnings, future projected COLA's, and the probability of death for retired members and beneficiaries. A listing of the actuarial assumptions is provided in Appendix 18. A summary of the results of the most recent five-year experience study is contained in Appendix 11. Most of the current actuarial assumptions were adopted by the Retirement Board on October 29, 2015, and first effective with the actuarial valuation of the Retirement System's assets and liabilities as of June 30, 2015. Specific details regarding the development of these actuarial assumptions can be found in the "*Report on the 2015 Recommended Actuarial Assumptions*". The Valuation Rate of Interest was adopted by the Retirement Board on October 26, 2017 and further revised on October 31, 2019 and are explained in memos from Richard Young dated October 26, 2017 and October 31, 2019. On October 31, 2019 additional assumption changes for the assumed rate of inflation, projected COLA increases, and mortality improvement were also adopted.

I. ASSET ALLOCATION

The Retirement Board, in consultation with Retirement System staff and the System's external investment consultant AON Hewitt, annually reviews the asset allocation to determine if any changes are appropriate. There were no changes made to the asset allocation between June 30, 2019 and the time of this report.

According to AON Hewitt, the system's adopted asset allocation produces a long-term (30 year) expected annual geometric rate of return of 6.9%, and an expected annual arithmetic rate of return of 7.6% based on their most recent report (1st quarter 2020 return assumptions).

The Retirement System's asset allocation, including targets and ranges, can be found in Appendix 13. Historical rate of return information can be found in Appendix 12. Detailed investment information is available in the System's Comprehensive Annual Financial Report (CAFR).

J. NEW LEGISLATION

The following significant legislation affecting the Retirement System was signed into law during the 2019 Legislative Session:

Earnings After Retirement:

Chapter 589 of the Laws of 2019 increases from $30,000 to $35,000 the amount of money a retiree of a public retirement system may earn in public employment without loss of pension benefits.

K. ASSESSMENT OF RISK

Included in Appendix 14 is an Assessment of Risk. The purpose of this exhibit is to provide various plan maturity measures, as well as illustrate what the Employer Contribution Rate would have been had various actuarial assumptions been altered. The chart also gives the reader a feel for the significance of the assumptions on the valuation results, and the potential impact of modifying them.

L. FUTURE EXPECTATIONS

Future actuarial measurements such as the funded ratio and employer contribution rate may differ significantly from the current 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 next employer contribution rate will be based upon the actuarial valuation as of June 30, 2020. The capital markets experienced a significant downturn in the Spring of 2020 due to the impact of the COVID-19 pandemic before regaining ground before the end of the fiscal year. For the year ending June 30, 2020, the System's main domestic equity index, the S&P1500, returned 6.1% for the fiscal year. The System's main international equity index, the ACWI ex-US, returned -4.8% for the

fiscal year. Our fixed income index, the Barclay's US Aggregate Float Adjusted Bond index, returned 8.9% for the year. The System's finalized investment rate of return for the fiscal year ending June 30, 2020 will not be available until October of 2020. Based on the performance of these benchmarks, however, the System's five-year rate of return will decrease from last year's 7.2% and will likely now be below the assumed rate of return of 7.1%.

M. COVID-19

The COVID-19 pandemic began in earnest in the United States in March 2020, resulting in sudden and widespread illness, hospitalizations, and death. Cases of the virus are surging in over half of the states in the U.S. The resultant closing of the national economy led to a dramatic increase in unemployment, and a significant drop in the stock market. Although stocks have since made up ground from their lows, there is still significant volatility in the market. While states are beginning to re-open their economies in stages, unemployment remains high. It's anticipated that state and local revenues will be significantly lower than previously anticipated, but the full impact is as yet unknown. What does this mean to the Retirement System? State aid to schools is projected to be decreased by 20%, which will lead to significant budgetary pressures on our employers. With respect to our members, schools closed in mid-March 2020 for the remainder of the school year, in order to reduce exposures. At this time, to the best of our knowledge, the System has had two active members and three retired members die due to COVID-19.

N. CERTIFICATION

This actuarial valuation 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 reconciles it against prior data. In addition, the valuation relies on financial data provided by the Retirement System's Finance Department. Data is reviewed by the Retirement System's independent auditors as part of the annual audit. We believe the data to be reasonable and appropriate for purposes of this valuation.

The benefits recognized in this actuarial valuation are prescribed by New York State statute (Article 11 of the Education Law and Articles 11, 14, 15, 18, 19, and 20 of the Retirement and Social Security Law) and are summarized in Appendix 19. All benefits are included in the actuarial valuation.

The actuarial methods, calculations, and actuarial assumptions are in accordance with standards of practice prescribed by the Actuarial Standards Board and generally accepted actuarial principles and procedures. The actuarial assumptions, as adopted by the Retirement Board and used in determining the liabilities and costs, 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.

Richard A. Young, ASA, EA, MAAA, FCA
Actuary

Sandra V. Pangburn, ASA, EA, MAAA
Manager, Office of the Actuary

New York State Teachers' Retirement System
Office of the Actuary
July 21, 2020

RECONCILIATION OF THE MARKET VALUE OF ASSETS

From June 30, 2018 to June 30, 2019

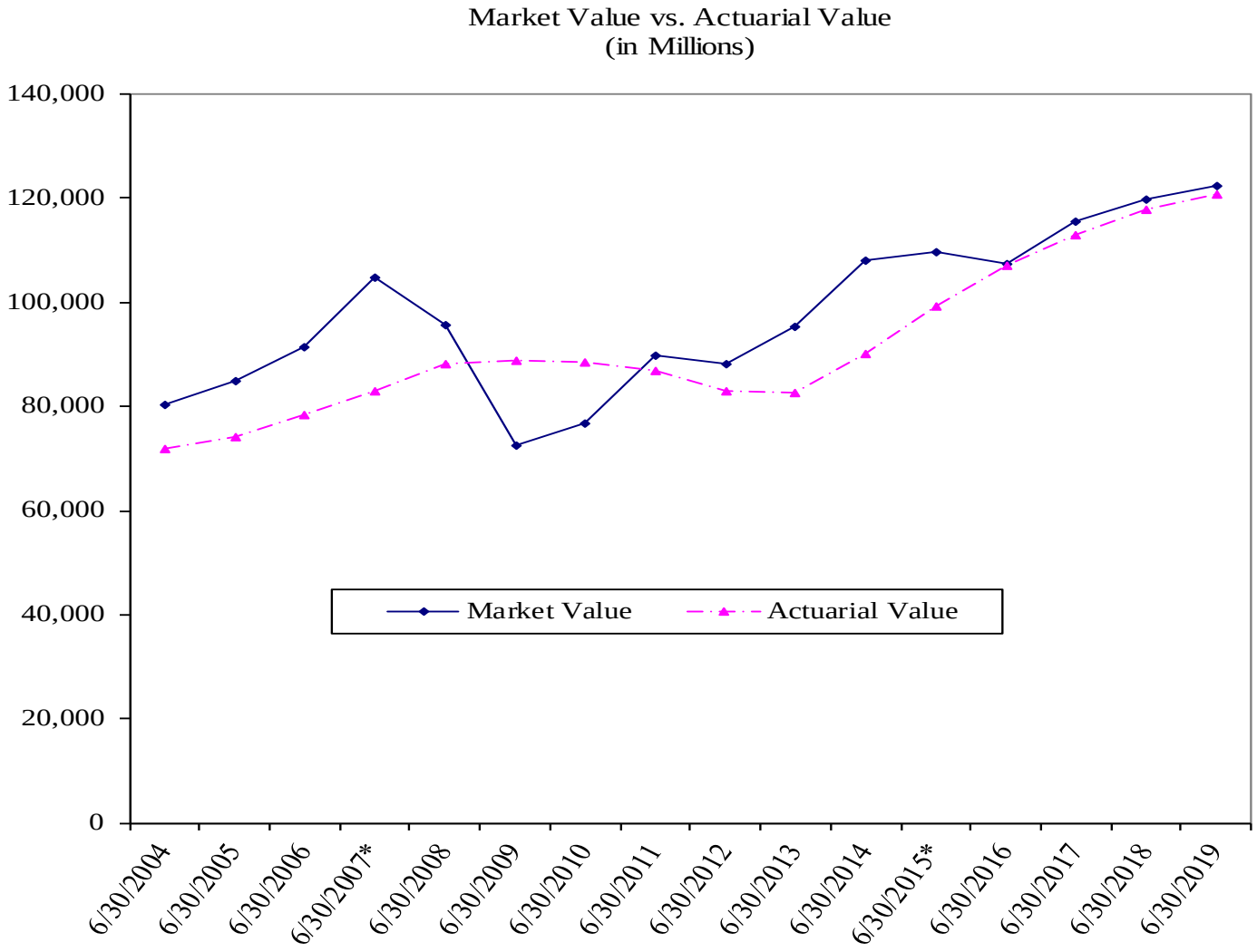
	Market Value* (in thousands)
1. Market Value of Assets as of June 30, 2018	$119,915,518
2. Contributions and Transfers	
Employer contributions	1,774,646
Member contributions	136,610
Net transfers in/(out)	9,087
Subtotal	1,920,343
3. Net Investment Income/(Loss)	8,023,179
4. Distributions	
Benefit payments	7,307,317
Administrative expenses	74,242
Subtotal	7,381,559
5. Market Value of Assets as of June 30, 2019 (1 + 2 + 3 - 4)	$122,477,481

* Totals may not add due to rounding.

COMPARISON OF MARKET VALUE TO ACTUARIAL VALUE OF ASSETS

(in Millions)

Fiscal Year Ending	Market Value	Actuarial Value	Fiscal Year Ending	Market Value	Actuarial Value
6/30/2004	80,276.2	72,044.4	6/30/2012	88,056.3	82,871.4
6/30/2005	84,908.5	74,074.3	6/30/2013	95,367.0	82,742.5
6/30/2006	91,492.2	78,335.8	6/30/2014	108,155.1	90,007.1
6/30/2007*	104,912.9	82,858.9	6/30/2015*	109,718.9	99,301.8
6/30/2008	95,769.3	88,254.7	6/30/2016	107,506.1	107,039.2
6/30/2009	72,471.8	88,805.5	6/30/2017	115,468.4	113,059.7
6/30/2010	76,844.9	88,544.4	6/30/2018	119,915.5	117,859.5
6/30/2011	89,889.7	86,892.2	6/30/2019	122,477.5	120,586.9



* The Retirement System's actuarial asset valuation method was changed effective with the June 30, 2007 and June 30, 2015 actuarial valuations. The assets above include the GLIF assets.

ACTUARIAL PRESENT VALUE OF FUTURE BENEFITS

as of June 30, 2019 and June 30, 2018

(in Thousands)

Each year an actuarial valuation determines the actuarial present value of future benefits (PVB), which is the present value of retirement and ancillary benefit payments, excluding group life insurance benefits, that the Retirement System can expect to pay in the future to current retirees and members. The PVB is based upon both service and salary projected to retirement. The results of the two most recent actuarial valuations are displayed in the following table.

	2019	**2018**
Present Value of Benefits Currently Being Paid:		
Service Retirement Benefits…….	$64,180,803	$63,093,963
Disability Retirement Benefits…….	353,622	357,913
Death Benefits……..	1,474	2,287
Survivor Benefits……..	1,107,460	1,063,411
Cost-of-Living Allowance……	4,878,105	5,242,492
Total Present Value of Benefits Presently Being Paid	70,521,464	69,760,066
Present Value of Benefits Payable in the Future to Current Active Members:		
Service Retirement Benefits…….	59,396,166	56,167,649
Disability Retirement Benefits…….	236,212	232,210
Termination Benefits……	2,290,161	2,188,574
Death and Survivor Benefits……	427,006	396,140
Cost-of-Living Allowance……	1,353,531	1,415,449
Total Active Member Liabilities	63,703,076	60,400,022
Present Value of Benefits Payable in the Future to Current Inactive (Vested) Members:		
Retirement Benefits……..	397,687	377,266
Death Benefits……..	308	319
Cost-of-Living Allowance……	32,819	32,016
Total Vested Liabilities	430,814	409,601
Unclaimed Funds…….	19,396	17,701
Total Actuarial Present Value of Future Benefits	**$134.674.750**	**$130.587.390**

Note: Totals may not sum due to rounding

FUNDING PROGRESS

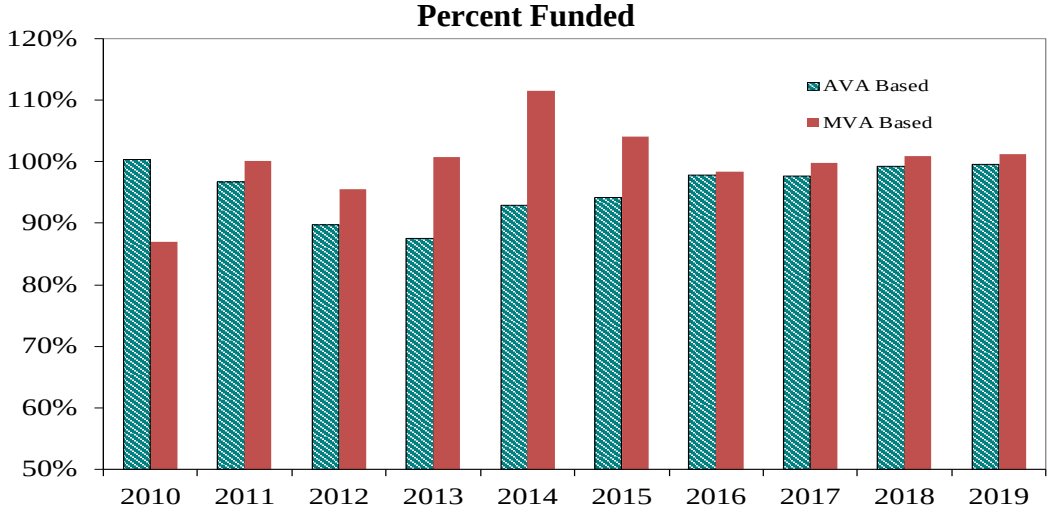
The portion of the actuarial present value of future benefits that is attributed to service rendered as of the valuation date is known as the actuarial accrued liability. In order to effectively assess the funding progress of a retirement system, it is necessary to compare the actuarial value of assets and the actuarial accrued liabilities over a period of time.

The Retirement System's funding method has allowed the accumulation of assets appropriate for the funding of its liabilities in a systematic and reasonable manner.

Analysis of Funding Progress
in Millions)

Fiscal Year Ended	Market Value of Assets (MVA)	Actuarial Value of Assets (AVA)[1]	Actuarial Accrued Liability[2]	Percent Funded based on MVA	Percent Funded based on AVA
2010	$76,844.9	$88,544.4	$88,318.8	87.0%	100.3%
2011	89,889.7	86,892.2	89,824.9	100.1	96.7
2012	88,056.3	82,871.4	92,250.9	95.5	89.8
2013	95,367.0	82,742.5	94,583.8	100.8	87.5
2014	108,155.1	90,007.1	96,904.5	111.6	92.9
2015	109,718.9	99,301.8	105,401.8	104.1	94.2
2016	107,506.1	107,039.2	109,305.1	98.4	97.9
2017	115,468.4	113,059.7	115,672.5	99.8	97.7
2018	119,915.5	117,859.5	118,861.1	100.9	99.2
2019	122,477.5	120,586.9	121,049.3	101.2	99.6

Percent Funded



[1] The Retirement System's asset valuation method was changed effective with the June 30, 2007 and June 30, 2015 actuarial valuations.

[2] Effective June 30, 2006, the Actuarial Accrued Liability is calculated under the Entry Age Normal Cost Method, including the Group Life Insurance Fund, as was required by Governmental Accounting Standards Board (GASB) Statement No. 50 prior to its replacement by GASB Statement No. 67. The Retirement System is funded in accordance with the Aggregate Cost Method. GASB Statement No. 50 required that the Entry Age Normal Cost Method be used to calculate the accrued liability for purposes of presenting the funded percentage.

APPENDIX 5

EMPLOYER CONTRIBUTION RATE

2019 Valuation

7.10% Interest

Normal Rate	9.14%
Group Life Insurance Rate	0.13
Excess Benefit Plan Rate	0.00
Expense Rate	0.26
Computed Contribution Rate as of June 30, 2019	9.53%

NORMAL RATE CALCULATION

2019 Valuation

7.10% Interest

Liabilities

Active Tier 1	
Service Pension	$178,447,542
Disability Pension	0
Vested Pension	0
Active Death over $50,000	1,519,201
Death Benefit After 10-Yr Withdrawal over $50,000	0
Annuity Savings Fund	2,117,589
COLA	1,714,746
Total	$183,799,078
Active Tier 2	
Service Pension	$197,308,103
Post Retired Death over $50,000	167,300
Disability Pension	0
Post Disabled Death over $50,000	0
Vested Pension	0
Active Death over $50,000	667,184
Death Benefit After 10-Yr Withdrawal over $50,000	0
COLA	2,675,080
Total	$200,817,667
Active Tier 3	
Service Pension	$1,355,581,471
Post Retired Death over $50,000	891,028
Disability Pension	2,582
Post Disabled Death over $50,000	39
Refund on Active Death	1,220,836
Active Death over $50,000	3,522,686
Refund on Quit	21,108
Vested Pension	22,986
Death Benefit After 10-Yr Withdrawal over $50,000	4
Refund on Death after Vested Withdrawal	7
COLA	22,931,267
Total	$1,384,194,014

NORMAL RATE CALCULATION (Cont'd)

2019 Valuation

7.10% Interest

Liabilities (Cont'd)

Active Tier 4	
Service Pension	$53,653,674,594
Post Retired Death over $50,000	34,283,092
Disability Pension	207,268,128
Post Disabled Death over $50,000	4,516,159
Refund on Active Death	38,146,799
Active Death over $50,000	258,955,889
Refund on Quit	21,653,896
Vested Pension	1,921,865,438
Death Benefit After 10-Yr Withdrawal over $50,000	2,490,011
Refund on Death after Vested Withdrawal	1,358,795
COLA	1,191,397,720
Total	$57,335,610,521
Active Tier 5	
Service Pension	$1,108,500,576
Post Retired Death over $50,000	893,285
Disability Pension	8,486,253
Post Disabled Death over $50,000	203,428
Refund on Active Death	4,245,753
Active Death over $50,000	11,321,198
Refund on Quit	27,806,638
Vested Pension	67,907,198
Death Benefit After 10-Yr Withdrawal over $50,000	188,084
Refund on Death after Vested Withdrawal	191,386
COLA	29,095,171
Total	$1,258,838,970
Active Tier 6	
Service Pension	$2,368,974,479
Post Retired Death over $50,000	2,042,848
Disability Pension	20,441,298
Post Disabled Death over $50,000	467,536
Refund on Active Death	19,043,031
Active Death over $50,000	35,649,998
Refund on Quit	123,175,468
Vested Pension	121,336,626
Death Benefit After 10-Yr Withdrawal over $50,000	430,674
Refund on Death after Vested Withdrawal	570,785
COLA	67,538,665
Total	$2,759,671,408

NORMAL RATE CALCULATION (Cont'd)

2019 Valuation

7.10% Interest

Liabilities (Cont'd)

Retirees	
Retired Pension	$64,086,199,686
Retired Annuity	94,603,687
Disability Pension	353,135,076
Disability Annuity	486,906
Beneficiary Pension	1,095,889,782
Beneficiary Annuity	7,109,752
DBA Pension	4,217,153
DBA Annuity	243,366
Escalation	3,166,644
Post Retired Death over $50,000	647,802
COLA	4,627,659,454
Catch-Up & Prior §532 Supp	247,279,100
Total	$70,520,638,408
Vesteds	
Inactive Vested	$397,686,901
Death Benefit After 10-Yr Withdrawal over $50,000	307,925
Active Vested	529,342,342
Death Benefit After 10-Yr Withdrawal over $50,000	1,125,675
COLA	70,830,571
Total	$999,293,414
TIAA	
Service Pension	$2,219,215
Disability Pension	13,725
Vested Pension	16,345
Active Death over $50,000	6,678
COLA	166,559
Total	$2,422,522
Miscellaneous	
Incurred Death but not Paid	$10,068,732
Unclaimed Non-Member Funds	19,395,706
Total	$29,464,438
Total Liabilities	$134,674,750,440

APPENDIX 5 (Cont'd)

NORMAL RATE CALCULATION (Cont'd)

2019 Valuation

7.10% Interest

Assets for Valuation

Current Total Assets (excluding contributions receivable)			$120,617,512,667
Less:	Expense Fund		$62,431,191
Less:	Group Life Insurance Fund		$335,322,079
Plus:	(Employer Contributions Receivable as of June 30, 2019[1])(1.0710)$^{-7/24}$ ($1,750,533,397)(1.0710)$^{-7/24}$	$1,715,859,822	
Plus:	Member Contributions Receivable as of June 30, 2019[1])(1.0710)$^{-7/24}$ ($109,434,590)(1.0710)$^{-7/24}$	$107,266,972	
	Adjusted Market Value of Assets for Normal Rate		$122,042,886,191
Less:	5 Year Smoothing Adjustment		$1,791,303,298
	Actuarial Value of Assets for Normal Rate Valuation Purposes		$120,251,582,893

Receivables

Employer Contributions Receivable from Normal Rate in 2020-2021 Fiscal Year [2] (2019-2020 Salaries)(2018 Normal Rate)(1.0710)$^{-1\ 7/24}$ ($16,248,929,839)(0.0847)(1.0710)$^{-1\ 7/24}$		$1,259,592,620
Present Value of Future Member Contributions [3]		
(Tier 4 Present Value of Future Employee Contributions)(1.0710)$^{-7/24}$ ($7,148,641)(1.0710)$^{-7/24}$		$7,007,045
(Tier 5 Present Value of Future Employee Contributions)(1.0710)$^{-7/24}$ ($262,175,924)(1.0710)$^{-7/24}$		$256,982,892
(Tier 6 Present Value of Future Employee Contributions)(1.0710)$^{-7/24}$ ($1,262,569,455)(1.0710)$^{-7/24}$		$1,237,561,194
	Total Receivables	$2,761,143,751

1.Employer and Member Contributions Receivables are based on the 2018-2019 Member Paybase and are collected in 3 installments on September 15, October 15, and November 15 of 2019. The discount represents the time value of money to the measurement date.

2.Employer Contributions Receivable is estimated based on projected 2019-2020 Member Salaries for the closed group population used to value the plan's liabilities and is collected in 3 installments on September 15, October 15, and November 15 of 2020. The discount represents the time value of money to the measurement date.

3.The Present Values of Future Member Contributions are estimated for the closed group population used to value the plan's liabilities. These member contributions are collected in the years 2020-2021 and beyond and have an additional discount factor applied to adjust for the timing of the actual payments on September 15, October 15, and November 15 of each prospective year.

NORMAL RATE CALCULATION (Cont'd)

2019 Valuation

7.10% Interest

Present Value of Future Salaries

	Total PVFS*			
Tier 1	$36,117,652			
Tier 2	63,206,957			
Tier 3	426,701,930			
Tier 4	99,189,873,257			
Tier 5	6,952,991,316			
Tier 6	23,501,287,172			
	$130,170,178,284	x	$(1.0710)^{-7/24}$ =	$127,591,841,051

Normal Rate

$$\frac{\text{Total Liabilities - (Assets + Receivables)}}{\text{Present Value of Future Salaries}}$$

$$\frac{\$11,662,023,796}{\$127,591,841,051} = 9.140102\%$$

9.14% (rounded)

* The Present Value of Future Salaries (PVFS) includes billable salaries starting with the 2020-2021 salary year. The billable salaries for the years 2018-2019 and 2019-2020 are excluded from the PVFS because a Normal Rate applicable to the 2018-2019 and 2019-2020 billable salary years has already been determined. The expected contributions thereon are included in the assets as receivables. Contributions are expected to be received on September 15, October 15, and November 15 of 2019 and 2020, respectively. Therefore, the total PVFS is discounted 3.5 months to the measurement date.

GROUP LIFE INSURANCE FUND

2019 Valuation

7.10% Interest

GLIF Balance as of June 30, 2018	**$330,240,954**
GLIF Adjustment [1]	($19,909,155)
Benefit Payments During 2018- 2019	$18,623,287
Contributions During 2018 - 2019	$21,175,549
GLIF Net Investment Income During 2018- 2019 (Based on 2018- 2019 Market Value of Assets Rate of Return of 7.10%)	$22,438,018
GLIF Balance as of June 30, 2019	**$335,322,079**
Estimated Benefit Payments During 2019- 2020	$20,000,000
Contributions During 2019 - 2020	$21,699,114
GLIF Estimated Net Investment Income During 2019-2020 (Based on Estimated 2019 - 2020 Market Value of Assets Rate of Return of 7.10%)	$24,190,359
Estimated GLIF Balance as of June 30, 2020	**$361,211,552**

Calculation of the GLIF Rate for the June 30, 2019 Actuarial Valuation:

Expected Salaries for the 2019- 2020 Fiscal Year	$17,092,000,000
GLIF Rate	0.13%
Expected Contribution for the 2020 - 2021 Fiscal Year	$22,219,600

Keep GLIF Rate at 0.13% as expected contribution and investment income will likely cover expected GLIF benefit payments, and once that is no longer true (as death benefits increase) GLIF balance can begin to be used.

1. An adjustment to the beginning balance made to account for post-retirement death benefits less than or equal to $50,000 of $10,790,992 made in fiscal years ending 2008, 2009, 2010 and 2011 not originally included in the benefit payments for those years. The adjustment includes an allocated share of Net Investment Income through June 30, 2018 resulting in a reduction of the GLIF balance of $19,909,155.

EXCESS BENEFIT PLAN FUND*

2019 Valuation

Excess Benefit Plan Balance as of June 30, 2018	**$4,140,966**
Final Adjustment for the Fiscal Year Ending June 30, 2018	$70,785
Benefit Payments during 2018 - 2019	$600,000
Contribution during 2018 - 2019	$0
Net Investment Income (including miscellaneous adjustments) during 2018 – 2019*	$0
Excess Benefit Plan Balance as of June 30, 2019	**$3,611,751**
Final Adjustment for the Fiscal Year Ending June 30, 2019	$186,455
Estimated Benefit Payments during 2019 - 2020	$600,000
Contribution during 2019 - 2020	$0
Expected Net Investment Income during 2019 – 2020*	$0
Expected Excess Benefit Plan Balance as of June 30, 2020	**$3,198,206**

Calculation of the Excess Benefit Plan Rate for the June 30, 2019 Actuarial Valuation:

Set the Excess Benefit Plan rate at 0.00% in order to use up the balance that has built up in the fund.

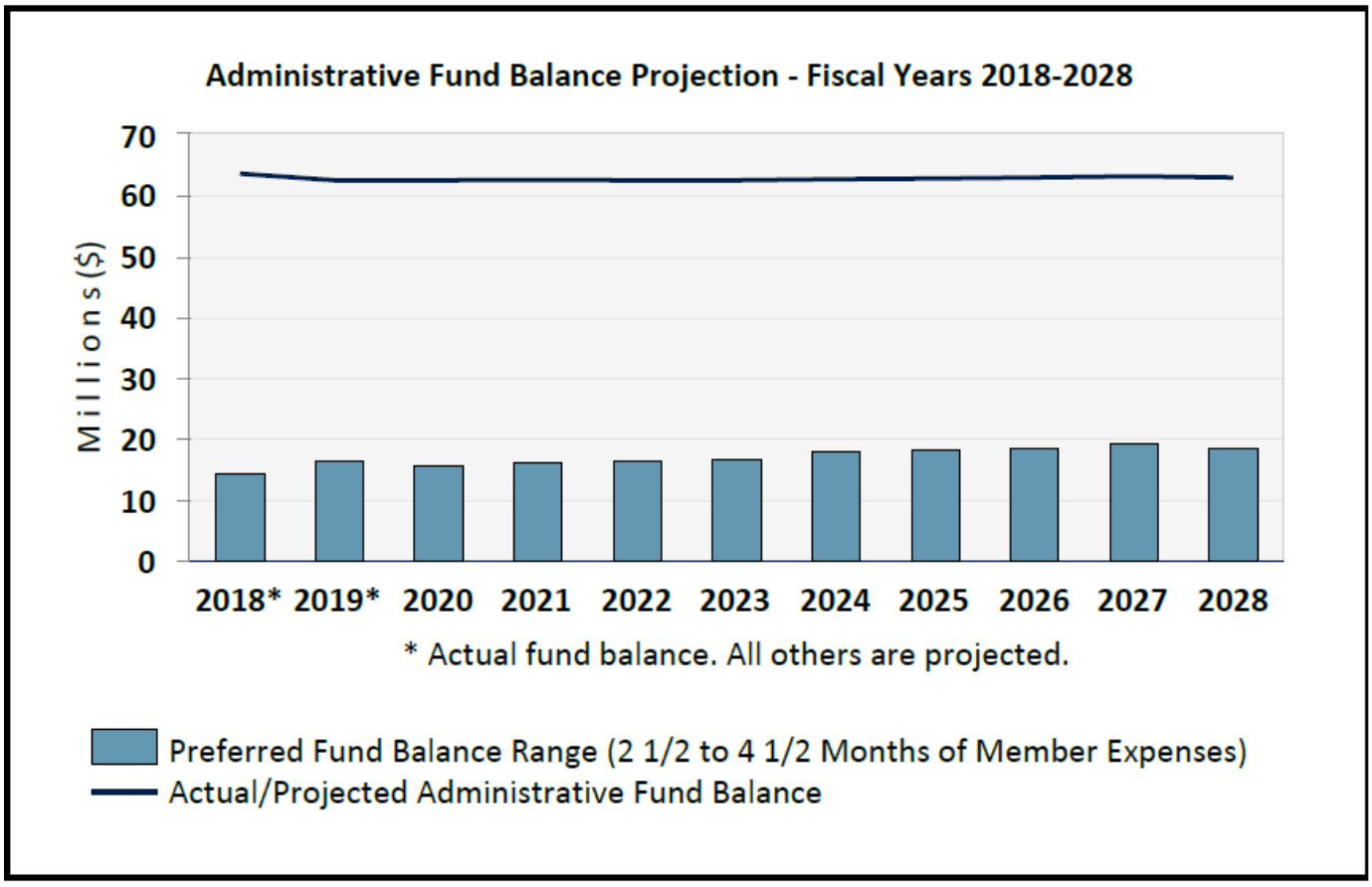
*Fund is in a zero-interest checking account

Administrative Rate and Employer Contributions[1]

The administrative portion (Rate) of the Employer Contribution Rate is adopted annually by the Retirement Board in the amount necessary to defray Retirement Administration related expenses for the following fiscal year. The first step in determining the rate is to divide the projected Retirement Administration related expenses by the projected member payroll. Consideration is also given to the overall status of the fund balance.

Based on the fall collection period for employer contributions, the preferred fund balance has been established to be 2 ½ to 4 ½ months of estimated member-related expenses. Since 2009, the fund balance has exceeded the preferred range due to prudent spending and cost containment initiatives. To bring the fund balance gradually back down within the preferred range, the administrative rate was lowered from 0.27% to 0.26% during the 2018-2019 fiscal year. The 2020-2021 fiscal year will be the second year that employer contributions will be collected at the 0.26% rate.

A forecast analysis of expenses was performed to examine the impact of maintaining the Administrative Rate at 0.26%. Based on the analysis, staff project the rate can remain at 0.26% without negatively impacting the System's ability to achieve its mission and vision.



Collections Based on Member Payroll – Fiscal Years 2015 - 2022

Annual Member Payroll *(dollars in thousands)*		Employer Contribution	Employer Contributions *(dollars in thousands)*		Percentage Increase (Decrease) in
Year	Amount	Rate (%)	Year Collected	Amount	Contributions
2021-22	$17,922,000 *	0.26% *	2022-23	$46,597 *	2.40% *
2020-21	17,502,000 *	0.26	2021-22	45,505 *	2.40 *
2019-20	17,092,000 *	0.26	2020-21	44,439 *	2.40 *
2018-19	16,691,600	0.26	2019-20	43,398 **	(1.35)
2017-18	16,288,900	0.27	2018-19	43,994	2.76
2016-17	15,846,700	0.27	2017-18	42,812	2.68
2015-16	15,431,000	0.27	2016-17	41,695	2.80
2014-15	15,021,400	0.27	2015-16	40,558	1.65

* *Estimate*

*** Reflects employer contributions based on actual member payroll. Employer contributions determined in prior year actuarial valuation can be found on page 9.*

Estimated Annual Member Payroll

The estimated annual member payroll is actuarially determined. Factors affecting the member payroll include membership additions, salary increases, retirements, and other separations.

[1] This entire section comes from the NYSTRS 2020-21 Operating Budget Report

Asset Valuation Method

Development of Smoothing Adjustment

FYE	Market Value	Contributions	Benefit Payments	Average Market Value[1]
6/30/2014	105,671,560,226	1,858,234,634	6,399,153,913	
6/30/2015	106,997,313,385	2,499,130,479	6,588,088,885	104,147,733,206
6/30/2016	105,357,811,418	2,726,314,201	6,780,291,815	105,538,306,703
6/30/2017	113,516,789,802	2,165,955,433	6,984,647,124	103,399,706,288
6/30/2018	118,230,310,625	1,994,973,683	7,169,609,705	111,345,091,308
6/30/2019	120,617,512,667	1,738,012,513	7,381,558,565	115,770,623,539

FYE	Actual Gain[2]	Expected Gain[3]	Unexpected Gain[4]	Smoothing Adjustment[5]
/30/2014	14,601,733,266			
6/30/2015	5,400,265,487	7,811,079,990	(2,410,814,503)	
6/30/2016	2,392,354,248	7,915,373,003	(5,523,018,755)	
6/30/2017	12,951,891,658	7,754,977,972	5,196,913,686	
6/30/2018	9,928,010,678	8,072,519,120	1,855,491,558	
6/30/2019	8,023,178,506	8,393,370,207	(370,191,701)	**1,791,303,298**

[1] Average Market Value = Market Value$_{(\text{previous yr.})}$ – (.5 x Benefit Payments) + ((8.5/12) x Contributions)

[2] Actual Gain = Net Appreciation for fiscal years ending prior to 6/30/2015
Actual Gain = Net Investment Income for fiscal years ending on or after 6/30/2015

[3] Expected Gain = 3.0% x Average Market Value for fiscal years ending prior to 6/30/2015
Expected Gain = 7.5% x Average Market Value for fiscal years ending on or after 6/30/2015 and on or before 6/30/2017.
Expected Gain = 7.25% x Average Market Value for fiscal years ending on or after 6/30/2018

[4] Unexpected Gain = Actual Gain – Expected Gain

[5] Smoothing Adjustment = (.20 x Unexpected Gain 6/30/2016)
+ (.40 x Unexpected Gain 6/30/2017)
+ (.60 x Unexpected Gain 6/30/2018)
+ (.80 x Unexpected Gain 6/30/2019)

HYPOTHETICAL LONG-TERM NORMAL RATE CALCULATION BASED ON NEW ENTRANT NORMAL RATE AS OF JUNE 30, 2019

The long-term expected normal rate has been determined based on the new entrant population for the year ending June 30, 2019. The new entrant population of **11,529 Tier 6 members** is defined to be members with the following characteristics:

1. date of membership between 7/1/2018 and 6/30/2019;
2. active as of 6/30/2019; and
3. no more than 1 year of NYS service as of 6/30/2019.

New Entrant Normal Rate as of June 30, 2019

The New Entrant Normal Rates determined under the benefit structures of Tiers 4, 5 and 6 using the member data for the current class of new entrants and the actuarial assumptions in the **June 30, 2019** actuarial valuation are as follows:

Valuation Rate of Interest: **7.10%**	Valued as Tier 4 Benefit Structure	Valued as Tier 5 Benefit Structure	Valued as Tier 6 Benefit Structure
(1) Present Value of Future Benefits (PVB)	$ 336,906,415	$ 318,314,576	$ 276,150,929
(2) Present Value of Future Member Contributions (PVFC)	51,095,849	106,701,693	141,068,607
(3) Present Value of Future Salaries (PVFS)	2,984,722,981	3,048,619,783	3,112,123,053
(4) Long Term Normal Cost of Benefit Structure as a Percent of Salary: (1) / (3)	11.3%	10.4%	8.9%
(5) Member's Share of the Normal Cost: (2) / (3)	1.7%	3.5%	4.5%
(6) Employer's Share of the Normal Cost: (4) - (5)	**9.6%**	**6.9%**	**4.4%**
Sensitivity Analysis[1] Valuation Rate of Interest**: 6.10%**	Valued as Tier 4 Benefit Structure	Valued as Tier 5 Benefit Structure	Valued as Tier 6 Benefit Structure
(1) Present Value of Future Benefits (PVB)	$ 423,530,836	$ 399,714,487	$ 348,249,138
(2) Present Value of Future Member Contributions (PVFC)	52,162,469	112,256,812	147,839,856
(3) Present Value of Future Salaries (PVFS)	3,136,278,014	3,207,337,474	3,282,168,966
(4) Long Term Normal Cost of Benefit Structure as a Percent of Salary: (1) / (3)	13.5%	12.5%	10.6%
(5) Member's Share of the Normal Cost: (2) / (3)	1.7%	3.5%	4.5%
(6) Employer's Share of the Normal Cost: (4) - (5)	**11.8%**	**9.0%**	**6.1%**

History

As of June 30, 2019, and the 4 prior years, the long-term expected normal rates for new entrants determined under the benefit structures for Tiers 4, 5 and 6 are as follows:

Valuation Year	Employer Normal Rate from the Valuation	New Entrant Employer Normal Rate			Sensitivity Analysis[1]			Number of New Entrants[2]
		Tier 4	Tier 5	Tier 6	Tier 4	Tier 5	Tier 6	
2015[3]	11.31%	10.1%	7.3%	4.6%	12.4%	9.3%	6.3%	8,864
2016	9.40%	10.0%	7.2%	4.5%	12.2%	9.2%	6.3%	10,578
2017[4]	10.23%	10.6%	7.6%	4.7%	13.0%	9.8%	6.7%	11,061
2018[5]	8.47%	9.4%	6.8%	4.2%	11.6%	8.8%	6.0%	11,759
2019[6]	9.14%	9.6%	6.9%	4.4%	11.8%	9.0%	6.1%	11,529

These rates represent the employers' costs only, not the total cost of the benefit structure which is in part funded by member contributions and excludes the Expense, GLIF and Excess Benefit Fund rates.

[1] New Entrant Normal Rate determined using an interest rate that is 1.0% below the actuarial assumed rate of return and the valuation salary scale arithmetically reduced by 0.50%.

[2] Number of new entrants processed through the valuation.

[3] Actuarial assumptions revised 10/29/2015, effective with the June 30, 2015 actuarial valuation.

[4] Actuarial assumed rate of return revised from 7.50% to 7.25% and the calculation of the New Entrant Normal Rate was amended to include (rather than exclude) the current year expected member contributions as a receivable asset. No other assets are assumed to exist for the determination of these rates.

[5] Definition of new entrants changed to exclude new members who have more than one year of service because they are transfers in from another retirement system and are older with higher salary. Also, the Present Value of Future Salaries was changed to no longer exclude the current year's salary for the purposes of the New Entrant Normal Rate.

[6] Actuarial assumed rate of return revised from 7.25% to 7.10%.

MEMBER RECONCILIATION

ACTIVE MEMBERS:

	Male	Female	Total
June 30, 2018	62,252	202,338	**264,590**
Changes During Year:			
Added	2,595	9,679	**12,274**
Withdrawn	1,512	4,768	**6,280**
Retired	1,397	5,493	**6,890**
Died	67	110	**177**
June 30, 2019	61,871	201,646	**263,517**

MEMBERS RETIRED FOR:

	Service *			Disability			Total		
	Male	Female	Total	Male	Female	Total	**Male**	**Female**	**Total**
June 30, 2018	49,561	108,372	157,933	458	1,658	2,116	**50,019**	**110,030**	**160,049**
Changes During Year:									
Retired	1,379	5,413	6,792	18	80	98	**1,397**	**5,493**	**6,890**
Died	1,542	2,289	3,831	35	75	110	**1,577**	**2,364**	**3,941**
Lump Sum	30	151	181	0	0	0	**30**	**151**	**181**
Restored to Active Membership	0	0	0	2	8	10	**2**	**8**	**10**
June 30, 2019	49,368	111,345	160,713	439	1,655	2,094 **	**49,807**	**113,000**	**162,807**

BENEFICIARIES OF DECEASED:

	Service Annuitants			Disability Annuitants			Active Members			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	**Male**	**Female**	**Total**
June 30, 2018	1,350	4,504	5,854	107	161	268	25	89	114	**1,482**	**4,754**	**6,236**
Changes During Year:												
Added	157	366	523	5	6	11	0	0	0	**162**	**372**	**534**
Died	84	275	359	3	5	8	2	5	7	**89**	**285**	**374**
June 30, 2019	1,423	4,595	6,018	109	162	271	23	84	107	**1,555**	**4,841**	**6,396**

SUMMARY:

	Male	Female	Total
Active Members	61,871	201,646	**263,517**
Retired Members	49,807	113,000	**162,807**
Beneficiaries	1,555	4,841	**6,396**
Total	113,233	319,487	**432,720**

*Also includes vested retirees.

**Includes 18 males and 41 females retired for disability who receive a service benefit.

APPENDIX 8

DISTRIBUTION OF ACTIVE MEMBERS

Distribution by Age as of June 30, 2019

Age*	Male	Female	Total Members
15-19	24	97	121
20-24	1,239	4,579	5,818
25-29	4,957	16,663	21,620
30-34	6,994	23,267	30,261
35-39	8,617	27,473	36,090
40-44	10,043	29,816	39,859
45-49	10,283	30,985	41,268
50-54	8,924	28,309	37,233
55-59	5,924	21,850	27,774
60-64	3,174	12,945	16,119
65-69	1,212	4,430	5,642
70-74	353	964	1,317
75-79	91	208	299
80-84	27	51	78
85 or older	9	9	18
Total	61,871	201,646	263,517

Average Male age is 44 years 0 months

Average Female age is 44 years 3 months

**Age as of last birthday*

Distribution by Age and Tier of Membership as of June 30, 2019

Age*	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5	Tier 6	Total Members
15-19	0	0	0	0	0	121	121
20-24	0	0	0	1	7	5,810	5,818
25-29	0	0	0	427	727	20,466	21,620
30-34	0	0	0	9,601	6,991	13,669	30,261
35-39	0	0	0	25,827	2,424	7,839	36,090
40-44	0	0	0	32,788	1,212	5,859	39,859
45-49	0	0	0	35,036	1,067	5,165	41,268
50-54	0	0	3	32,496	870	3,864	37,233
55-59	0	0	315	24,310	645	2,504	27,774
60-64	3	52	1,426	12,851	383	1,404	16,119
65-69	72	278	456	4,133	200	503	5,642
70-74	195	62	52	828	49	131	1,317
75-79	53	9	20	166	15	36	299
80-84	18	2	4	44	4	6	78
85 or older	8	0	0	8	1	1	18
Total	349	403	2,276	178,516	14,595	67,378	263,517
Average Age (yrs. – mos.)	72-6	67-6	62-8	47-9	38-1	35-4	44-3

**Age as of last birthday*

Distribution of Active Members by Age and New York State Service as of June 30, 2019

Male

Age*	Less Than 10 Years New York State Service	10 or More Years New York State Service	Total New York State Service
15-19	24	0	24
20-24	1,239	0	1,239
25-29	4,957	0	4,957
30-34	6,281	713	6,994
35-39	3,962	4,655	8,617
40-44	2,509	7,534	10,043
45-49	1,887	8,396	10,283
50-54	1,493	7,431	8,924
55-59	1,115	4,809	5,924
60-64	765	2,409	3,174
65-69	414	798	1,212
70-74	167	186	353
75-79	50	41	91
80-84	18	9	27
85 or older	5	4	9
Total	24,886	36,985	61,871

Female

Age*	Less Than 10 Years New York State Service	10 or More Years New York State Service	Total New York State Service
15-19	97	0	97
20-24	4,579	0	4,579
25-29	16,663	0	16,663
30-34	20,971	2,296	23,267
35-39	13,181	14,292	27,473
40-44	9,432	20,384	29,816
45-49	8,820	22,165	30,985
50-54	7,457	20,852	28,309
55-59	4,714	17,136	21,850
60-64	2,440	10,505	12,945
65-69	968	3,462	4,430
70-74	273	691	964
75-79	72	136	208
80-84	15	36	51
85 or older	3	6	9
Total	89,685	111,961	201,646

**Age as of last birthday*

Distribution of Active Members by Total Service as of June 30, 2019

Years of Service	Male	Female	Total
0-4	16,095	55,497	71,592
5-9	8,290	32,074	40,364
10-14	8,971	31,931	40,902
15-19	11,254	35,099	46,353
20-24	9,401	25,507	34,908
25-29	4,881	13,192	18,073
30-34	2,263	6,780	9,043
35 or more	716	1,566	2,282
Total	61,871	201,646	263,517

Average Male has 13 Years of Total Service

Average Female has 12 Years of Total Service

Distribution of Active Members by Total Service and Tier of Membership as of June 30, 2019

Years of Service	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5	Tier 6	Total
0-4	32	20	25	7,643	6,010	57,862	71,592
5-9	19	29	68	22,486	8,330	9,432	40,364
10-14	29	43	123	40,418	224	65	40,902
15-19	26	36	139	46,113	25	14	46,353
20-24	22	31	288	34,559	5	3	34,908
25-29	33	52	281	17,704	1	2	18,073
30-34	41	51	332	8,619	0	0	9,043
35 or more	147	141	1,020	974	0	0	2,282
Total	349	403	2,276	178,516	14,595	67,378	263,517
Average Service (yrs. – mos.)	29-7	27-3	29-8	16-6	5-1	2-1	12-4

Total and Average Earnings by Tier of Membership for Active Members as of June 30, 2019

	Total Earnings	Average Earnings*	Average Earnings* of Full-Time Members
Tier 1	$29,930,560	$100,776	$116,163
Tier 2	$33,773,806	$99,043	$110,765
Tier 3	$216,613,734	$103,248	$107,839
Tier 4	$13,736,314,365	$87,839	$91,700
Tier 5	$575,571,519	$58,127	$65,368
Tier 6	$2,026,394,203	$39,564	$53,613
Total	$16,618,598,187	$75,458	$84,078

* Average earnings calculated using only those active members with earnings during the 2018-19 school year.

APPENDIX 9

HISTORICAL MEMBER STATISTICS

Active Members and Annuitants 1925-2019

As of June 30	Active Members	Retirees & Beneficiaries
1925	29,057	1,815
1930	39,663	2,732
1935	45,031	3,919
1940	48,193	4,771
1945	52,359	5,637
1950	56,504	6,374
1955	71,273	7,897
1960	99,555	10,796
1965	129,543	16,043
1970	186,914	22,700
1975	227,038	35,252
1980	203,330	46,812
1985	178,516	57,366
1990	195,194	69,127
1995	199,398	82,459
2000	224,986	100,839
2005	260,356	125,325
2010	285,774	141,716
2015	267,715	158,458
2019	263,517	169,203

Number of Active Members by Tier

As of June 30	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5	Tier 6	Total
2000	47,234	15,700	20,159	141,893	--	--	224,986
2001	41,169	15,472	19,914	157,795	--	--	234,350
2002	35,601	15,121	19,674	172,438	--	--	242,834
2003	28,327	14,463	19,083	185,374	--	--	247,247
2004	22,986	13,947	18,835	198,747	--	--	254,515
2005	17,901	13,210	18,535	210,710	--	--	260,356
2006	13,621	12,084	18,173	220,532	--	--	264,410
2007	10,838	10,178	17,743	231,286	--	--	270,045
2008	8,630	8,171	17,007	241,093	--	--	274,901
2009	6,943	6,752	16,111	250,532	--	--	280,338
2010	5,582	5,706	14,942	255,966	3,578	--	285,774
2011	3,814	4,137	12,690	247,530	12,264	--	280,435
2012	2,756	3,253	11,180	239,199	19,969	916	277,273
2013	1,968	2,447	9,450	231,258	19,452	8,753	273,328
2014	1,439	1,810	7,753	222,545	19,124	17,368	270,039
2015	1,116	1,348	6,222	214,020	18,878	26,131	267,715
2016	832	974	4,920	204,912	18,540	36,172	266,350
2017	607	720	3,881	195,226	17,722	46,605	264,761
2018	446	546	2,993	186,581	16,499	57,525	264,590
2019	349	403	2,276	178,516	14,595	67,378	263,517

RETIREMENT STATISTICS

RETIREMENT STATISTICS 2018-2019 MEMBERS RETIRED FOR:

	Service*	**Disability**
Number Retired.....	**6,792**	**98**
Age at Retirement:		
Average.....	61 yrs., 0 mos.	51 yrs., 4 mos.
Median.....	61 yrs., 1 mo.	51 yrs., 3 mos.
Years of Service:		
Average.....	25 yrs., 1 mo.	18 yrs., 6 mos.
Median.....	27 yrs., 3 mos.	18 yrs., 0 mos.
**Benefit:		
Average.....	$45,713	$29,949
Median.....	$47,621	$28,643
Final Average Salary (FAS):		
Average.....	$87,085	$85,500
Median.....	$86,737	$83,915
***Benefit as % of FAS:		
Average.....	47.25%	34.34%
Median.....	53.33%	33.33%

2018-2019 MEMBERS RETIRED FOR SERVICE* WITH:

	Less Than 10 Yrs. Svc.	**10 or More Yrs. and Less Than 20 Yrs. Svc.**	**20 or More Yrs. and Less Than 30 Yrs. Svc.**	**30 or More Yrs. Svc.**
Number Retired.....	**531**	**1,075**	**2,218**	**2,968**
Age at Retirement:				
Average.....	61 yrs., 4 mos.	60 yrs., 11 mos.	62 yrs., 10 mos.	59 yrs., 8 mos.
Median.....	60 yrs., 4 mos.	61 yrs., 0 mos.	62 yrs., 9 mos.	58 yrs., 9 mos.
Years of Service:				
Average.....	7 yrs., 0 mos.	14 yrs., 5 mos.	24 yrs., 1 mo.	33 yrs., 0 mos.
Median.....	7 yrs., 0 mos.	14 yrs., 7 mos.	24 yrs., 0 mos.	32 yrs., 0 mos.
**Benefit:				
Average.....	$3,419	$12,646	$40,722	$68,986
Median.....	$2,989	$9,927	$39,424	$64,696
Final Average Salary (FAS):				
Average.....	$34,396	$56,813	$87,803	$106,941
Median.....	$29,668	$51,865	$85,406	$99,564
***Benefit as % of FAS:				
Average.....	9.81%	21.58%	45.87%	64.27%
Median.....	9.80%	21.11%	45.11%	63.00%

**Also includes vested retirees.*

***The Maximum, even though the member may have chosen an option.*

****The average and median of individual benefits as percentages of final average salary.*

RETIREMENT STATISTICS ALL RETIREES AS OF JUNE 30, 2019 RETIRED FOR:

	Service*	**Disability**
Number Retired.....	**160,772**	**2,035**
Age at Retirement:		
Average.....	58 yrs., 10 mos.	49 yrs., 7 mos.
Median.....	57 yrs., 10 mos.	50 yrs., 5 mos.
Age Attained as of June 30, 2019:		
Average.....	73 yrs., 2 mos.	65 yrs., 7 mos.
Median.....	72 yrs., 2 mos.	66 yrs., 3 mos.
Years of Service:		
Average.....	28 yrs., 0 mos.	18 yrs., 4 mos.
Median.....	30 yrs., 2 mos.	17 yrs., 5 mos.
**Benefit:		
Average.....	$42,700	$21,149
Median.....	$43,025	$19,259
Final Average Salary (FAS):		
Average.....	$73,539	$58,349
Median.....	$71,973	$55,646
***Benefit as % of FAS:		
Average.....	53.86%	35.50%
Median.....	60.17%	33.33%

ALL RETIREES AS OF JUNE 30, 2019 RETIRED FOR SERVICE* WITH:

	Less Than 10 Yrs. Svc.	**10 or More Yrs. and Less Than 20 Yrs. Svc.**	**20 or More Yrs. and Less Than 30 Yrs. Svc.**	**30 or More Yrs. Svc.**
Number Retired.....	**4,701**	**23,009**	**47,470**	**85,592**
Age at Retirement:				
Average.....	60 yrs., 5 mos.	59 yrs., 0 mos.	60 yrs., 0 mos.	58 yrs., 1 mo.
Median.....	59 yrs., 7 mos.	57 yrs., 5 mos.	60 yrs., 0 mos.	57 yrs., 1 mo.
Years of Service:				
Average.....	7 yrs., 3 mos.	14 yrs., 5 mos.	24 yrs., 7 mos.	34 yrs., 4 mos.
Median.....	7 yrs., 4 mos.	14 yrs., 4 mos.	25 yrs., 0 mos.	34 yrs., 0 mos.
**Benefit:				
Average.....	$4,165	$9,515	$33,283	$58,960
Median.....	$3,551	$7,381	$30,842	$55,417
Final Average Salary (FAS):				
Average.....	$39,986	$42,410	$69,147	$86,185
Median.....	$36,368	$35,536	$65,288	$81,595
***Benefit as % of FAS:				
Average.....	10.46%	21.83%	47.86%	68.18%
Median.....	10.04%	20.92%	48.44%	67.67%

**Also includes vested retirees.*

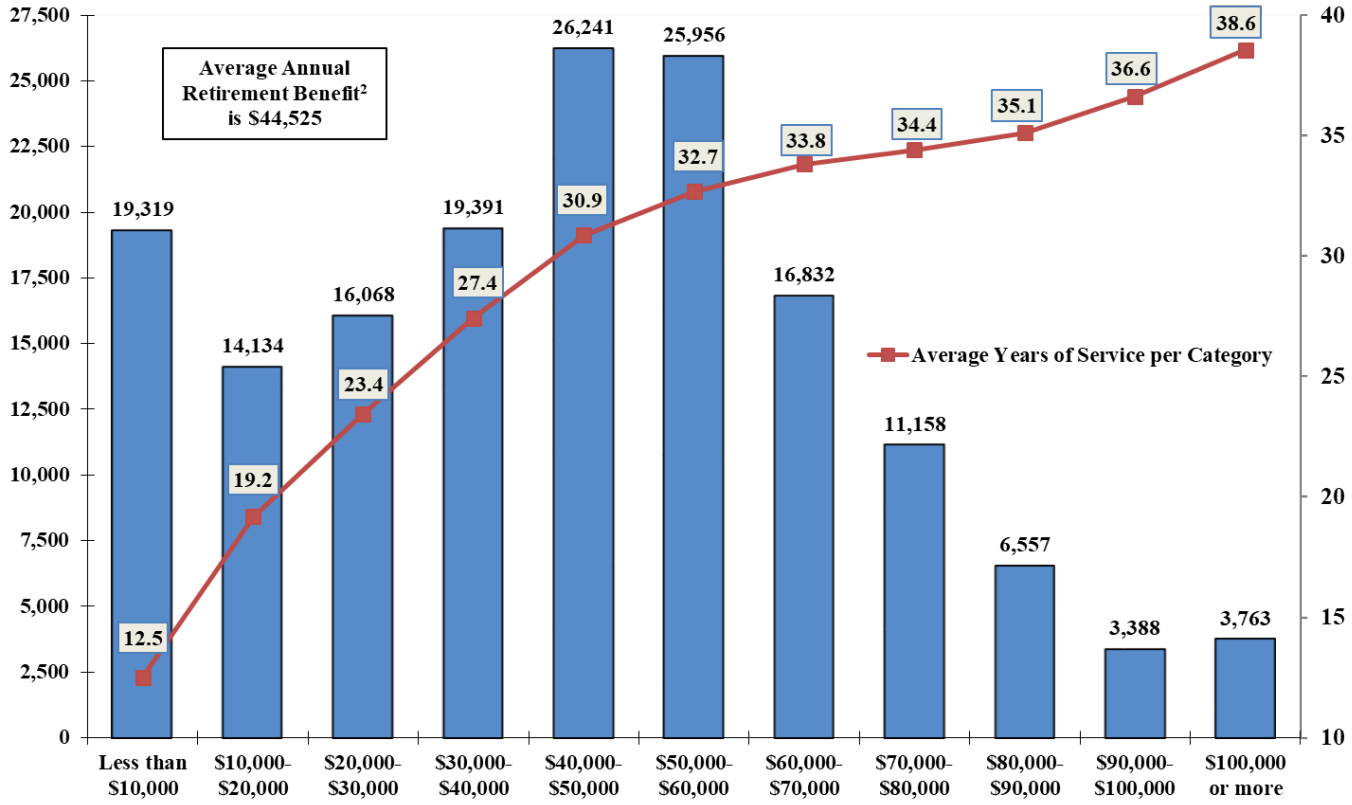
***The Maximum, even though the member may have chosen an option.*

****The average and median of individual benefits as percentages of final average salary.*

Retired Members' Characteristics[1] by Year of Retirement

Retired in Fiscal Year Ended	Number of Retired Members	Average Age at Retirement (yrs.- mos.)	Average Service at Retirement (yrs.- mos.)	Average Final Average Salary	Average Maximum Annual Benefit
2010	5,501	60-0	27-5	$79,615	$46,489
2011	8,423	60-3	28-7	85,010	51,200
2012	6,033	60-9	26-3	82,461	45,759
2013	6,330	60-10	25-6	81,987	44,768
2014	6,547	61-0	25-4	84,545	44,978
2015	6,161	60-11	25-4	84,362	44,487
2016	6,245	61-2	25-0	84,308	44,215
2017	6,396	61-3	25-0	85,242	45,049
2018	6,416	61-1	25-1	86,910	45,725
2019	6,890	61-0	25-1	87,085	45,713

Distribution of the Annual Benefit[2] of All Retired Members as of June 30, 2019



[1] Averages are for service and vested retirees.

[2] Maximum annual retirement benefit as of June 30, 2019 including supplementation and COLA.

APPENDIX 11

2015-2019 EXPERIENCE STUDY
NUMBER OF SERVICE RETIREMENTS

TIER 1 AND TIERS 2, 3, 4 AT LEAST AGE 62 OR WITH 30 YEARS OF SERVICE
AND TIER 5 AT LEAST AGE 62

EXPOSURE BASED ON ACTIVE TEACHERS
ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE				FEMALE			
AGE	EXPOSURES	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
50	12	0	0.00	N/A	24	0	0.00	N/A
51	28	0	0.00	N/A	85	0	0.00	N/A
52	310	0	0.00	N/A	824	0	0.00	N/A
53	758	0	0.00	N/A	2,070	0	0.00	N/A
54	1,187	64	0.00	N/A	3,259	138	0.00	N/A
55	1,511	552	463.42	1.191	4,090	1,472	1284.23	1.146
56	1,258	349	353.22	0.988	3,371	1,114	971.24	1.147
57	1,188	293	299.91	0.977	2,929	783	789.29	0.992
58	1,146	302	297.31	1.016	2,752	727	718.32	1.012
59	1,074	291	307.75	0.946	2,588	743	695.62	1.068
60	982	299	305.41	0.979	2,352	756	657.17	1.150
61	869	237	278.28	0.852	2,120	694	587.59	1.181
62	2,716	658	734.14	0.896	12,373	3,298	3,181.80	1.037
63	2,103	434	482.33	0.900	9,178	2,054	2,137.98	0.961
64	1,663	327	344.01	0.951	7,141	1,393	1,565.47	0.890
65	1,344	300	281.81	1.065	5,568	1,335	1,326.70	1.006
66	1,039	299	225.91	1.324	4,025	1,123	984.20	1.141
67	748	189	162.27	1.165	2,764	680	654.49	1.039
68	530	115	110.39	1.042	1,937	458	426.85	1.073
69	398	90	74.46	1.209	1,323	283	305.53	0.926
70	302	72	49.40	1.457	926	210	212.33	0.989
71	210	42	30.81	1.363	661	148	140.17	1.056
72	147	36	24.93	1.444	461	95	83.19	1.142
73	113	32	18.92	1.691	344	64	62.99	1.016
74	84	18	13.79	1.305	252	39	48.41	0.806
75	61	10	8.16	1.225	204	35	38.89	0.900
76	223	55	223.00	0.247	562	113	562.00	0.201
TOTAL	22,004	5,064	5,089.63	0.995	74,183	17,755	17,434.46	1.018

APPENDIX 11 (Cont'd)

2015-2019 EXPERIENCE STUDY NUMBER OF SERVICE RETIREMENTS

TIERS 2,3,4 LESS THAN AGE 62 AND WITH LESS THAN 30 YEARS OF SERVICE EXPOSURE BASED ON ACTIVE TEACHERS

ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE				FEMALE			
AGE	EXPOSURES	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
50	6,803	0	0.00	N/A	20,079	0	0.00	N/A
51	6,540	0	0.00	N/A	20,059	0	0.00	N/A
52	6,022	0	0.00	N/A	19,449	0	0.00	N/A
53	5,375	0	0.00	N/A	18,508	0	0.00	N/A
54	4,750	33	0.00	N/A	17,555	135	0.00	N/A
55	4,089	120	130.70	0.918	16,576	571	572.95	0.997
56	3,650	111	116.00	0.957	15,452	489	552.58	0.885
57	3,242	94	117.56	0.800	14,680	461	612.89	0.752
58	2,906	93	127.57	0.729	13,832	521	641.10	0.813
59	2,641	98	148.95	0.658	12,975	551	782.90	0.704
60	2,448	114	155.64	0.732	12,344	735	869.20	0.846
61	2,184	174	157.72	1.103	11,501	846	949.87	0.891
TOTAL	50,650	837	954.14	0.877	193,010	4,309	4,981.49	0.865

APPENDIX 11 (Cont'd)

2015-2019 EXPERIENCE STUDY
NUMBER OF SERVICE RETIREMENTS

TIER 5 LESS THAN AGE 62 AND WITH LESS THAN 30 YEARS OF SERVICE
EXPOSURE BASED ON ACTIVE TEACHERS
ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE				FEMALE			
AGE	EXPOSURES*	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES*	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
50	2	0	0.00	N/A	9	0	0.00	N/A
51	1	0	0.00	N/A	7	0	0.00	N/A
52	3	0	0.00	N/A	8	0	0.00	N/A
53	2	0	0.00	N/A	7	0	0.00	N/A
54	1	0	0.00	N/A	8	2	0.00	N/A
55	1	0	0.02	0.000	14	0	0.24	0.000
56	1	0	0.02	0.000	14	1	0.25	4.000
57	3	0	0.05	0.000	12	1	0.25	4.000
58	2	0	0.04	0.000	9	1	0.21	4.762
59	2	0	0.06	0.000	9	0	0.27	0.000
60	4	0	0.13	0.000	8	1	0.28	3.571
61	3	1	0.11	9.091	7	3	0.29	10.345
TOTAL	25	1	0.43	2.326	112	9	1.79	5.028

* Exposures have at least 10 years of service.

2015-2019 EXPERIENCE STUDY NUMBER OF SERVICE RETIREMENTS TIER 6

EXPOSURE BASED ON ACTIVE TEACHERS ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE				FEMALE			
AGE	EXPOSURES*	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	EXPOSURES*	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
50	1	0	0.00	N/A	3	0	0.00	N/A
51	0	0	0.00	N/A	5	0	0.00	N/A
52	0	0	0.00	N/A	8	0	0.00	N/A
53	0	0	0.00	N/A	9	0	0.00	N/A
54	0	0	0.00	N/A	5	0	0.00	N/A
55	0	0	0.00	N/A	6	0	0.10	0.000
56	0	0	0.00	N/A	3	0	0.05	0.000
57	0	0	0.00	N/A	4	0	0.08	0.000
58	0	0	0.00	N/A	3	0	0.07	0.000
59	0	0	0.00	N/A	2	0	0.06	0.000
60	1	0	0.03	0.000	5	0	0.18	0.000
61	0	0	0.00	N/A	4	1	0.17	5.882
62	0	0	0.00	N/A	10	2	0.47	4.255
63	0	0	0.00	N/A	4	0	1.26	0.000
64	0	0	0.00	N/A	4	1	1.15	0.870
65	1	1	0.25	4.000	2	0	0.54	0.000
66	1	1	0.26	3.846	3	1	0.78	1.282
67	1	1	0.29	3.448	0	0	0.00	N/A
68	0	0	0.00	N/A	2	0	0.56	0.000
69	0	0	0.00	N/A	0	0	0.00	N/A
70	0	0	0.00	N/A	0	0	0.00	N/A
71	0	0	0.00	N/A	0	0	0.00	N/A
72	0	0	0.00	N/A	0	0	0.00	N/A
73	1	0	0.21	0.000	0	0	0.00	N/A
74	1	0	0.22	0.000	0	0	0.00	N/A
75	1	0	0.22	0.000	0	0	0.00	N/A
76	1	0	1.00	0.000	2	1	2.00	0.500
TOTAL	9	3	2.48	1.210	84	6	7.47	0.803

* Exposures have at least 10 years of service.

2015-2019 EXPERIENCE STUDY

NUMBER OF DEATHS AMONG ACTIVE MEMBERS

EXPOSURE BASED ON ACTIVE TEACHERS

ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE			FEMALE		
CENTRAL AGE	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
20	0	0.21	0.000	0	0.39	0.000
25	3	4.04	0.743	4	5.54	0.722
30	13	7.25	1.793	10	10.33	0.968
35	8	12.55	0.637	15	15.80	0.949
40	18	20.54	0.876	26	25.73	1.010
45	24	29.41	0.816	46	47.40	0.970
50	33	31.09	1.061	55	64.47	0.853
55	38	33.49	1.135	88	80.90	1.088
60	33	38.13	0.865	75	80.81	0.928
65	13	31.39	0.414	48	44.75	1.073
70	6	14.37	0.418	14	14.12	0.992
75	7	4.22	1.659	3	3.66	0.820
TOTAL	196	226.69	0.865	384	393.90	0.975

2015-2019 EXPERIENCE STUDY
NUMBER OF DISABILITY RETIREMENTS
EXPOSURE BASED ON ACTIVE TEACHERS
ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE			FEMALE		
CENTRAL AGE	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
30	0	0.01	0.000	0	0.02	0.000
35	2	1.53	1.307	7	4.97	1.408
40	7	7.67	0.913	42	19.36	2.169
45	16	17.68	0.905	54	47.41	1.139
50	25	28.87	0.866	118	90.80	1.300
54	21	14.18	1.481	66	51.78	1.275
TOTAL	71	69.94	1.015	287	214.34	1.339

APPENDIX 11 (Cont'd)

2015-2019 EXPERIENCE STUDY

COMPARISON OF SALARY SCALE TO ACTUAL SALARY INCREASES
ASSUMPTIONS ADOPTED OCTOBER 2015

MALE

PREVIOUS YEAR'S SERVICE	PREVIOUS YEAR'S DURATION*	PREVIOUS YEAR'S SALARIES	ACTUAL SALARIES	EXPECTED SALARIES **	RATIO OF ACTUAL TO EXPECTED
0-0 to 1-4	1	345,105,123	481,426,139	379,615,635	1.268
1-5 to 2-4	2	336,288,936	365,037,187	359,829,162	1.014
2-5 to 3-4	3	323,883,078	345,005,607	343,510,393	1.004
3-5 to 4-4	4	318,608,131	335,795,731	335,239,475	1.002
4-5 to 5-4	5	329,228,818	346,203,472	344,768,418	1.004
5-5 to 6-4	6	355,184,612	370,836,596	370,990,327	1.000
6-5 to 7-4	7	416,423,280	431,883,976	434,371,123	0.994
7-5 to 8-4	8	491,686,437	510,872,832	512,435,605	0.997
8-5 to 9-4	9	563,645,108	584,313,993	587,036,380	0.995
9-5 to 10-4	10	654,157,969	677,232,298	680,782,198	0.995
10-5 to 11-4	11	739,322,971	763,494,377	768,748,025	0.993
11-5 to 12-4	12	820,458,822	846,177,762	852,210,578	0.993
12-5 to 13-4	13	888,357,480	916,440,728	921,670,886	0.994
13-5 to 14-4	14	981,373,210	1,008,758,721	1,016,800,783	0.992
14-5 to 15-4	15	1,031,295,594	1,060,586,287	1,066,978,422	0.994
15-5 to 16-4	16	1,071,982,071	1,100,246,392	1,107,464,678	0.993
16-5 to 17-4	17	1,062,562,423	1,089,569,981	1,096,245,652	0.994
17-5 to 18-4	18	1,035,109,945	1,060,491,142	1,066,577,287	0.994
18-5 to 19-4	19	966,949,567	990,845,273	995,281,189	0.996
19-5 to 20-4	20	883,949,473	901,379,357	908,876,848	0.992
20-5 to 21-4	21	784,062,658	800,844,486	805,389,162	0.994
21-5 to 22-4	22	698,286,823	711,380,960	716,651,766	0.993
22-5 to 23-4	23	602,538,745	614,268,800	617,843,229	0.994
23-5 to 24-4	24	544,603,760	554,728,717	557,946,552	0.994
24-5 to 25-4	25	497,287,582	504,879,934	509,073,298	0.992
25-5 to 26-4	26	466,208,444	473,905,904	476,884,617	0.994
26-5 to 27-4	27	427,003,672	432,731,538	436,483,154	0.991
27-5 to 28-4	28	419,781,915	426,315,394	428,807,226	0.994
28-5 to 29-4	29	401,605,847	407,438,925	410,039,570	0.994
29-5 to 30-4	30	327,944,821	321,376,450	334,700,484	0.960
30-5 to 31-4	31	249,717,922	248,834,784	254,762,224	0.977
31-5 to 32-4	32	192,197,657	190,280,576	196,041,610	0.971
32-5 to 33-4	33	143,461,813	140,316,530	146,259,318	0.959
33-5 to 34-4	34	105,256,433	103,957,349	107,287,882	0.969
34-5 to 35-4	35	84,474,293	82,396,609	86,079,305	0.957
35-5 to 36-4	36	70,259,041	67,858,975	71,565,859	0.948
36-5 to 37-4	37	55,018,007	54,044,568	56,008,331	0.965
37-5 to 38-4	38	42,064,470	39,867,564	42,804,805	0.931
38-5 or more	39	141,033,716	133,904,320	143,515,909	0.933
TOTAL		19,868,380,667	20,495,930,234	20,547,577,367	0.997

*For service less than 5 months duration is set to one.

**Totals may not add due to rounding.

APPENDIX 11 (Cont'd)

2015-2019 EXPERIENCE STUDY

COMPARISON OF SALARY SCALE TO ACTUAL SALARY INCREASES
ASSUMPTIONS ADOPTED OCTOBER 2015

FEMALE

PREVIOUS YEAR'S SERVICE	PREVIOUS YEAR'S DURATION*	PREVIOUS YEAR'S SALARIES	ACTUAL SALARIES	EXPECTED SALARIES**	RATIO OF ACTUAL TO EXPECTED
0-0 to 1-4	1	1,155,953,882	1,643,896,546	1,271,549,270	1.293
1-5 to 2-4	2	1,130,657,654	1,236,351,509	1,209,803,690	1.022
2-5 to 3-4	3	1,069,191,993	1,144,047,017	1,133,985,028	1.009
3-5 to 4-4	4	1,027,752,070	1,088,208,397	1,081,400,728	1.006
4-5 to 5-4	5	1,025,077,842	1,080,912,580	1,073,461,516	1.007
5-5 to 6-4	6	1,117,635,507	1,169,605,243	1,167,370,287	1.002
6-5 to 7-4	7	1,280,613,190	1,334,363,768	1,335,807,618	0.999
7-5 to 8-4	8	1,492,337,854	1,553,016,346	1,555,314,511	0.999
8-5 to 9-4	9	1,712,699,083	1,777,454,986	1,783,776,095	0.996
9-5 to 10-4	10	1,945,699,983	2,017,736,718	2,024,889,972	0.996
10-5 to 11-4	11	2,150,474,148	2,227,783,797	2,236,063,019	0.996
11-5 to 12-4	12	2,340,761,861	2,420,547,890	2,431,349,345	0.996
12-5 to 13-4	13	2,519,987,017	2,602,219,297	2,614,486,530	0.995
13-5 to 14-4	14	2,728,172,244	2,813,511,268	2,826,659,262	0.995
14-5 to 15-4	15	2,854,167,618	2,937,522,227	2,952,921,818	0.995
15-5 to 16-4	16	2,894,520,543	2,974,547,873	2,990,329,173	0.995
16-5 t5 17-4	17	2,823,699,590	2,897,318,461	2,913,210,867	0.995
17-5 to 18-4	18	2,675,337,441	2,743,415,912	2,756,667,699	0.995
18-5 to 19-4	19	2,436,176,528	2,498,047,193	2,507,556,500	0.996
19-5 to 20-4	20	2,186,778,812	2,229,157,353	2,248,445,975	0.991
20-5 to 21-4	21	1,927,862,450	1,963,276,331	1,980,300,309	0.991
21-5 to 22-4	22	1,715,461,995	1,746,514,287	1,760,578,645	0.992
22-5 to 23-4	23	1,529,649,142	1,555,287,769	1,568,502,230	0.992
23-5 to 24-4	24	1,418,997,967	1,442,661,348	1,453,763,417	0.992
24-5 to 25-4	25	1,314,624,405	1,335,257,027	1,345,781,003	0.992
25-5 to 26-4	26	1,246,847,966	1,262,997,534	1,275,400,784	0.990
26-5 to 27-4	27	1,199,281,496	1,215,246,259	1,225,905,545	0.991
27-5 to 28-4	28	1,173,770,770	1,189,953,898	1,199,006,842	0.992
28-5 to 29-4	29	1,116,671,449	1,130,161,396	1,140,121,549	0.991
29-5 to 30-4	30	884,620,168	864,478,687	902,843,343	0.958
30-5 to 31-4	31	642,036,980	639,896,304	655,006,127	0.977
31-5 to 32-4	32	485,774,907	478,193,896	495,490,405	0.965
32-5 to 33-4	33	332,961,160	326,885,836	339,453,903	0.963
33-5 to 34-4	34	236,404,931	232,720,596	240,967,546	0.966
34-5 to 35-4	35	168,819,506	167,770,802	172,027,077	0.975
35-5 to 36-4	36	128,613,933	125,799,932	131,006,152	0.960
36-5 to 37-4	37	98,603,861	96,680,000	100,378,731	0.963
37-5 to 38-4	38	68,220,067	67,088,163	69,420,740	0.966
38-5 or more	39	191,134,724	185,919,864	194,498,695	0.956
TOTAL		54,448,052,737	56,416,454,310	56,365,501,948	1.001

*For service less than 5 months duration is set to one.

**Totals may not add due to rounding.

2015-2019 EXPERIENCE STUDY
NUMBER OF WITHDRAWALS
EXPOSURE BASED ON ACTIVE TEACHERS
ASSUMPTIONS ADOPTED OCTOBER 2015

	MALE			FEMALE		
CENTRAL AGE	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
20	178	239.28	0.744	589	760.56	0.774
25	2,141	2,336.65	0.916	6,616	7,542.55	0.877
30	1,974	1,960.42	1.007	5,836	7,012.75	0.832
35	1,293	1,296.73	0.997	4,861	5,268.24	0.923
40	964	950.66	1.014	3,438	3,665.80	0.938
45	848	864.39	0.981	3,190	3,377.20	0.945
50	702	727.72	0.965	3,039	2,920.19	1.041
54	249	270.75	0.920	1,064	1,017.73	1.045
TOTAL	8,349	8,646.60	0.966	28,633	31,565.02	0.907

2015-2019 EXPERIENCE STUDY

NUMBER OF DEATHS AMONG MEMBERS RETIRED FOR DISABILITY
MORTALITY[1] ADOPTED OCTOBER 2015

	MALE			FEMALE		
CENTRAL AGE	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
30	0	0.00	N/A	0	0.00	N/A
35	1	0.28	3.571	3	1.73	1.734
40	2	2.47	0.810	9	11.73	0.767
45	7	8.71	0.804	14	21.14	0.662
50	10	8.54	1.171	29	33.06	0.877
55	15	15.09	0.994	57	50.53	1.128
60	14	8.98	1.559	52	44.81	1.160
65	15	14.85	1.010	49	48.21	1.016
70	13	19.48	0.667	53	47.07	1.126
75	17	17.65	0.963	31	32.44	0.956
80	15	12.41	1.209	28	24.14	1.160
85	14	13.74	1.019	20	22.72	0.880
90	12	6.77	1.773	19	20.91	0.909
95	0	0.00	N/A	5	8.97	0.557
100	0	0.00	N/A	2	2.24	0.893
105	0	0.00	N/A	0	0.00	N/A
110	0	0.00	N/A	0	0.00	N/A
TOTAL	135	128.97	1.047	371	369.70	1.004

[1]Base mortality was improved using MP-2014 through July1, 2017 – the middle of the study period.

2015-2019 EXPERIENCE STUDY
NUMBER OF DEATHS AMONG BENEFICIARIES AND MEMBERS RETIRED FOR SERVICE
MORTALITY[1] ADOPTED OCTOBER 2015

	MALE			FEMALE		
CENTRAL AGE	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED	ACTUAL	EXPECTED	RATIO OF ACTUAL TO EXPECTED
5	0	0.00	N/A	0	0.00	N/A
10	0	0.00	N/A	0	0.00	N/A
15	0	0.00	N/A	0	0.00	N/A
20	0	0.00	N/A	0	0.00	N/A
25	0	0.00	N/A	0	0.00	N/A
30	0	0.00	N/A	0	0.00	N/A
35	0	0.00	N/A	0	0.00	N/A
40	0	0.01	0.000	0	0.00	N/A
45	0	0.05	0.000	2	0.05	40.000
50	0	0.08	0.000	0	0.15	0.000
55	13	12.92	1.006	47	29.93	1.570
60	74	70.11	1.055	179	161.11	1.111
65	316	300.88	1.050	534	580.55	0.920
70	761	778.49	0.978	905	1,018.58	0.888
75	966	991.42	0.974	1,160	1,178.30	0.984
80	1,326	1,293.48	1.025	1,502	1,447.32	1.038
85	1,950	1,814.19	1.075	2,286	2,167.07	1.055
90	1,614	1,582.28	1.020	2,647	2,548.92	1.038
95	733	649.90	1.128	1,946	1,843.47	1.056
100	125	115.46	1.083	684	616.95	1.109
105	9	9.75	0.923	105	91.90	1.143
110	1	0.47	2.128	6	6.81	0.881
TOTAL	7,888	7,619.49	1.035	12,003	11,691.11	1.027

[1]Base mortality was improved using MP-2014 through July1, 2017 – the middle of the study period.

APPENDIX 12

RATES OF RETURN

Investment Rate of Return
on
Market and Actuarial Value of Assets

as of June 30, 2019

Annualized rates of return over the last:

	Based Upon Market Value of Assets	Based Upon Actuarial Value of Assets[1]
1 Year:	7.1%	7.3%
3 Years:	9.5%	8.7%
5 Years:	7.2%	10.2%
10 Years:	10.4%	7.9%
15 Years:	7.5%	8.6%
20 Years:	6.3%	
25 Years:	8.7%	
30 Years:	8.8%	

Annualized inflation over the last:

	Inflation Assumption		COLA Benefit	
	Actual	Expected	Actual	Expected[2]
1 Year:	1.86%	2.2%	1.0 %	1.3%
3 Years:	2.20%	2.2%	1.1%	1.3%
5 Years:	1.48%	2.2%	1.1%	1.3%

[1] The Retirement System's asset valuation method was changed effective with the June 30, 2007 and June 30, 2015 actuarial valuations.

[2] The annual percentage for estimating future COLA benefit payments is 1.3% effective with the June 30, 2019 actuarial valuation. It was 1.5% previously. The COLA percentage is one-half of the increase in the CPI with a floor of 1.0% and a cap of 3.0%. Therefore, the estimate of inflation for the COLA benefit is the result of analyzing available CPI data with percentages bounded between 2.0% and 6.0%, and reduced by 50%. The COLA benefit was first initiated in 2001.

RATES OF RETURN

Annual Rates of Return through June 30, 2019

Year Ending June 30th	Annual Rate of Return	Year Ending June 30th	Annual Rate of Return
1983	37.1%	2006	11.8%
1984	-4.8%	2007	19.4%
1985	31.3%	2008	-6.3%
1986	28.4%	2009	-20.5%
1987	14.6%	2010	12.1%
1988	-1.5%	2011	23.2%
1989	16.8%	2012	2.8%
1990	11.4%	2013	13.7%
1991	8.3%	2014	18.2%
1992	13.0%	2015	5.2%
1993	13.6%	2016	2.3%
1994	1.8%	2017	12.5%
1995	19.3%	2018	9.0%
1996	18.8%	2019	7.1%
1997	22.0%		
1998	21.5%		
1999	14.0%		
2000	6.8%		
2001	-5.7%		
2002	-6.8%		
2003	4.0%		
2004	16.1%		
2005	10.6%		

APPENDIX 13

ASSET ALLOCATION

The table below displays the Retirement System's asset allocation targets, actual allocation percentages, and ranges as of June 30, 2019. No changes have been made between June 30, 2019 and the time of this report.

	Target	Actual	Range
Domestic Equity	33%	35.2%	29-37%
International Equity	16%	17.2%	12-20%
Global Equity	4%	2.1%	0-8%
Real Estate Equity	11%	10.7%	6-16%
Private Equity	8%	7.8%	3-13%
Total Equities	72%	73.0%	
Domestic Fixed Income	16%	15.6%	12-20%
High Yield Bonds	1%	0.2%	0-3%
Global Bonds	2%	2.4%	0-3%
Real Estate Debt	7%	5.9%	3-11%
Private Debt	1%	0.5%	0-5%
Cash Equivalents	1%	2.4%	0-4%
Total Debt	28%	27.0%	

Changes to the Asset Allocation between June 30, 2018 and June 30, 2019

None.

APPENDIX 14

ASSESSMENT OF RISK

ACTUARIAL STANDARDS OF PRACTICE NO. 51

NYSTRS is exposed to various risks that can impact the plan's future financial condition, including the plan's funded status and calculated employer contribution rates. The four most significant risks that NYSTRS is exposed to are:

1. Investment risk – the potential that investment returns on System assets will be lower than expected. The System counts on a significant portion of its funding being achieved through returns on investments, as has historically been the case. If future returns are less than expected, employers will be required to contribute greater amounts. The System currently has 72% of its targeted asset allocation in equity investments, and 28% in fixed income instruments.

2. Longevity and other demographic risks – the potential that mortality or other demographic experience will be different than expected. Increases in longevity, for example, imply that retirees are living longer than expected. Retirees living longer than expected translates into more years of benefit payments, and increasing costs to the plan. The System's actuarial valuation uses base annuitant mortality rates which are developed from retired member experience. Generationally-applied mortality improvement is then applied to these base rates to account for anticipated mortality improvement for retired members. Another demographic risk concerns the ages at which members retire. Generally the earlier members retire, the more expensive it is for the plan, as more years of benefit payments will be required. Typically these types of changes emerge slowly over time.

3. Assumption Modification risk – the potential that plan experience begins to deviate significantly from the actuarial assumptions, and the assumptions are modified to better reflect recent experience and better predict expected future experience. The most impactful of the actuarial assumptions is the assumed investment rate of return. Even a small change in the plan's assumed rate of return will have a large impact on the employer contribution rate.

4. Contribution risk – the potential that employers will fail to make the actuarially determined contribution. In accordance with statute and case law, employers are required to contribute at the actuarially determined employer contribution rate as adopted by the Retirement Board, and have historically done so. If this rate were to climb precipitously high and fast, however, this would put a significan amount of stress on school district budgets. ASOP51 does not require an actuary to evaluate the ability of the plan sponsor to make the contribution to the plan when due and in the amount due.

A. Plan Maturity Measurements

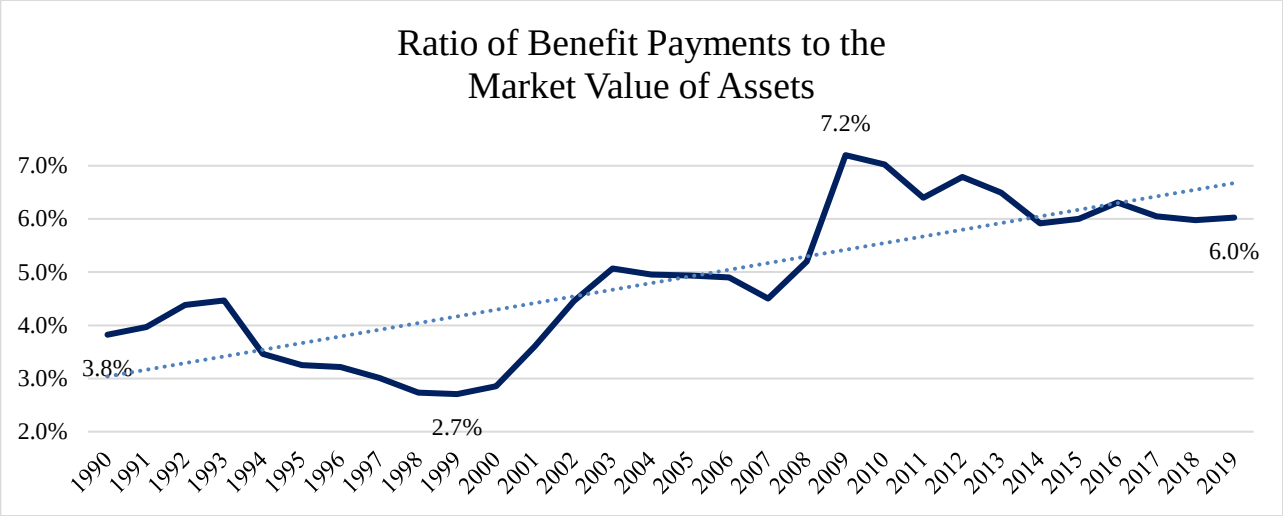
1. Cash Flow Ratios

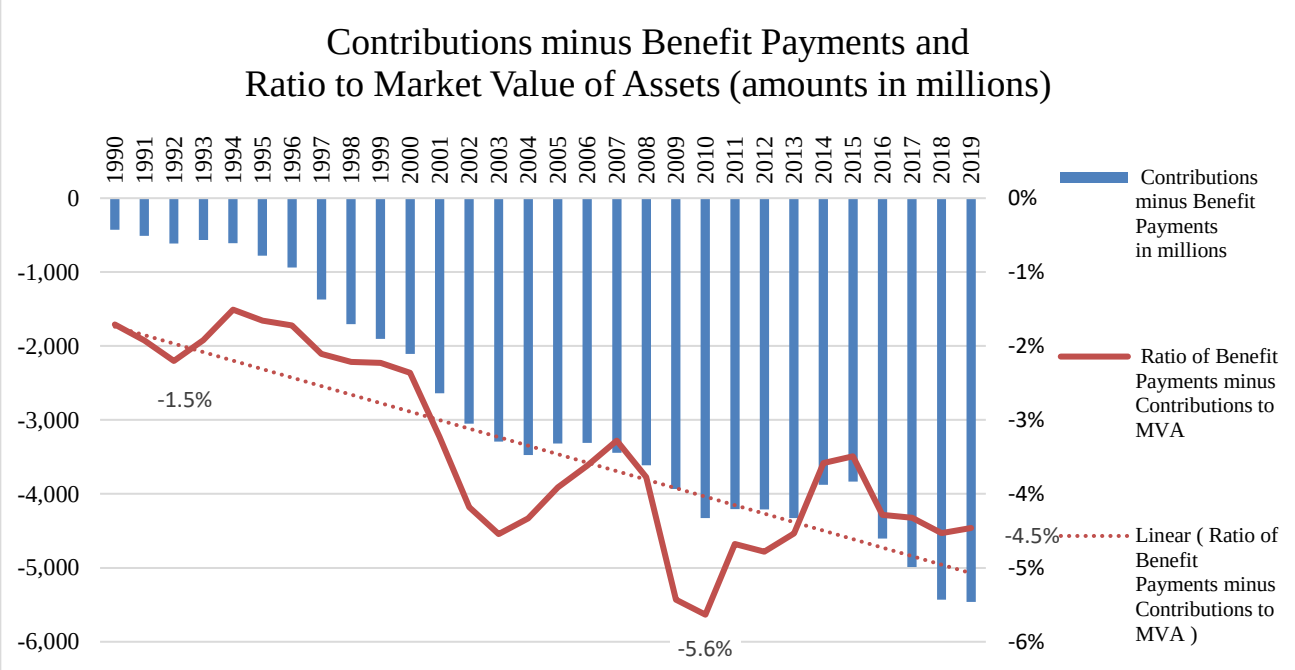
A plan that is mature such as NYSTRS can be expected to have a negative cash flow (cash flow here being defined as contributions in minus benefit payments out), and it does not mean the plan is in trouble or has been poorly managed. A plan such as NYSTRS is advance funded, and accumulates assets in order to pay future benefits. In this manner, it would be expected for the plan to grow into a negative cash flow. Additionally, if a plan is well funded, like NYSTRS, its required contribution rate will be low even as its benefit payroll is high, creating more negative cash flow.

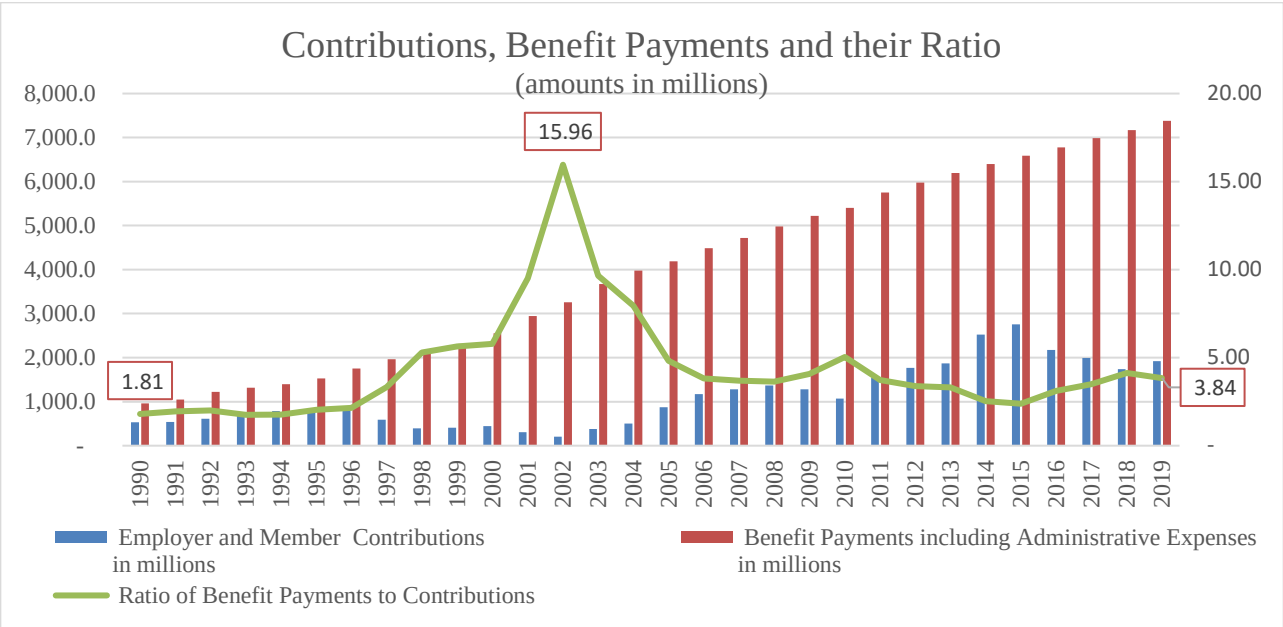
When investments lose money, however, and net cash flow is negative, it's more difficult for plans to recover from a poor investment return, as the invested asset base is lower. Therefore plans will need an even higher return to recover.

	(1)	(2)	(3)	(4) = (2) - (3)	(5)= (3) / (1)	(6) = (4) / (1)	(7) = (3) / (2)
Fiscal Year Ending June 30th	Market Value of Assets [1] (MVA) in millions	Employer and Member Contributions in millions	Benefit Payments including Administrative Expenses in millions	Contributions minus Benefit Payments in millions	Ratio of Benefit Payments to MVA	Ratio of Contributions less Benefit Payments to MVA	Ratio of Benefit Payments to Contributions
1990	$25,045.0	$ 530.1	$ 958.2	$ (428.1)	3.8%	-1.7%	1.81
1991	26,474.2	540.6	1,050.3	(509.7)	4.0%	-1.9%	1.94
1992	27,890.5	609.2	1,223.2	(614.0)	4.4%	-2.2%	2.01
1993	29,497.4	751.9	1,318.2	(566.3)	4.5%	-1.9%	1.75
1994	40,291.5	787.3	1,394.8	(607.5)	3.5%	-1.5%	1.77
1995	46,999.1	750.2	1,529.5	(779.3)	3.3%	-1.7%	2.04
1996	54,567.5	817.0	1,755.4	(938.4)	3.2%	-1.7%	2.15
1997	65,152.4	589.5	1,960.5	(1,371.0)	3.0%	-2.1%	3.33
1998	76,980.5	396.9	2,102.9	(1,706.0)	2.7%	-2.2%	5.30
1999	85,514.4	411.2	2,314.4	(1,903.2)	2.7%	-2.2%	5.63
2000	89,247.3	441.5	2,549.3	(2,107.8)	2.9%	-2.4%	5.77
2001	81,664.2	309.8	2,946.7	(2,636.9)	3.6%	-3.2%	9.51
2002	73,041.2	204.1	3,256.1	(3,052.0)	4.5%	-4.2%	15.96
2003	72,391.5	379.8	3,670.1	(3,290.3)	5.1%	-4.5%	9.66
2004	80,276.2	501.0	3,976.3	(3,475.3)	5.0%	-4.3%	7.94
2005	84,908.5	871.2	4,190.9	(3,319.7)	4.9%	-3.9%	4.81
2006	91,492.2	1,174.6	4,484.7	(3,310.1)	4.9%	-3.6%	3.82
2007	104,912.9	1,279.7	4,722.4	(3,442.7)	4.5%	-3.3%	3.69
2008	95,769.3	1,368.4	4,980.3	(3,611.9)	5.2%	-3.8%	3.64
2009	72,471.8	1,283.5	5,217.9	(3,934.4)	7.2%	-5.4%	4.07
2010	76,844.9	1,070.9	5,399.9	(4,329.0)	7.0%	-5.6%	5.04
2011	89,889.7	1,545.9	5,751.5	(4,205.6)	6.4%	-4.7%	3.72
2012	88,056.3	1,771.3	5,980.0	(4,208.7)	6.8%	-4.8%	3.38
2013	95,367.0	1,868.3	6,194.1	(4,325.8)	6.5%	-4.5%	3.32
2014	108,155.1	2,522.5	6,399.2	(3,876.7)	5.9%	-3.6%	2.54
2015	109,718.9	2,756.3	6,588.1	(3,831.8)	6.0%	-3.5%	2.39
2016	107,506.1	2,175.2	6,780.3	(4,605.1)	6.3%	-4.3%	3.12
2017	115,468.4	1,995.0	6,984.6	(4,989.6)	6.0%	-4.3%	3.50
2018	119,915.5	1,738.0	7,169.6	(5,431.6)	6.0%	-4.5%	4.13
2019	122,477.5	1,920.3	7,381.6	(5,461.3)	6.0%	-4.5%	3.84

[1] Assets prior to 1994 are valued at book value.


Ratio of Benefit Payments to the Market Value of Assets
7.2%
6.0%
3.8%
2.7%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019


Contributions minus Benefit Payments and Ratio to Market Value of Assets (amounts in millions)
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
0%
-1%
-2%
-3%
-4%
-5%
-6%
-1.5%
-4.5%
-5.6%
Contributions minus Benefit Payments in millions
Ratio of Benefit Payments minus Contributions to MVA
Linear (Ratio of Benefit Payments minus Contributions to MVA)


Contributions, Benefit Payments and their Ratio
(amounts in millions)
15.96
1.81
3.84
8,000.0
7,000.0
6,000.0
5,000.0
4,000.0
3,000.0
2,000.0
1,000.0
-
20.00
15.00
10.00
5.00
-
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Employer and Member Contributions in millions
Benefit Payments including Administrative Expenses in millions
Ratio of Benefit Payments to Contributions

2. Ratio of Retiree Accrued Liability to Total

This chart shows the ratio of the accrued liability of retired members and beneficiaries to the total accrued liability. As a plan matures it is not unusual for this ratio to grow, and is also not unusual for this ratio to be above 50%.

Fiscal Year Ended June 30th	Accrued Liability (AL) for Retired Members and Beneficiaries	Total Accrued Liability(AL) for All Members	Ratio of Retired AL to Total AL
2006	$42,983.4	$ 76,353.0	56.3%
2007	45,320.0	79,537.2	57.0%
2008	47,515.4	82,777.5	57.4%
2009	49,091.3	86,062.0	57.0%
2010	50,546.3	88,318.8	57.2%
2011	54,635.2	89,824.9	60.8%
2012	56,197.6	92,250.9	60.9%
2013	57,681.9	94,583.8	61.0%
2014	59,190.2	96,904.5	61.1%
2015	64,504.9	105,401.8	61.2%
2016	65,858.4	109,305.1	60.3%
2017	68,736.2	115,672.5	59.4%
2018	70,128.9	118,861.1	59.0%
2019	70,971.4	121,049.3	58.6%

3. Asset Volatility Ratio

Asset Volatility can be measured by the ratio of the market value of assets (MVA) to the active member paybase, i.e. total of active member salaries. Liability Volatility can be measured by the ratio of the Actuarial Accrued Liability using the Entry Age Normal Actuarial Funding Method to the active member paybase.

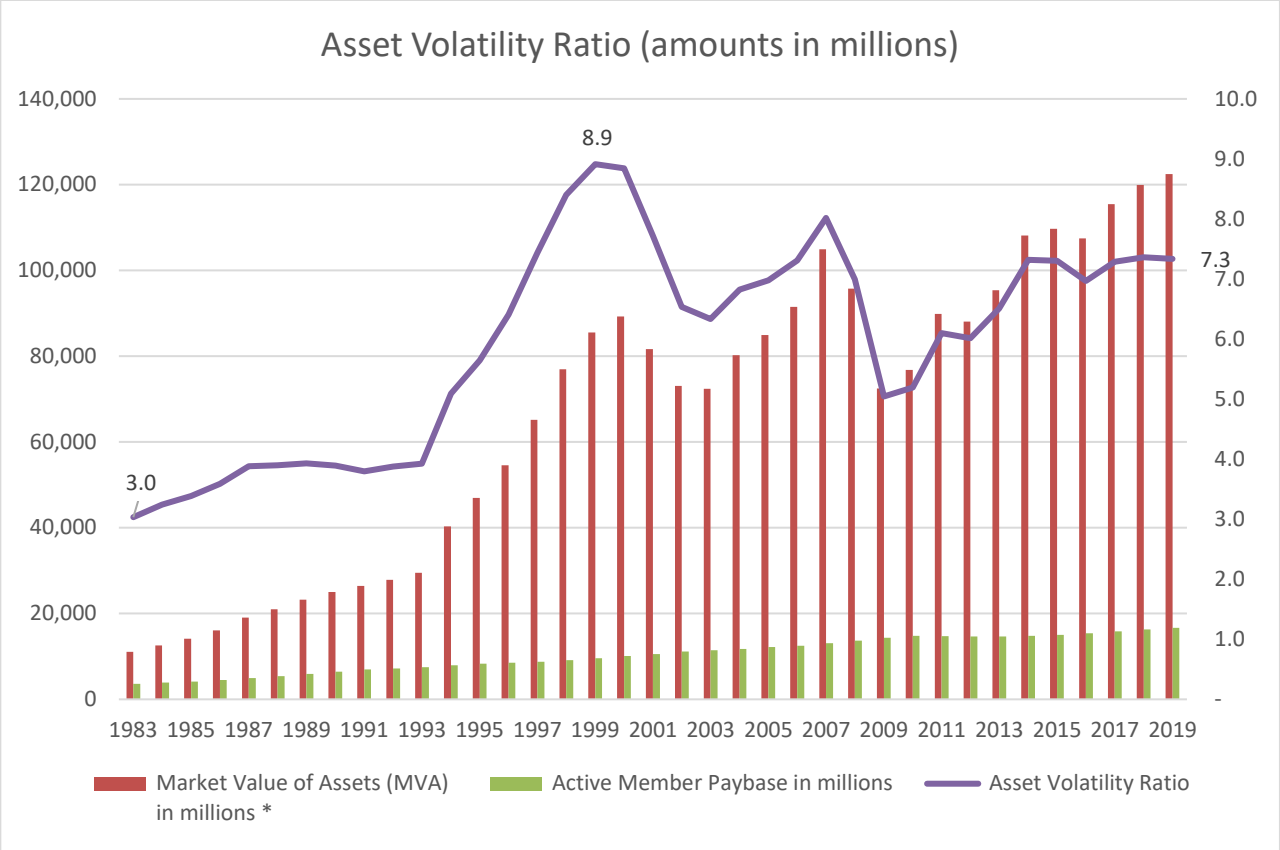
The higher the asset volatility ratio, the more susceptible the plan is to large swings in the employer contribution rate (ECR) due to large annual asset gains or losses. An asset volatility ratio of 7.3 implies that a if the assets return 10% less than expected, there is an increase to the amount remaining to be funded of 73% of member paybase. This does NOT imply, however, that the employer contribution rate would increase by 73%. Asset gains and losses are smoothed in the valuation, and liabilities remaining to be funded are spread over the present value of future members' salaries, which have a mitigating effect.

It's worth noting that recent years of relatively good performance and experience have driven the ECR down to a relatively low point, leaving it susceptible to large increases following poor performance.

It's also important to note that a higher asset volatility ratio is also indicative of a plan having a high level of assets, which is clearly a good thing and preferable to having a low level of assets.

Fiscal Year Ending June 30th	Market Value of Assets (MVA) in millions [1]	Active Member Paybase in millions	Asset Volatility Ratio	Fiscal Year Ending June 30th	Market Value of Assets (MVA) in millions	Active Member Paybase in millions	Asset Volatility Ratio
1983	11,053.0	3,643.6	3.0	2002	73,041.2	11,171.5	6.5
1984	12,589.4	3,882.9	3.2	2003	72,391.5	11,427.1	6.3
1985	14,123.0	4,168.5	3.4	2004	80,276.2	11,766.7	6.8
1986	16,096.6	4,486.6	3.6	2005	84,908.5	12,163.7	7.0
1987	19,089.1	4,919.7	3.9	2006	91,492.2	12,518.0	7.3
1988	21,018.1	5,394.9	3.9	2007	104,912.9	13,083.0	8.0
1989	23,214.4	5,907.4	3.9	2008	95,769.3	13,690.1	7.0
1990	25,045.0	6,433.8	3.9	2009	72,471.8	14,366.4	5.0
1991	26,474.2	6,976.4	3.8	2010	76,844.9	14,792.1	5.2
1992	27,890.5	7,193.7	3.9	2011	89,889.7	14,732.9	6.1
1993	29,497.4	7,517.9	3.9	2012	88,056.3	14,640.8	6.0
1994	40,291.5	7,909.5	5.1	2013	95,367.0	14,647.8	6.5
1995	46,999.1	8,326.1	5.6	2014	108,155.1	14,771.3	7.3
1996	54,567.5	8,516.0	6.4	2015	109,718.9	15,021.4	7.3
1997	65,152.4	8,757.9	7.4	2016	107,506.1	15,431.0	7.0
1998	76,980.5	9,163.8	8.4	2017	115,468.4	15,846.7	7.3
1999	85,514.4	9,594.2	8.9	2018	119,915.5	16,288.9	7.4
2000	89,247.3	10,093.3	8.8	2019	122,477.5	16,691.6	7.3
2001	81,664.2	10,581.2	7.7				

[1] Assets prior to 1994 are valued at book value.



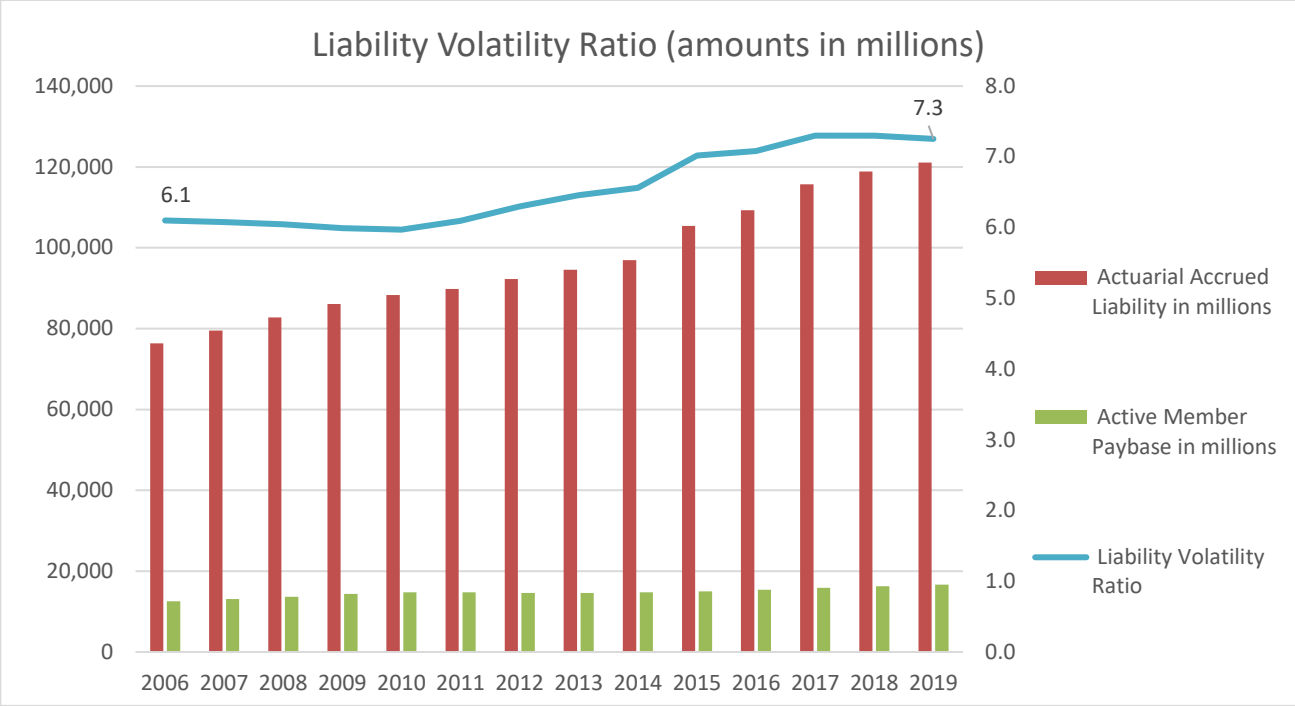
* Assets prior to 1994 are valued at book value.

4. Liability Volatility Ratio

Liability Volatility can be measured by the ratio of the Actuarial Accrued Liability using the Entry Age Normal Actuarial Funding Method to the active member paybase.

Changes in actuarial assumptions, such as reducing the assumed rate of return, and improving mortality assumptions, will have a larger impact on plans with higher liability volatility ratios. However as plans naturally mature it is expected that their liability volatility ratios will grow as well.

Fiscal Year Ending June 30th	Actuarial Accrued Liability in millions	Active Member Paybase in millions	Liability Volatility Ratio
2006	76,353.0	12,518.0	6.1
2007	79,537.2	13,083.0	6.1
2008	82,777.5	13,690.1	6.0
2009	86,062.0	14,366.4	6.0
2010	88,318.8	14,792.1	6.0
2011	89,824.9	14,732.9	6.1
2012	92,250.9	14,640.8	6.3
2013	94,583.8	14,647.8	6.5
2014	96,904.5	14,771.3	6.6
2015	105,401.8	15,021.4	7.0
2016	109,305.1	15,431.0	7.1
2017	115,672.5	15,846.7	7.3
2018	118,861.1	16,288.9	7.3
2019	121,049.3	16,691.6	7.3



B. Risk Assessment Methods:

1. Sensitivity Analysis

Valuation results are highly dependent on the actuarial assumptions used to project future events. If actual experience emerges differently from the assumptions used in the valuation process, actuarial gains or losses will result, and future Employer Contribution Rates will be higher or lower. In this section, results of a sensitivity analysis are presented in order to illustrate how deviations in specific assumptions would have changed the current Employer Contribution Rate of 9.53%.

It is important to note that the results displayed here, except for those for the investment return, are the consequence of altering each assumption individually without accounting for possible correlation between assumptions. Therefore, these results are presented in order to provide an illustration as to the order of magnitude that a variation in key assumptions could have on valuation results. There is no guarantee that future experience will be consistent with either our current or the following alternative set of assumptions.

Assumption	Adjustment Made	Calculated Employer Contribution Rate
Current Assumptions		**9.53%**
Valuation Rate of Interest[1]	Decrease from 7.10% to 6.85%	12.40%
Valuation Rate of Interest[1]	Decrease from 7.10% to 6.60%	15.35%
Valuation Rate of Interest[1]	Decrease from 7.10% to 6.10%	23.17%
Salary Scale	Decrease of 10%	8.62%
Salary Scale	Increase of 10%	10.43%

Service Retirement Rates	Decrease of 10%	8.68%
Service Retirement Rates	Increase of 10%	10.26%
Healthy Annuitant Mortality[2]	Decrease of 10%	11.35%
Healthy Annuitant Mortality[2]	Increase of 10%	7.85%
Active Mortality	Decrease of 10%	9.55%
Active Mortality	Increase of 10%	9.51%

[1] In the event that a change to the long-term investment return assumption would be warranted, it is likely that a related change to the salary scale assumption would also be necessary in order for these assumptions to remain consistent with overall inflation. Therefore, for the results presented here, the salary scale assumption was decreased by one-half of the reduction in the investment return assumption.

[2] Healthy Annuitant Mortality was sensitivity tested for both inactive members and for active members post-decrement.

2. Scenario Tests – Deterministic Projections

The table below was developed with deterministic projections to estimate the next few years' **approximate employer contribution rates (ECR's)** based upon various investment rates of return for the 2019-2020 fiscal year. Rates of return for the following two fiscal years are assumed to be at the System's assumed rate of return of 7.1%. The System's ECR based upon the June 30, 2019 actuarial valuation is 9.53% of pay.

Valuation Date:	**6/30/2020**	**6/30/2021**	**6/30/2022**
2019-2020 Fiscal Year Investment Return*	Applies to Salary Year 2021-2022	Applies to Salary Year 2022-2023	Applies to Salary Year 2023-2024
7.10%	9.0% to 9.5%	8.5% to 9.5%	8.0% to 9.5%
2.10%	10.0% to 11.0%	10.0% to 11.5%	10.0% to 12.5%
-2.90%	10.5% to 11.5%	12.0% to 14.0%	13.0% to 16.0%
-7.90%	11.5% to 12.5%	12.5% to 15.0%	15.0% to 18.5%

* Assuming Investment Returns after 2019-2020 are 7.1%.

It's important to note that there are many assumptions used in these estimated ECR's and the actual rates will likely differ, perhaps substantially, as investment and plan experience emerges. These estimates are based upon current actuarial assumptions as well as assumptions for new entrants and changes in the present value of liabilities and salaries. Modifications to these assumptions, as is likely to occur during this period, could lead to large changes in the estimated ECR.

HISTORY OF THE EMPLOYER CONTRIBUTION RATE

Salary Year	Employer Contribution Rate	Salary Year	Employer Contribution Rate	Salary Year	Employer Contribution Rate
1921-22	5.10 %	1956-57	10.90 %	1991-92	6.64 %
1922-23	5.10	1957-58	11.20	1992-93	8.00
1923-24	5.20	1958-59	13.40	1993-94	8.41
1924-25	5.20	1959-60	14.00	1994-95	7.24
1925-26	5.20	1960-61	18.35	1995-96	6.37
1926-27	5.20	1961-62	18.55	1996-97	3.57
1927-28	5.20	1962-63	19.55	1997-98	1.25
1928-29	5.30	1963-64	21.13	1998-99	1.42
1929-30	5.50	1964-65	17.67	1999-00	1.43
1930-31	5.50	1965-66	17.70	2000-01	0.43
1931-32	5.50	1966-67	17.72	2001-02	0.36
1932-33	5.50	1967-68	18.50	2002-03	0.36
1933-34	5.50	1968-69	18.80	2003-04	2.52
1934-35	5.60	1969-70	18.60	2004-05	5.63
1935-36	5.70	1970-71	18.80	2005-06	7.97
1936-37	5.80	1971-72	18.80	2006-07	8.60
1937-38	5.93	1972-73	18.80	2007-08	8.73
1938-39	6.03	1973-74	18.80	2008-09	7.63
1939-40	6.13	1974-75	18.80	2009-10	6.19
1940-41	6.23	1975-76	19.40	2010-11	8.62
1941-42	6.33	1976-77	19.40	2011-12	11.11
1942-43	6.43	1977-78	20.40	2012-13	11.84
1943-44	6.53	1978-79	21.40	2013-14	16.25
1944-45	7.10	1979-80	22.49	2014-15	17.53
1945-46	7.20	1980-81	23.49	2015-16	13.26
1946-47	7.50	1981-82	23.49	2016-17	11.72
1947-48	7.80	1982-83	23.49	2017-18	9.80
1948-49	8.00	1983-84	22.90	2018-19	10.62
1949-50	8.40	1984-85	22.80	2019-20	8.86
1950-51	8.80	1985-86	21.40	2020-21	9.53
1951-52	9.60	1986-87	18.80	**Average**	**10.91 %**
1952-53	9.90	1987-88	16.83		
1953-54	9.90	1988-89	14.79		
1954-55	10.30	1989-90	6.87		
1955-56	10.40	1990-91	6.84		

APPENDIX 16

HISTORY OF THE MEMBER CONTRIBUTION RATE

Year of Membership	Required Contribution
1921	4%
1948	5% (new members - 1948 and after)
1948	Voluntary 4% could be contributed (all members eligible)
1951	If member elected special retirement allowance: 4% went to 6.5%, 5% went to 8% (all members eligible)
1957	If member elected 1/120th plan: 6.5% went to 9%, 8% went to 11% (all members eligible)
1968	0%
1976	3% (new members - 1976 and after)
2000	3% employee contribution ceases after ten years of service or membership
2010	3.5% throughout career for members joining 1/1/2010 –
2012	Throughout career for members joining on or after 4/1/2012: - 3.0% if salary less than or equal to $45,000 - 3.5% if salary greater than $45,000 and less than or equal to $55,000 - 4.5% if salary greater than $55,000 and less than or equal to $75,000 - 5.75% if salary greater than $75,000 and less than or equal to $100,000 - 6.0% if salary greater than $100,000 and less than or equal to $179,000 ($179,000 amended in 2019 to increase to $200,000 in 2020, $225,000 in 2021 and $250,000 in 2022 and thereafter)

As of August 1, 1921, when the Retirement System was established, members contributed 4% of salary. These contributions were used to fund a separate annuity, over and above the regular pension. New members on or after July 1, 1948 were required to contribute 5% of salary. Additional contributions, not in excess of 4% of salary, were permitted during the five-year period beginning July 1, 1948.

Under the provisions of a law passed in 1950, members could elect before July 1, 1951, or within one year of their date of membership, if later, to contribute towards a special service retirement allowance that would allow them to retire up to five years earlier. If their rate of contribution had been 4%, their new rate would be 6.5%. If their rate of contribution had been 5%, their new rate would be 8%. In 1956, an amendment was passed which provided additional benefits for service in excess of 25 years, but not in excess of 35 years, for those members who elected to contribute an additional 2.5% or 3% of their salaries. This increased the rate of contribution to 9% or 11% depending on whether the member's rate of contribution had been 6.5% or 8%.

Throughout the 1960's the advent of the "take-home pay" program effectively reduced the required contribution rate to zero for many members. As of July 1, 1968, all members were no longer required to make contributions, nor permitted to make voluntary contributions unless they had been making them previously.

HISTORY OF THE MEMBER CONTRIBUTION RATE (Cont'd)

The law that created Tier 3 in 1976 reinstated member contributions and required members who joined the System after July 26, 1976 to contribute 3% of their annual salary. This money, however, helps fund the member's pension and does not fund a separate annuity as before. Effective October 1, 2000, however, in accordance with Chapter 126 of the Laws of 2000, the 3% required member contribution ceases upon the attainment of the earlier of 10 years of service credit or 10 years of membership.

In accordance with Tier 5, enacted in 2009, members joining on or after January 1, 2010 and prior to April 1, 2012 must contribute 3.5% of salary throughout their working career towards the funding of their pension.

Tier 6, enacted in 2012, requires members joining on or after April 1, 2012 to contribute between 3.0% and 6.0% of salary throughout their working career towards the funding of their pension. The contribution percentage for Tier 6 members can vary during their working career depending on the salary received two years prior to the year of contribution.

APPENDIX 17

ACTUARIAL VALUATION INFORMATION

1. Actuarial Cost Method

The cost method used to determine the liabilities and normal cost in this valuation is the Aggregate Cost Method. This funding method is required by statute, specifically Section 517 of the New York State Education Law.

Each year a normal rate percentage is developed as a level percentage of total member compensation. This percentage equals the portion of the actuarial present value of projected benefits which exceeds the actuarial value of assets divided by one percent of the present value of future compensation of the active members, as of the valuation date.

The cost of the first $50,000 of member death benefits, Retirement System administrative expenses, and benefits in excess of the IRC §415 limits are each determined using the pay-as-you-go method, which is not considered to be an actuarial cost method.

Each year, actuarial gains and losses will occur because actual experience will vary from the actuarial assumptions. All gains and losses are automatically amortized as part of the normal rate, over the expected future working lifetime of active members.

The average expected future working lifetime for our active population as determined by the actuarial valuation as of June 30, 2019 is 13.11 years.

2. Asset Valuation Method

The actuarial value of assets for the normal rate is determined by recognizing each year's net investment income/loss in excess of (or less than) 7.25% at a rate of 20% per year, until fully recognized after five years. For fiscal years ending prior to June 30, 2015, realized and unrealized appreciation in excess of (or less than) the assumed inflationary rate of 3% is recognized at a rate of 20% per year, until fully recognized after five years.

The actuarial value of assets for the expense, group life insurance, and excess benefit plan rates is equal to the fair market value of assets, excluding contributions receivable.

3. Actuarial Assumptions

The valuation rate of interest of 7.1% was adopted by the Board on October 31, 2019 and was effective with the June 30, 2019 actuarial valuation. The valuation rate of interest of 7.25% was adopted by the Board on October 26, 2017 and was effective with the June 30, 2017 actuarial valuation.

At the October 31, 2019 Board meeting, the Board also adopted three other changes to assumptions effective with the June 30, 2019 actuarial valuation:

- mortality improvement scale MP-2018 replacing MP-2014;

ACTUARIAL VALUATION INFORMATION (Cont'd)

- assumed rate of projected COLA increase of 1.3% replacing 1.5%; and
- assumed inflation rate of 2.2% replacing 2.25%.

The remaining actuarial assumptions were adopted by the Retirement Board on October 29, 2015 and were effective with the June 30, 2015 actuarial valuation. Specific details regarding the development of the present actuarial assumptions can be found in the "*Report on the 2015 Recommended Actuarial Assumptions*."

The withdrawal rates are the assumed rates of termination of employment from all causes other than death, disability or retirement. The withdrawal rates vary by gender, age and service. The withdrawal rates for active members age 55 or older are set to the age 54 withdrawal rates.

The healthy annuitant mortality rates are the assumed rates of death for service and deferred retired members and beneficiaries. The healthy annuitant mortality rates vary by gender and age. Future mortality improvement was projected on a generational basis using the Society of Actuaries Mortality Projection Scale MP-2018, formerly MP-2014.

The salary scale is the assumed annual rate of increase in compensation. The rates are based upon salary experience for members, vary by service, and are independent of the member's gender. Inflation, merit and productivity increases are included in these rates. The assumed inflation component is 2.2%, formerly 2.25%.

APPENDIX 18

PRESENT ACTUARIAL ASSUMPTIONS

Actuarial assumptions have been developed based upon actual member experience. Various actuarial and graduation techniques are applied to experience data and tables are developed. An experience study is performed annually, and assumptions are revised when warranted. The current actuarial assumptions were adopted by the Retirement Board on October 29, 2015 revised on October 26, 2017 and October 30, 2019. Specific details regarding the development of the present actuarial assumptions can be found in the "*Report on the 2015 Recommended Actuarial Assumptions*" and memos from R. Young to the Board dated October 26, 2017 and October 30, 2019.

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I. Active Member Mortality Rates

Males		Females	
Age	Rate	Age	Rate
20	0.000189	20	0.000108
21	0.000212	21	0.000112
22	0.000233	22	0.000112
23	0.000258	23	0.000112
24	0.000281	24	0.000112
25	0.000286	25	0.000112
26	0.000286	26	0.000112
27	0.000287	27	0.000112
28	0.000288	28	0.000119
29	0.000290	29	0.000124
30	0.000293	30	0.000129
31	0.000298	31	0.000132
32	0.000305	32	0.000135
33	0.000314	33	0.000137
34	0.000326	34	0.000140
35	0.000342	35	0.000144
36	0.000361	36	0.000151
37	0.000384	37	0.000160
38	0.000410	38	0.000174
39	0.000441	39	0.000191
40	0.000474	40	0.000213
41	0.000510	41	0.000239
42	0.000548	42	0.000269
43	0.000586	43	0.000302
44	0.000624	44	0.000338
45	0.000661	45	0.000374
46	0.000697	46	0.000412
47	0.000732	47	0.000450
48	0.000765	48	0.000487
49	0.000800	49	0.000523
50	0.000836	50	0.000559
51	0.000876	51	0.000595
52	0.000923	52	0.000632
53	0.000979	53	0.000671
54	0.001050	54	0.000711

I. Active Member Mortality Rates (cont'd)

Males		Females	
Age	Rate	Age	Rate
55	0.001139	55	0.000755
56	0.001251	56	0.000802
57	0.001391	57	0.000854
58	0.001565	58	0.000911
59	0.001779	59	0.000973
60	0.002039	60	0.001042
61	0.002349	61	0.001117
62	0.002716	62	0.001199
63	0.003143	63	0.001291
64	0.003636	64	0.001393
65	0.004197	65	0.001509
66	0.004828	66	0.001642
67	0.005370	67	0.001797
68	0.006058	68	0.001981
69	0.006834	69	0.002350
70	0.007709	70	0.002550
71	0.008696	71	0.002864
72	0.009810	72	0.003217
73	0.011066	73	0.003613
74	0.012483	74	0.004058
75	0.014082	75	0.004558

II. Disability Retirement Rates

Males		Females	
Age	Rate	Age	Rate
30	0.000003	30	0.000005
31	0.000008	31	0.000008
32	0.000015	32	0.000010
33	0.000024	33	0.000037
34	0.000040	34	0.000076
35	0.000062	35	0.000098
36	0.000091	36	0.000102
37	0.000126	37	0.000105
38	0.000164	38	0.000126
39	0.000196	39	0.000159
40	0.000226	40	0.000214
41	0.000245	41	0.000274
42	0.000278	42	0.000310
43	0.000330	43	0.000376
44	0.000398	44	0.000452
45	0.000470	45	0.000501
46	0.000530	46	0.000522
47	0.000569	47	0.000568
48	0.000611	48	0.000666
49	0.000707	49	0.000818
50	0.000889	50	0.000986
51	0.001091	51	0.001187
52	0.001190	52	0.001325
53	0.001250	53	0.001380
54	0.001225	54	0.001375

III. Withdrawal Rates

a) Males

Age	0 Years of Service	1 Year of Service	2 Years of Service	3 Years of Service	4 Years of Service	5 Years of Service	6 Years of Service	7 Years of Service	8 Years of Service	9 Years of Service	10 or more Years of Service
20	0.254275	0.165892	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
21	0.254275	0.139607	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
22	0.258777	0.126464	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
23	0.267780	0.124274	0.116327	0.094647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
24	0.281285	0.133035	0.119082	0.088647	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
25	0.294790	0.168083	0.124171	0.081761	0.057858	0.035354	0.020319	0.011763	0.010924	0.007796	0.008873
26	0.308295	0.185606	0.128845	0.077761	0.057858	0.036379	0.020319	0.011763	0.011922	0.007796	0.008873
27	0.319549	0.194368	0.131962	0.080715	0.059296	0.036635	0.020319	0.011763	0.012975	0.007796	0.008873
28	0.325176	0.196558	0.134039	0.083668	0.061071	0.036892	0.020319	0.011763	0.013931	0.007796	0.008873
29	0.328927	0.194368	0.135424	0.086621	0.064622	0.037533	0.021368	0.012912	0.014537	0.007796	0.008873
30	0.330803	0.190091	0.136168	0.089575	0.068227	0.040481	0.025825	0.019809	0.015106	0.007796	0.008873
31	0.322070	0.187568	0.131286	0.093049	0.069540	0.043533	0.031397	0.022317	0.015955	0.007796	0.008873
32	0.313337	0.185045	0.125654	0.096523	0.070854	0.046585	0.036969	0.023571	0.018078	0.007796	0.008873
33	0.304605	0.182523	0.123777	0.099997	0.072167	0.049638	0.039754	0.023884	0.020201	0.008513	0.008873
34	0.295872	0.180000	0.126812	0.103470	0.073481	0.052690	0.041147	0.023963	0.022323	0.011216	0.008873
35	0.287140	0.177477	0.133047	0.105207	0.074794	0.055742	0.041993	0.023963	0.023738	0.015946	0.008508
36	0.286690	0.171821	0.138075	0.104196	0.077092	0.060321	0.041209	0.023963	0.024021	0.019585	0.008299
37	0.286241	0.166165	0.135561	0.101447	0.076326	0.064899	0.040425	0.023963	0.024163	0.020908	0.008091
38	0.285791	0.160509	0.130616	0.098699	0.075560	0.067189	0.039641	0.025293	0.024233	0.021664	0.007882
39	0.285342	0.154853	0.130202	0.095950	0.074219	0.067761	0.038857	0.034440	0.024269	0.021916	0.007673
40	0.284892	0.152025	0.129787	0.093202	0.069959	0.067904	0.038073	0.037085	0.025711	0.021664	0.007464
41	0.289068	0.152732	0.132358	0.094006	0.067933	0.064863	0.035133	0.037747	0.027438	0.021286	0.007534
42	0.293244	0.156266	0.134928	0.094810	0.066920	0.057260	0.033664	0.037747	0.029166	0.020625	0.007638
43	0.297420	0.159800	0.137499	0.095614	0.065907	0.053458	0.035133	0.037747	0.030893	0.018971	0.007795
44	0.301596	0.163334	0.140070	0.096418	0.064894	0.052983	0.038073	0.037747	0.032620	0.016781	0.008147
45	0.303684	0.166868	0.142640	0.086769	0.063881	0.052698	0.045610	0.037747	0.033484	0.015314	0.008659
46	0.297917	0.169216	0.142902	0.077120	0.064110	0.054366	0.053147	0.037747	0.032404	0.014047	0.008915
47	0.290062	0.171564	0.143164	0.073904	0.067541	0.055072	0.060684	0.037747	0.029166	0.014943	0.009043
48	0.282207	0.173912	0.143426	0.077120	0.070973	0.057785	0.064453	0.038438	0.027546	0.020435	0.009106
49	0.274352	0.176260	0.143687	0.092398	0.072689	0.059956	0.065709	0.042311	0.028356	0.022630	0.009170
50	0.266497	0.178609	0.143949	0.099585	0.072689	0.061041	0.065709	0.044893	0.032404	0.023728	0.009227
51	0.258643	0.178609	0.144211	0.106772	0.072689	0.061041	0.065709	0.045754	0.036452	0.023728	0.009227
52	0.250788	0.178609	0.144211	0.110366	0.072689	0.061041	0.065709	0.047475	0.037465	0.023728	0.009227
53	0.246860	0.178609	0.144211	0.110366	0.072689	0.061041	0.065709	0.048336	0.037754	0.023728	0.009227
54+	0.246860	0.178609	0.144211	0.110366	0.072689	0.061041	0.065709	0.051133	0.037754	0.023728	0.009227

III. Withdrawal Rates

b) Females

Age	0 Years Of Service	1 Year of Service	2 Years of Service	3 Years of Service	4 Years of Service	5 Years of Service	6 Years of Service	7 Years of Service	8 Years of Service	9 Years of Service	10 or more Years of Service
20	0.221624	0.111743	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
21	0.222584	0.102302	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
22	0.227539	0.100414	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
23	0.241991	0.107967	0.100290	0.059871	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
24	0.306350	0.130625	0.100290	0.059474	0.079156	0.057015	0.041279	0.030151	0.037037	0.022766	0.019527
25	0.332325	0.175943	0.102290	0.064680	0.042156	0.051015	0.040469	0.030151	0.037037	0.022766	0.019527
26	0.353217	0.189852	0.106684	0.072489	0.048382	0.047684	0.039012	0.030151	0.037037	0.022766	0.019527
27	0.360933	0.198520	0.127538	0.080297	0.051495	0.039255	0.037846	0.030151	0.037037	0.022766	0.019527
28	0.360817	0.202853	0.141441	0.088106	0.054608	0.042029	0.037458	0.030151	0.035810	0.022766	0.019527
29	0.354235	0.205020	0.141602	0.095915	0.057721	0.048963	0.039012	0.031232	0.032407	0.022766	0.019527
30	0.346747	0.202316	0.139988	0.099819	0.073286	0.053123	0.042120	0.033722	0.029005	0.022766	0.019527
31	0.343752	0.199612	0.136830	0.106115	0.076094	0.060404	0.051611	0.036984	0.029725	0.024035	0.019527
32	0.335848	0.195888	0.133673	0.109263	0.078901	0.067684	0.056356	0.040686	0.032607	0.026574	0.019527
33	0.327944	0.192164	0.130516	0.112411	0.081709	0.071845	0.058505	0.043387	0.035489	0.027589	0.019527
34	0.320040	0.188440	0.127358	0.113290	0.084516	0.072885	0.060654	0.045088	0.038371	0.030635	0.019527
35	0.312137	0.181656	0.124201	0.113729	0.087323	0.073130	0.061088	0.046793	0.039811	0.033681	0.018793
36	0.304496	0.174543	0.122312	0.110640	0.086076	0.070552	0.058894	0.048497	0.040833	0.035204	0.017327
37	0.296856	0.167429	0.120422	0.105598	0.084828	0.067974	0.056701	0.048838	0.040413	0.034443	0.015860
38	0.289215	0.160316	0.118533	0.100557	0.082956	0.065396	0.054507	0.049179	0.039994	0.033681	0.014393
39	0.281575	0.153202	0.116644	0.095515	0.080149	0.062819	0.052314	0.049213	0.039574	0.031777	0.012192
40	0.273935	0.146089	0.114754	0.092994	0.073750	0.060241	0.050120	0.049359	0.039155	0.030254	0.011459
41	0.269779	0.144793	0.111172	0.091252	0.074162	0.059860	0.048675	0.044929	0.037437	0.030242	0.011182
42	0.265623	0.143498	0.107590	0.092030	0.074575	0.059479	0.047230	0.040499	0.035718	0.030230	0.010905
43	0.261467	0.142203	0.104009	0.092809	0.074987	0.059098	0.045785	0.036070	0.034000	0.030218	0.010628
44	0.257311	0.140908	0.100427	0.093587	0.075400	0.058717	0.044339	0.035516	0.032282	0.030207	0.010351
45	0.253155	0.140260	0.098636	0.094366	0.075812	0.058336	0.043617	0.038284	0.030564	0.030195	0.010074
46	0.257124	0.142616	0.099349	0.095174	0.074383	0.058048	0.044604	0.038381	0.030284	0.029256	0.009941
47	0.267047	0.143794	0.101854	0.095983	0.072954	0.057761	0.046315	0.038478	0.030004	0.028317	0.009808
48	0.276970	0.147033	0.104358	0.096791	0.071525	0.057474	0.048025	0.038574	0.029724	0.027377	0.009675
49	0.286893	0.151626	0.106862	0.097600	0.070096	0.057187	0.049735	0.038671	0.029444	0.026438	0.009542
50	0.296815	0.154630	0.109367	0.098408	0.068667	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
51	0.299296	0.157633	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
52	0.299296	0.160636	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
53	0.299296	0.162138	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409
54+	0.299296	0.162138	0.111871	0.098408	0.067238	0.056900	0.051446	0.038767	0.029164	0.025499	0.009409

IV. Retirement Rates

a) Tier 1 Members and Tier 2, 3, and 4 Members at Least Age 62 or with at Least 30 Years of Service and Tier 5 Members at Least Age 62

Males		Females	
Age	Rate	Age	Rate
55	0.306695	55	0.313992
56	0.280779	56	0.288116
57	0.252448	57	0.269473
58	0.259437	58	0.261016
59	0.286545	59	0.268785
60	0.311011	60	0.279410
61	0.320232	61	0.277166
62	0.270303	62	0.257157
63	0.229352	63	0.232947
64	0.206863	64	0.219224
65	0.209678	65	0.238272
66	0.217437	66	0.244523
67	0.216934	67	0.236791
68	0.208294	68	0.220367
69	0.187086	69	0.230935
70	0.163555	70	0.229295
71	0.146721	71	0.212056
72	0.169602	72	0.180451
73	0.167377	73	0.183107
74	0.164226	74	0.192125
75	0.133890	75	0.190633
76+	1.000000	76+	1.000000

IV. Retirement Rates

b) Tier 2, 3, and 4 Members Less Than Age 62 and with Less Than 30 Years of Service

Males		Females	
Age	Rate	Age	Rate
55	0.031965	55	0.034565
56	0.031782	56	0.035761
57	0.036262	57	0.041750
58	0.043899	58	0.046349
59	0.056398	59	0.060339
60	0.063578	60	0.070415
61	0.072217	61	0.082590

IV. Retirement Rates

c) Tier 5 Members Less Than Age 62 and with Less Than 30 Years of Service

Males		Females	
Age	Rate	Age	Rate
55	0.015983	55	0.017283
56	0.015891	56	0.017881
57	0.018131	57	0.020875
58	0.021950	58	0.023175
59	0.028199	59	0.030170
60	0.031789	60	0.035208
61	0.036109	61	0.041295

IV. Retirement Rates

d) Tier 5 Members Less Than Age 62 and with at Least 30 Years of Service

Males		Females	
Age	Rate	Age	Rate
55	0.015983	55	0.017283
56	0.015891	56	0.017881
57	0.306695	57	0.313992
58	0.280779	58	0.288116
59	0.252448	59	0.269473
60	0.259437	60	0.261016
61	0.286545	61	0.268785

IV. Retirement Rates

e) Tier 6 Members

Males		Females	
Age	Rate	Age	Rate
55	0.015983	55	0.017283
56	0.015891	56	0.017881
57	0.018131	57	0.020875
58	0.021950	58	0.023175
59	0.028199	59	0.030170
60	0.031789	60	0.035208
61	0.036109	61	0.041295
62	0.039942	62	0.046683
63	0.306695	63	0.313992
64	0.280779	64	0.288116
65	0.252448	65	0.269473
66	0.259437	66	0.261016
67	0.286545	67	0.268785
68	0.311011	68	0.279410
69	0.320232	69	0.277166
70	0.270303	70	0.257157
71	0.229352	71	0.232947
72	0.206863	72	0.219224
73	0.209678	73	0.238272
74	0.217437	74	0.244523
75	0.216934	75	0.236791
76+	1.000000	76+	1.000000

V. Service and Deferred Annuitant and Beneficiary Base Mortality Rates

Males		Females	
Age	Rate	Age	Rate
1	0.000410	1	0.000361
2	0.000277	2	0.000236
3	0.000230	3	0.000176
4	0.000179	4	0.000132
5	0.000157	5	0.000119
6	0.000141	6	0.000110
7	0.000124	7	0.000102
8	0.000105	8	0.000094
9	0.000085	9	0.000087
10	0.000072	10	0.000082
11	0.000076	11	0.000084
12	0.000113	12	0.000097
13	0.000149	13	0.000110
14	0.000183	14	0.000121
15	0.000218	15	0.000132
16	0.000253	16	0.000142
17	0.000290	17	0.000150
18	0.000256	18	0.000144
19	0.000288	19	0.000148
20	0.000317	20	0.000148
21	0.000351	21	0.000148
22	0.000381	22	0.000148
23	0.000397	23	0.000152
24	0.000403	24	0.000155
25	0.000378	25	0.000158
26	0.000361	26	0.000164
27	0.000351	27	0.000171
28	0.000347	28	0.000179
29	0.000348	29	0.000189
30	0.000353	30	0.000199

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

V. Service and Deferred Annuitant and Beneficiary Base Mortality Rates
(cont'd)

Males		Females	
Age	Rate	Age	Rate
31	0.000361	31	0.000211
32	0.000372	32	0.000223
33	0.000384	33	0.000236
34	0.000397	34	0.000249
35	0.000408	35	0.000262
36	0.000418	36	0.000275
37	0.000430	37	0.000291
38	0.000445	38	0.000310
39	0.000464	39	0.000334
40	0.000490	40	0.000362
41	0.000524	41	0.000396
42	0.000566	42	0.000436
43	0.000619	43	0.000484
44	0.000684	44	0.000539
45	0.000760	45	0.000601
46	0.000849	46	0.000671
47	0.000949	47	0.000747
48	0.001060	48	0.000829
49	0.001183	49	0.000916
50	0.001316	50	0.001008
51	0.001461	51	0.001104
52	0.001618	52	0.001203
53	0.001951	53	0.001419
54	0.002311	54	0.001645
55	0.002522	55	0.001805
56	0.002753	56	0.001980
57	0.003004	57	0.002172
58	0.003279	58	0.002382
59	0.003579	59	0.002613
60	0.003906	60	0.002866

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

V. Service and Deferred Annuitant and Beneficiary Base Mortality Rates

(cont'd)

Males		Females	
Age	Rate	Age	Rate
61	0.004264	61	0.003053
62	0.004654	62	0.003298
63	0.005050	63	0.003604
64	0.005564	64	0.003976
65	0.006204	65	0.004417
66	0.006976	66	0.004931
67	0.007886	67	0.005524
68	0.008942	68	0.006203
69	0.010151	69	0.006979
70	0.011524	70	0.007864
71	0.013074	71	0.008874
72	0.014821	72	0.010029
73	0.016788	73	0.011349
74	0.019009	74	0.012863
75	0.021524	75	0.014602
76	0.024380	76	0.016603
77	0.027633	77	0.018909
78	0.031346	78	0.021567
79	0.035590	79	0.024631
80	0.040445	80	0.028162
81	0.045997	81	0.032228
82	0.052342	82	0.036904
83	0.059585	83	0.042268
84	0.067844	84	0.048410
85	0.077246	85	0.055421
86	0.087929	86	0.063404
87	0.100040	87	0.072465
88	0.113741	88	0.082724
89	0.129208	89	0.094308
90	0.141713	90	0.107360

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

V. Service and Deferred Annuitant and Beneficiary Base Mortality Rates (cont'd)

Males		Females	
Age	Rate	Age	Rate
91	0.158130	91	0.122037
92	0.175288	92	0.138518
93	0.193131	93	0.157000
94	0.211674	94	0.177701
95	0.230976	95	0.191477
96	0.251106	96	0.210235
97	0.272113	97	0.229998
98	0.293848	98	0.250723
99	0.313988	99	0.270858
100	0.334365	100	0.291040
101	0.354599	101	0.311444
102	0.374524	102	0.331900
103	0.393982	103	0.352232
104	0.412831	104	0.372273
105	0.430946	105	0.391860
106	0.448227	106	0.410849
107	0.464592	107	0.429112
108	0.479987	108	0.446544
109	0.494376	109	0.463061
110	0.500000	110	0.478604

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

VI. Disabled Annuitant
Base Mortality Rates

Males		Females	
Age	Rate	Age	Rate
30	0.180013	30	0.106487
31	0.180013	31	0.106487
32	0.180013	32	0.106487
33	0.180013	33	0.103280
34	0.173269	34	0.100083
35	0.166522	35	0.096905
36	0.159773	36	0.093763
37	0.153024	37	0.090676
38	0.146284	38	0.087665
39	0.139576	39	0.084746
40	0.132936	40	0.081925
41	0.126401	41	0.079198
42	0.120012	42	0.076550
43	0.113802	43	0.073965
44	0.107801	44	0.071430
45	0.102029	45	0.068936
46	0.096503	46	0.066480
47	0.091236	47	0.064061
48	0.086231	48	0.061677
49	0.081479	49	0.059314
50	0.076958	50	0.056949
51	0.072640	51	0.054543
52	0.068494	52	0.052046
53	0.064498	53	0.049422
54	0.060638	54	0.046664
55	0.056938	55	0.043813
56	0.053442	56	0.040949
57	0.050216	57	0.038174
58	0.047308	58	0.035582
59	0.044759	59	0.033251

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

VI. Disabled Annuitant Base Mortality Rates (cont'd)

Males		Females	
Age	Rate	Age	Rate
60	0.042595	60	0.031256
61	0.040829	61	0.029665
62	0.039455	62	0.028522
63	0.038461	63	0.027851
64	0.037830	64	0.027664
65	0.037550	65	0.027957
66	0.037620	66	0.028701
67	0.038040	67	0.029851
68	0.038798	68	0.031348
69	0.039890	69	0.033140
70	0.041328	70	0.035196
71	0.043137	71	0.037505
72	0.045337	72	0.040079
73	0.047925	73	0.042938
74	0.050890	74	0.046105
75	0.054216	75	0.049628
76	0.057882	76	0.053557
77	0.061871	77	0.057934
78	0.066162	78	0.062794
79	0.070742	79	0.068155
80	0.075602	80	0.074002
81	0.080733	81	0.080289
82	0.086134	82	0.086960
83	0.087929	83	0.093972
84	0.100040	84	0.101322
85	0.113741	85	0.109018
86	0.129208	86	0.117066
87	0.141713	87	0.122037
88	0.158130	88	0.138518
89	0.175288	89	0.157000

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

VI. Disabled Annuitant Base Mortality Rates (cont'd)

Males		Females	
Age	Rate	Age	Rate
90	0.193131	90	0.177701
91	0.211674	91	0.191477
92	0.230976	92	0.210235
93	0.251106	93	0.229998
94	0.272113	94	0.250723
95	0.293848	95	0.270858
96	0.313988	96	0.291040
97	0.334365	97	0.311444
98	0.354599	98	0.331900
99	0.374524	99	0.352232
100	0.393982	100	0.372273
101	0.412831	101	0.391860
102	0.430946	102	0.410849
103	0.448227	103	0.429112
104	0.464592	104	0.446544
105	0.479987	105	0.463061
106	0.494376	106	0.478604
107	0.500000	107	0.478604
108	0.500000	108	0.478604
109	0.500000	109	0.478604
110	0.500000	110	0.478604

Society of Actuaries Mortality Improvement Scale MP-2018 will be applied on a generational basis to base table rates.

VII. Salary Scale

Duration	Rate	Duration	Rate
1	1.1000	21	1.0272
2	1.0700	22	1.0263
3	1.0606	23	1.0254
4	1.0522	24	1.0245
5	1.0472	25	1.0237
6	1.0445	26	1.0229
7	1.0431	27	1.0222
8	1.0422	28	1.0215
9	1.0415	29	1.0210
10	1.0407	30	1.0206
11	1.0398	31	1.0202
12	1.0387	32	1.0200
13	1.0375	33	1.0195
14	1.0361	34	1.0193
15	1.0346	35	1.0190
16	1.0331	36	1.0186
17	1.0317	37	1.0180
18	1.0304	38	1.0176
19	1.0293	39	1.0176
20	1.0282		

VIII. Valuation Rate of Interest Assumption

The interest rate for valuation purposes is a level 7.1%. This valuation rate of interest is made up of a 2.2%[1] annual rate of inflation and a 4.9% real rate of return.

The valuation rate of interest assumption represents our best estimate of the anticipated annual rate of return on plan assets over a very long-term horizon.

The valuation rate of interest assumption is developed based upon the Retirement System's specific asset allocation, and capital market assumptions, based upon recommendations from AON Hewitt, the System's investment consultant. Using expected returns and standard deviations for each asset class, and including anticipated correlation between the classes, a long-term anticipated rate of return is developed. Based on their 1st quarter 2020 capital market return assumptions, AON Hewitt has estimated the geometric annual rate of return to be 6.9%, and the arithmetic annual rate of return to be 7.6%, given the System's asset allocation. This analysis is performed annually and intended to be over a 30-year time horizon.

For a complete explanation of the rationale behind the System's valuation rate of interest assumption, please see pages 28 through 33 of the "*Report on the 2015 Recommended Actuarial Assumptions*" and memos from R. Young dated October 26, 2017 and October 30, 2019.

IX. Other Assumptions

Projected COLA Assumption

The annual percentage for estimating future COLA benefit payments is 1.3%.[2]

IRC Section 415(b) and 401(a)(17)

For purposes of the normal rate, the limitations under IRC Section 415(b) were not reflected due to immateriality. The IRC Section 401(a)(17) limit for the fiscal year ending June 30, 2019 was reflected for members with a membership date on or after July 1, 1996.

Retirement Rates

Retirement Rates for terminated vested members (no earnings in the fiscal year and entitled to a vested benefit, not yet retired): 100% at the age of 55 or current age if later.

Marriage Assumptions

None

[1] The average annual rate of increase in the Consumer Price Index (CPI) for 1925 – 2019 was 2.90%.

[2] The COLA percentage is one-half of the increase in the CPI with a floor of 1.0% and a cap of 3.0%. Therefore, the estimate of inflation for the COLA benefit is the result of analyzing available CPI data with percentages bounded between 2.0% and 6.0% and reduced by 50%.

Tier 6 Pensionable Salary Limit

Tier 6 Pensionable earnings are limited to the current Governor's salary of $200,000 per year, which is then assumed to increase annually by the assumed rate of inflation of 2.2%.

Maximum Salary for Tier 2-6 Death Benefits

The Tier 2 to Tier 6 maximum Salary allowable under Section 130 of the Civil Service Law as of June 30, 2019 is $184,540. It is assumed to increase annually by the assumed annual rate of inflation of 2.2%.

APPENDIX 19

SUMMARY OF BENEFIT PROVISIONS

1. Membership

With certain very limited exceptions, membership is mandatory for all full-time New York State public school teachers and administrators, outside New York City. Membership is optional for certain teachers/administrators eligible for the Optional Retirement Program and teachers employed on other than a full-time basis and for certain employees of the State University of New York, community colleges, and the State Education Department. Generally, the membership of any non-vested person will terminate when seven years have elapsed since (s)he last rendered at least 20 days of credited service in a school year.

Tiers are determined by a member's most recent date of membership in the Retirement System as follows:

Tier 1:	Membership prior to 7/1/1973;
Tier 2:	Membership 7/1/1973 – 7/26/1976*;
Tier 3:	Membership 7/27/1976* – 8/31/1983;
Tier 4:	Membership 9/1/1983 – 12/31/2009;
Tier 5:	Membership 1/1/2010 – 3/31/2012;
Tier 6:	Membership on or after 4/1/2012.

*The end date for Tier 2 and the start date for Tier 3 differs from what is in the law due to a court case known as the Oliver decision, making the start date of the new tier the date that it was signed into law.

Tier 3 members are entitled to receive the benefits of either Tier 3 or Tier 4, however, they may not mix the provisions of the two tiers. For valuation purposes, Tier 3 members are assumed to receive the Tier 4 benefit at retirement, as that is generally always the larger benefit.

2. Final Average Salary (FAS)

For Tiers 1-5, FAS is generally the average of the three highest consecutive full years of regular salary, whenever they occurred in the salary history, for duties involving the supervision and instruction of students.

For Tier 6 members, FAS calculation is based on 5 years. Pensionable earnings can be no more than the Governor's salary, which is $200,000 as of 1/1/2019, $225,000 as of 1/1/2020, and $250,000 as of 1/1/2021 and thereafter.

Certain other restrictions apply to pensionable earnings that can be used in the FAS calculation. There are also limits on the year-over-year percentage increase in salary used in calculating FAS.

3. Service Retirement

The service retirement benefits are payable for life generally as follows:

Tier 1:

Non-Contributory Plan

For Tier 1 members with a date of membership prior to July 1, 1970 the benefit is generally calculated as:

For New York State service *prior to* 7/1/1959 and *all out-of-state service*:
$1/100^{th}$ of final average salary (FAS) per year for each of the first 25 years of service, plus $1/120^{th}$ of FAS per year for each of the next 10 years of service, plus $1/140^{th}$ of FAS per year for each year of NYS service in excess of 35, *plus*

For New York State service *subsequent to* 7/1/1959:

$1/50^{th}$ of final average salary (FAS) per year for each of the first 25 years of NYS service, plus $1/60^{th}$ of FAS per year for each of the next 10 years of NYS service, plus $1/70^{th}$ of FAS per year for each year of NYS service in excess of 35.

Non-Contributory Plan members generally may retire at:

- Age 55 with 20 years of total service or
- Any age with 35 years of total service.

Career Plan

If 20 or more years of NYS service: 2% of final average salary (FAS) per year of NYS service after July 1, 1959, plus 1.8% of FAS per year of NYS service prior to that date, plus 1% of FAS per year of out-of-state service. Out-of-state service is allowed only up to a maximum of 10 years, and only to the extent that it does not raise the total service credit to greater than 35 years. The maximum pension permitted is 75% of FAS.

If less than 20 years of NYS service, the above formula is used except the benefit is reduced by 5% for each year of service less than 20, subject to a maximum reduction of 50%.

Career Plan members generally may retire at:

- Age 55 with 2 years of NYS service or
- Any age with 35 years of total service.

The provisions of Article 19 of the Retirement and Social Security Law, effective July 11, 2000, provides to eligible Tier 1 and 2 members additional service credit of one-twelfth of a year of service for each year of retirement credit as of the date of retirement or death, up to a maximum of two additional years. The maximum pension, as a result of Article 19, can be 79% of FAS.

Tier 2: Computed under the Tier 1 Career Plan formula, but may be reduced for early retirement, as noted below.

Tier 2 members generally may retire at:

- Age 62 with 5 years of service, or
- Age 55 with 30 years of service, or
- Age 55 with 5 years of service, with benefit reduced by 6% for each of the first 2 years under age 62 and 3% for each of the next 5 years.

Tier 3: 1⅔% of FAS per year of NYS service (if less than 20 years) or 2% of FAS per year of NYS service (if 20 to 30 years). There is no additional benefit for more than 30 years of service. At age 62 the benefit is reduced by 50% of the primary Social Security benefit accrued while in NYS public employment. A member may be eligible for automatic cost-of-living adjustments.

Tier 3 members generally may retire at:

- Age 62 with 5 years of service, or
- Age 55 with 30 years of service, or
- Age 55 with 5 years of service, with benefit reduced by 1/15th for each of the first 2 years under age 62 and 1/30th for each of the next 5 years.

Tier 4: 1⅔% of FAS per year of NYS service (if less than 20 years), or 2% of FAS per year of NYS service (if 20 to 30 years), plus 1½% of FAS per year of NYS service in excess of 30 years.

Tier 4 members generally may retire at:

- Age 62 with 5 years of service, or
- Age 55 with 30 years of service, or
- Age 55 with 5 years of service, with benefit reduced by 6% for each of the first 2 years under age 62 and 3% for each of the next 5 years.

Tier 5: 1⅔% of FAS per year of NYS service (if less than 25 years), or 2% of FAS per year of NYS service (if 25 to 30 years), plus 1½% of FAS per year of NYS service in excess of 30 years.

Tier 5 members generally may retire at:

- Age 62 with 10 years of service, or
- Age 57 with 30 years of service, or
- Age 55 with 10 years of service, with benefit reduced by 6⅔% for each of the first 2 years under age 62 and 5% for each of the next 5 years.

Tier 6: 1⅔% of FAS per year of NYS service (if less than 20 years), 1.75% of FAS per year of NYS service (if credited with 20 years) or 35% plus 2% per year of NYS service in excess of 20 years (if beyond 20 years).

Tier 6 members generally may retire at:

- Age 63 with 10 years of service, or
- Age 55 with 10 years of service, with benefit reduced by 6.5% for each year under age 63.

4. Disability Retirement

Generally, a member with at least 10 years of service may qualify for a disability retirement benefit of the smaller of 1) 1⅔% of FAS per year of projected service to age 60 or 2) ⅓ of FAS; but the benefit shall not be less than 1⅔% of FAS per year of completed service.

5. Death Benefits

a) Active Service

The Tier 1 death benefit is generally equal to the greater of 1) 3 times annual salary after 36 years of service (proportionately reduced for less than 36 years) or 2) for members who are at least age 55 with 20 years of service, the pension reserve calculated under a prior, lower service retirement formula.

Under legislation enacted in 2000, all Tier 2-6 members will be covered by the Paragraph 2 Death Benefit, unless they selected Paragraph 1 (see Tier 1 Calculation above) and it is greater than Paragraph 2. All members joining on or after Jan. 1, 2001, will be covered by the Paragraph 2 Death Benefit. The benefit is one year's salary[1] after a year of service, increasing to a maximum of three years' salary after three years or more of service. The benefit is reduced after age 60 by 4% per year, up to a maximum reduction of 40% at age 70. (Reductions begin at age 61; age is not rounded, and the reduction is not prorated.) Under Paragraph 2, if the in-service death benefit is in effect when a member retires, coverage may continue after retirement. The benefit would be:

- 1st Year: 50% of the death benefit in effect at retirement;
- 2nd Year: 25% of the benefit at retirement; and,
- 3rd & Ensuing Years: 10% of the benefit in effect at retirement (or at age 60, if the member retires after age 59). To be eligible for the continued coverage in retirement, the member must retire within one year of leaving the payroll and not be employed (other than NYSTRS service) between the member's cease-teaching date and retirement date.

b) Not in Active Service

The death benefit for members of all tiers with at least ten years of service credit who die when not in active service is equal to one-half the active member death benefit.

6. Deferred Retirement

Tiers 1-4:
A member with at least 5 years of credited service who ceases teaching has a vested right to receive a deferred service retirement benefit. A member with at least five, but less than ten years of service credit, has the choice of receiving a refund of their member contributions with interest or a deferred service retirement benefit. A member with ten or more years of service credit will receive the deferred service retirement benefit.

[1] The law limits the amount of salary that can be used in the calculation of the Paragraph 2 Death Benefit.

Tiers 5 and 6:

A member with at least 10 years of credited service who ceases teaching has a vested right to receive a deferred service retirement benefit. Members with less than 10 years of credited service who cease teaching may receive a refund of their contributions with interest.

7. Member Contributions

Certain Tier 1 and 2 members may elect to contribute in order to receive an additional benefit upon retirement. Tier 3 and 4 members are required to contribute 3% of pay to fund a portion of their benefit. Effective October 1, 2000, such contributions cease upon the attainment of the earlier of 10 years of service credit or 10 years of membership. Tier 5 members are required to contribute 3.5% of their salary throughout their active membership.

Tier 6 members are required to contribute throughout their active membership. From 4/1/2012 through 3/31/2013, all Tier 6 members were required to contribute 3.5%. Beginning 4/1/2013 members are required to contribute in accordance with the following schedule:

Salary	Contribution Rate
$45,000 and less	3.00%
More than $45,000 to $55,000	3.50%
More than $55,000 to $75,000	4.50%
More than $75,000 to $100,000	5.75%
More than $100,000 to $200,000 (the limit currently equal to the NYS governor's salary)	6.00%

For purposes of administration, a Tier 6 member's contribution rate in any given year is based on regular compensation earned two years prior. During the member's first three years of membership, he/she will contribute a percentage based on a salary projection provided by the employer.

8. Cost-of-Living Adjustment (COLA)

A permanent, annually adjusted cost-of-living benefit is provided to both current and future retired members. This benefit was first paid commencing September 2001, and is increased every September thereafter, to retired members who meet one of the following eligibility criteria:

- Age 62 and retired for 5 years, or
- Age 55 and retired for 10 years, or
- Retired for 5 years under a disability retirement.

The annual COLA percentage is equal to 50% of the increase in the annual CPI; not to exceed 3% nor be lower than 1%. It is applied to the first $18,000 of annual benefit. Additionally, commencing September 2000, members retired before 1997 are eligible for a "Catch-Up" supplemental benefit upon satisfaction of the above eligibility criteria.