COMMONWEALTH
Actuarial Valuation Report

January 1, 2019

PUBLIC EMPLOYEE RETIREMENT ADMINISTRATION COMMISSION
COMMONWEALTH OF MASSACHUSETTS

COMMONWEALTH ACTUARIAL VALUATION REPORT

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1. INTRODUCTION & CERTIFICATION

This report presents the results of the actuarial valuation of the pension benefits that are the obligation of the Commonwealth of Massachusetts. The four components are:

- State Employees' Retirement System (SRS)
- Massachusetts Teachers' Retirement System (TRS)
- Boston Teachers
- Cost of Living Allowance Reimbursements to Local Systems

The valuation was performed as of January 1, 2019 pursuant to Chapter 32 of the General Laws of the Commonwealth of Massachusetts, and is based on the plan provisions in effect at that time. The actuarial assumptions used to calculate the actuarial accrued liability and the normal cost primarily reflect our latest experience studies of SRS and TRS issued in 2014 and our most recent analysis of retiree mortality during 2015 and 2016. The actuarial assumptions used in this valuation are the same as those used in the January 1, 2018 actuarial valuation, except the investment return assumption was decreased from 7.35% to 7.25%.

This valuation is based on member data as of December 31, 2018, which was supplied by the State, Massachusetts Teachers', and Boston Retirement Boards. We performed a number of tests on the data to ensure reasonableness and made specific assumptions for a number of TRS and Boston Teachers data items. Asset information as of December 31, 2018 was provided by the Pension Reserves Investment Management (PRIM) Board. We reviewed both the membership data and financial information for reasonableness but we did not audit this information.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of natural operation of the methodology used for these measurements such as additional contribution requirements based on the plan's funded status; and changes in plan provisions or applicable law. As part of this valuation, we have not performed an analysis of the potential range of future measurements.

We, the undersigned actuaries, meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained in this report. In our opinion, the actuarial assumptions used in this report are reasonable, are related to plan experience and expectations, and represent our best estimate of anticipated experience. We believe this report represents an accurate appraisal of the actuarial status of the Commonwealth's total pension obligation performed in accordance with generally accepted actuarial principles and practices relating to pension plans.

Respectfully submitted,
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October 17, 2019

2. EXECUTIVE SUMMARY

PART A | PRINCIPAL VALUATION RESULTS

The provisions of Chapter 32, Section 22C mandate the establishment of a funding schedule for the Commonwealth of Massachusetts' pension obligation. The SRS, TRS, liabilities for Boston Teachers, and State reimbursements to local systems to reflect COLAs granted from 1982 through 1996 (determined on an actuarial basis) have been the components of the Commonwealth schedule. Beginning in FY18, Chapter 5 of the Acts of 2017 required that several additional items that are included in the development of the Commonwealth funding schedule be shown separately. These items include the administrative expenses of the Public Employee Retirement Administration Commission (PERAC), the payment to the Optional Retirement Plan (ORP) under Section 40 of Chapter 15A, and a modification to the COLA reimbursement to local systems described above to reflect actual reimbursements. The schedule, as mandated by law, calls for payment of the Normal Cost plus an amortization payment on the Unfunded Actuarial Liability (UAL).

The Commonwealth's current funding schedule was filed in January, 2017 and was based on the results of the January 1, 2016 Commonwealth Actuarial Valuation. The FY20 appropriation under the schedule is $2.842 billion. The total appropriation under the schedule increases 8.94% each year until FY36. The amortization of the 2015 Early Retirement Incentive (ERI) will be completed in FY27. The next funding schedule is expected to be adopted in early 2020 based on the results of the 2019 Commonwealth actuarial valuation.

In the 2014 and prior actuarial valuations, the Annual Required Contribution (ARC) was developed under GASB 27 for accounting purposes. The ARC was developed using the minimum allowable schedule for local systems under Chapter 32 (UAL amortized on a 4.0% annual increasing basis to FY40). This ARC calculation is no longer applicable for GASB purposes, but we show it for comparison. Using the ARC basis and the January 1, 2019 valuation results, the FY20 appropriation would be approximately $3.80 billion. Therefore, the FY20 appropriation is 74.8% of the ARC ($2.842B/$3.80B). Had there been no assumption changes in this valuation, this figure would have been approximately 76%. Based on the 2018 valuation results, the FY19 appropriation was 74.6% of the ARC. We expect this percentage to generally increase each year until ultimately the appropriation exceeds the ARC, although changes to the actuarial assumptions and actuarial gains or losses could affect this result.

The principal results of the January 1, 2019 actuarial valuation are as follows (in thousands):

Total Normal Cost	$1,996,729
Expected Employee Contributions	$1,355,905
Net Normal Cost	$640,824
Total Expenses and Transfers	$103,500
Net Normal Cost Plus Expenses	$744,324
Total Actuarial Liability	$100,650,744
Assets	$56,661,376
Unfunded Actuarial Liability	$43,989,368
Funded Ratio	56.3%

2. EXECUTIVE SUMMARY *(continued)*

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS

A comparison of the results of this valuation and the January 1, 2018 valuation is shown below (in thousands).

	1/1/19	1/1/18	Increase (Decrease)	Increase (Decrease)
Total Normal Cost	$1,996,729	$1,897,356	$99,373	5.2%
Expected Employee Contributions	1,355,905	1,305,290	50,615	3.9%
Net Normal Cost	$640,824	$592,066	$48,758	8.2%
Administrative Expenses	$69,400	$64,600	$4,800	7.4%
Optional Retirement Plan Payment	14,600	13,500	1,100	8.1%
3(8)(c) Amounts Transferred to Other Systems	19,500	19,400	100	0.5%
Total Expenses and Transfers	$103,500	$97,500	$6,000	6.2%
Net Normal Cost Plus Expenses and Transfers	$744,324	$689,566	$54,758	7.9%
Actuarial Liability				
Actives	$42,085,916	$40,075,804	$2,010,112	5.0%
Retirees and Inactives	58,564,828	56,241,090	2,323,738	4.1%
Total	$100,650,744	$96,316,894	$4,333,850	4.5%
Assets (Actuarial Value)	56,661,376	54,918,125	1,743,251	3.2%
Unfunded Actuarial Liability	$43,989,368	$41,398,769	$2,590,599	6.3%
Funded Ratio	56.3%	57.0%	(0.7)%	

Total Expenses and Transfers

In our 2017 valuation, we began showing the expense and transfer items separately from the normal cost. Administrative expenses (including PERAC's administrative expenses) reflect the expenses from the most recent Annual Statements excluding investment related expenses and the Optional Retirement Plan (ORP) payment which is shown separately for the SRS. The ORP payment is the amount transferred by statute from the Commonwealth (previously from SRS) to the ORP for higher education employees. By including this payment as part of the normal cost, we have treated it as a reimbursement to the pension trust fund. Finally, $19.5 million is included for amounts transferred to other systems under Section 3(8)(c) for members with SRS and TRS service who retired from another system. Section 3(8)(c) receipts from other systems are transferred to the State's general account. By including the Section 3(8)(c) disbursements with normal cost, the net Section 3(8)(c) cash flow is zero for funding purposes.

Gain/(Loss) and Change in Unfunded Actuarial Liability (UAL)

The development of the actuarial gain/(loss) is shown in Section 4. During 2018, there was an overall actuarial loss of $280 million. There was a non-investment related gain on actuarial liability of approximately $165 million and a loss on assets (on an actuarial value basis) of approximately $445 million. The return on assets was approximately 6.9% on an AVA basis compared to -1.8% on a market value basis.

PERAC values system assets using a smoothing technique which spreads gains and losses over short periods (5 years) and employs a "corridor" so that the actuarial value is within 10% of the market value of assets. The calculated AVA as of January 1, 2019 is 102.8% of the market value and is within the specified corridor.

The UAL increased from $41.4 billion as of January 1, 2018 to $44.0 billion as of January 1, 2019. The UAL would have only increased to $42.9 billion and the funded ratio would have been 56.9% had there been no change in the investment return assumption (see next sections).

Actuarial Assumptions

Investment Return

The January 1, 2019 report reflects a 7.25% investment return assumption (reduced from the 7.35% assumption in the January 1, 2018 valuation). The investment return assumption previously decreased four times from the 8.25% assumption as of January 1, 2012 (see detail on page 8). As part of this valuation, we considered whether to maintain the 7.35% assumption used in 2018 or reduce it further. Although a case can be made to maintain this assumption, we believe a stronger case can be made to slightly reduce it.

Early this year, NEPC, PRIT's investment consultant, provided figures for 30-year expected return projections using a building block approach, the target allocation, and expected long-term returns by asset class. The expected annual return is 7.9% (7.4% assuming expenses of 50 basis points and the expected return reflects a gross return) in this study. This figure is 20 basis points higher than the figure from the study released last year despite a more conservative allocation adopted by PRIT. Note that the 7.9% average expected return does not mean that the expected return each year will be 7.9%. In fact, over the shorter term (5-7 years) the average expected return is 6.8% (also 20 basis points higher than last year). Greater expected returns in later years determined NEPC's long-term projection. The NEPC projected returns are one measure we use to determine the long-term investment return assumption.

A comparison of recent expected return projections as well as historical PRIT returns is shown below.

	Expected Annual Return (gross)						
	2013	2014	2015	2016	2017	2018	2019
5-7 year expected return	7.4%	7.1%	6.8%	6.8%	6.8%	6.6%	6.8%
30 year expected return	8.2%	8.2%	7.9%	7.8%	7.8%	7.7%	7.9%

Actual Returns as of December 31, 2018	
2018	-1.8%
5 years (2014-2018)	6.4%
10 years (2009-2018)	9.1%
20 years (1999-2018)	6.9%
34 years (1985-2018)	9.3%

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS *(continued)*

The increase in both the short-term and long-term projections was unexpected especially since the 2019 study used a more conservative asset allocation than the 2018 study. The reason for the increase is primarily due to an increase in the projected returns by asset class and an increase in interest rates.

In past valuations, we primarily used the NEPC study to help us determine a reasonable range for the investment return assumption. In addition, we reviewed other capital market studies for comparison. However, with the unexpected result in the NEPC projection described above, this year we relied more on the other studies.

One study that we use for comparison is the Horizon study. This study compares 34 different investment consultants (including NEPC). The most recent Horizon study was published in August 2018. Overall, this study continued to show the trend of decreasing expected investment returns. As a result, we are generally recommending a slight decrease in this assumption for 2019 valuations of PRIT systems.

Furthermore, we believe placing greater reliance on the shorter-term expectation is a reasonable approach. In addition, the most recent NASRA study (February 2019) shows the average investment return assumption used for large public plans across the country (7.28%) continues to decrease. The February 2018 NASRA study showed the average assumption to be 7.36%. Note that these results are for comparison only as differences in investment allocations are not considered.

The 7.28% national average shown above would likely decrease if the 2019 assumptions for all state systems were known and included. For example, the study does not include the decision earlier this year to use a 7.25% assumption for the SRS and TRS.

The change in the investment return assumption increased the normal cost by $44 million and the actuarial liability by $1.05 billion.

<u>Mortality</u>
In our 2011 actuarial valuation, we began reflecting future mortality improvement (longer life expectancy). Each year we modified this assumption as we moved closer to a fully generational mortality assumption (a two dimensional table based on a member's age and calendar year that includes all expected future mortality improvements). Based on our analysis of SRS and TRS retiree mortality during 2012, 2013, and 2014, we adopted a fully generational assumption in the 2015 valuation. In early 2017, we analyzed retiree mortality experience during 2015 and 2016. We adopted updated generational mortality assumptions for superannuation retirees in our 2017 actuarial valuation. For SRS, we adopted a blue collar version of the RP-2014 table for superannuation retirees as it best matched our experience. For TRS and Boston teachers, we adopted the RP-2014 White Collar table. We maintained these assumptions in this valuation. We will review retiree mortality in 2017 and 2018 before completing the 2020 actuarial valuation.

Job groups
We noted several issues relating to job group as part of the valuation data we received from SRS and made adjustments as we have in the past. As we have done in previous years, we changed the job group for about 90 University of Massachusetts Police members (from Group 1 to Group 2).

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS *(continued)*

In the 2017 valuation, we analyzed costs for certain members of the Department of Mental Health (DMH) and Social Services who were coded as job Group 1. We determined plan liabilities for these members based on both Group 1 and Group 2 status. DMH members with certain titles and Social Services workers with 10 years of service in certain capacities are eligible to be in Group 2. Based on our discussions with SRS, most of these members will ultimately be eligible for Group 2 status. By assuming these members will ultimately be in Group 2, we are being somewhat conservative. We used the results of our 2017 work to estimate the increase in actuarial liability due to this adjustment to be approximately $140 million in this valuation.

Other Chapter 176 issues

There are several other changes under Chapter 176 that we have discussed in previous valuations that have the most impact on decreasing plan liabilities over the longer term. These include an increase in the normal retirement age by two years (for example, from age 65 to age 67 for Group 1 members), an increase in the age (early retirement) reduction factors for ages below the maximum age (from a 4.0% to a 6.0% annual reduction), and an increase in the period for determining a member's average annual compensation (from 3 years to 5 years). These changes are effective only for members hired after April 1, 2012.

As of January 1, 2019, there were approximately 68,500 members hired after April 1, 2012. The employer normal cost is approximately $108 million lower than it would have been if the prior provisions were in place for these members. The actuarial liability is approximately $570 million lower than it would have been if the prior provisions were in place.

Teachers

We have detailed a number of the assumptions we made for missing or questionable data for active members of the TRS in Part C of Section 7. TRS implemented a new software system with the data submission for the January 1, 2014 valuation. As part of the 2014 and 2015 valuations, we identified several issues that TRS subsequently reviewed prior to the January 1, 2016 data submission. Since then, the data submissions for valuations have improved.

Boston Teachers

The Boston Retirement System (BRS) also implemented a new system with the data submission for the January 1, 2014 valuation. As part of the 2014 valuation, we identified several issues that BRS subsequently reviewed prior to the January 1, 2015 data submission and we believed the data submission improved in 2016 and 2017. In 2018, we found several issues regarding the number of active members and reported pay. We asked the Board to review approximately 500 active members with reported pay decreases of more than 20%. The review found approximately 250 of those members actually terminated employment in 2017, but due to a retroactive payment from a recent contract settlement, the data provided showed these former members as active as of January 1, 2018. For many of the others with significant reported pay decreases, the reason was due to a leave of absence during the year. In this valuation, there were almost no active members with this issue.

We reduced the pay provided by 5.1% to reflect contract settlements retroactive to 2016 that were settled February, 2018. Despite this reduction, the pay for continuing active members increased by 6.7%. We expect some of this increase reflects estimated pay in this and last year's valuations.

2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS

The UAL and funded ratio are measures of the plan's funded status. These measures reflect the plan's position as of January 1, 2019. We believe these measures alone are not appropriate for assessing the sufficiency of assets to cover the estimated cost of settling the Commonwealth's benefit obligations or assessing the need for or the amount of future contributions. However, we believe these measures, in conjunction with maintaining the appropriations required under the Commonwealth funding schedule, are appropriate for assessing the amount of future contributions.

The nature of actuarial funding is that assets gradually catch up to the actuarial liability. When pension funding was adopted in 1987, the initial amortization period was established as 40 years. Based on the amortization basis of the schedules adopted, the UAL was expected to increase for a period of time. However, due to actual investment returns significantly exceeding the expected return in the 1990's, the UAL actually decreased until January 1, 2000.

It is important to note that plan assets have grown faster than plan liabilities, despite recent assumption changes and plan amendments (outlined on the next page) that have increased plan liabilities. As of January 1, 1990, the actuarial liability was $20.0 billion and assets were $7.8 billion. The difference of $12.2 billion was the UAL. As of January 1, 2019, the actuarial liability is $100.7 billion and the actuarial value of assets is $56.7 billion. The difference of $44.0 billion is the UAL. The actuarial liability has grown 5.0 times over this period ($100.7B / $20.0B). But assets have grown 7.3 times over this same period ($56.7B / $7.8B).

For this reason, we believe the funded ratio represents a better measure of the Commonwealth's progress. If you draw a straight line from the 1990 funded ratio of 39.0% to the January 1, 2019 ratio of 56.3%, the line is moving upward to the right. This demonstrates the funding progress to date despite significant assumption and plan changes since 2009 that have increased plan liabilities (see next page). Similar changes made prior to 2009 have also dampened funding progress. Although the funded ratio reached 85.2% on January 1, 2000, this was the result of average annual returns from 1985-1999 that exceeded 12.5% and attaining such a high level of funding so quickly was not expected. Over the past 19 years (2000-2018), the average annual return on assets on a market value basis is approximately 6.2%. Over a 10-year and 5-year period, the returns have been 9.3% and 6.5% respectively. The 34-year return (since inception) is 9.3%. All returns are shown gross of investment fees.

As outlined above, the actuarial liability as of January 1, 2019 increased $1.05 billion to reflect a decrease in the investment return assumption. There have been a number of other plan and assumption changes since 2009 that have increased the actuarial liability. These changes include four other separate reductions in the investment return assumption, annual adjustments to the mortality assumption prior to the change to a fully generational assumption as of January 1, 2015, with subsequent adjustments in 2017 and 2018. The other changes include the adoption of a $13,000 COLA base, the transfer of active members of sheriff departments in six counties to the SRS, the transfer of former members of the Massachusetts Turnpike Authority Retirement System to the SRS, the transfer of ORP members to the SRS, the 2015 ERI, the 2016 ERI for toll collectors, and the adoption of a $14,000 COLA base for Boston Teachers. Including the changes as of January 1, 2019, the unfunded actuarial liability is approximately $13.9 billion greater than it would have been using the 2009 valuation assumptions and plan provisions. Therefore, on a comparable basis with the 2009 assumptions and plan provisions, the UAL on January 1, 2019 would be $30.1 billion and the funded ratio would be 65.3%.

2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS *(continued)*

Change in Unfunded Actuarial Liability since 2009 Valuation (in billions)

	State	Mass. Teachers	Boston Teachers	Total
Assumption Changes	$4.18	$7.61	$.62	$12.41
Plan Amendments	1.14	0.15	0.15	1.44
Total	$5.32	$7.76	$.77	$13.85

Assumption changes (with valuation date reflected)	(in millions)
Reduction in investment return assumption from 8.25% to 8.0% (2013)	$1,670
Reduction in investment return assumption from 8.0% to 7.75% (2015)	1,947
Reduction in investment return assumption from 7.75% to 7.50% (2016)	2,218
Reduction in investment return assumption from 7.50% to 7.35% (2018)	1,520
Reduction in investment return assumption from 7.35% to 7.25% (2019)	1,053
Adoption of fully generational mortality assumption (2015)	1,700
Other mortality adjustments (2012, 2013, 2014)	1,050
Mortality adjustment (2017)	1,574
Mortality adjustment (2018)	9
Other experience study changes (2013)	(335)
Total	$12,406

Plan amendments (with valuation date reflected)	
Transfer of Massachusetts Turnpike Authority (2010)	$136
Transfer of sheriff departments (2011)	225
Boston Teachers (2011)	127
$13,000 COLA base (2012)	298
$14,000 COLA base for Boston Teachers (2018)	14
Early Retirement Incentive (2016)	230
Transfer of ORP members (2016)	400
Early Retirement Incentive for toll collectors (2017)	10
Total	$1,440

2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS *(continued)*

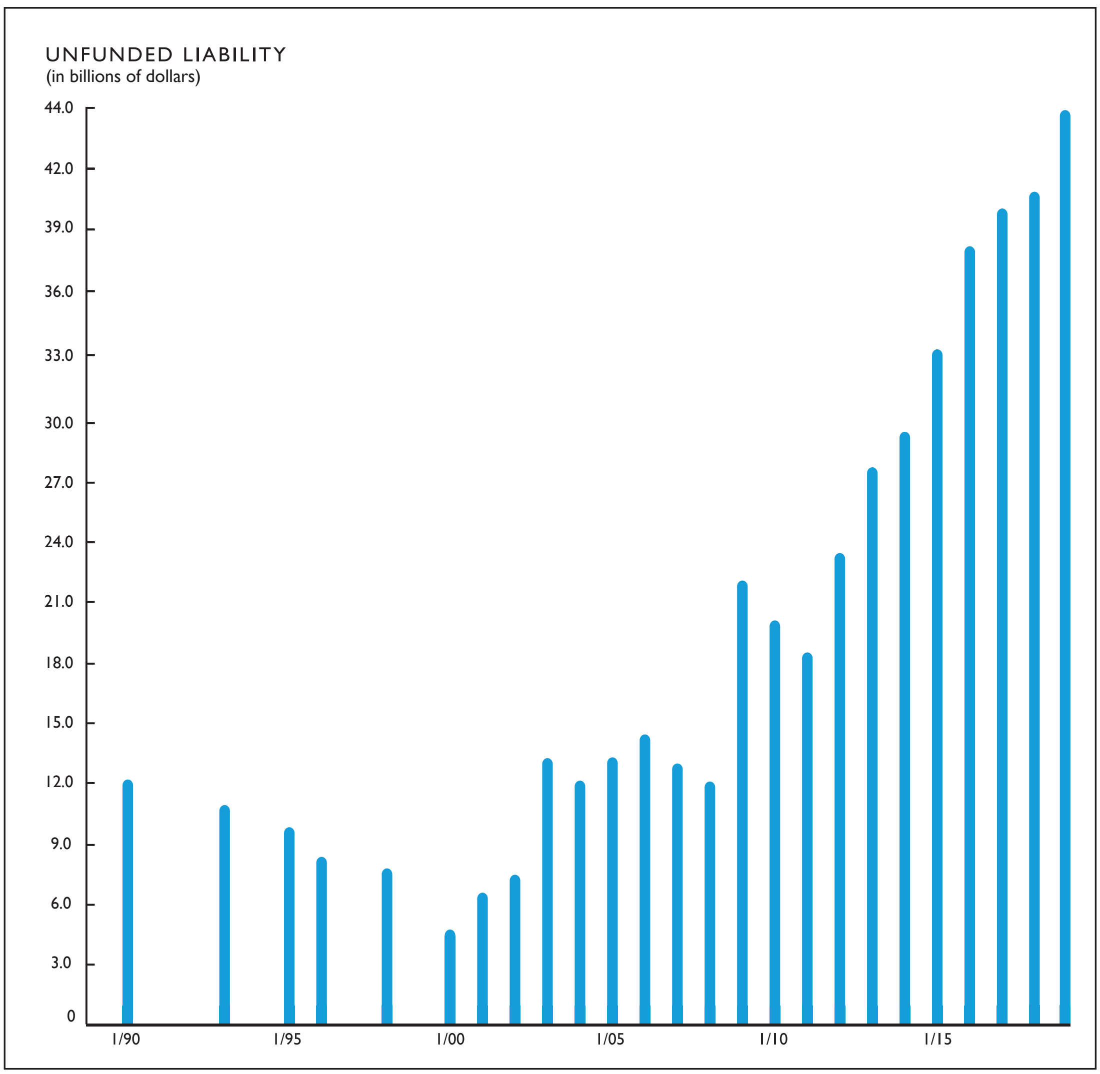
UNFUNDED LIABILITY

The chart below shows the Commonwealth's Unfunded Actuarial Accrued Liability (UAL) since 1990. The UAL represents the actuarial accrued liability less the actuarial value of plan assets. When there is no UAL, a system is said to be "fully funded". In this exhibit, estimates were developed for years prior to 2000 to reflect our implementation of updated actuarial software at that time.

The UAL is $44.0 billion. On a market value basis, the UAL is $45.6 billion.

The UAL increased $2.59 billion since January 1, 2018. The revised assumptions and change in plan provisions increased the UAL by $870 million. If the 2019 valuation reflected the 2018 valuation assumptions and plan provisions, the UAL would have been $43.1 billion.

Based on the current funding schedule and the results of this valuation, if going forward, the actuarial assumptions are exactly realized and there are no changes in the assumptions or plan provisions each year, the UAL is scheduled to increase until FY26 before decreasing each year until FY36 with a final amortization payment in FY37.



2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS *(continued)*

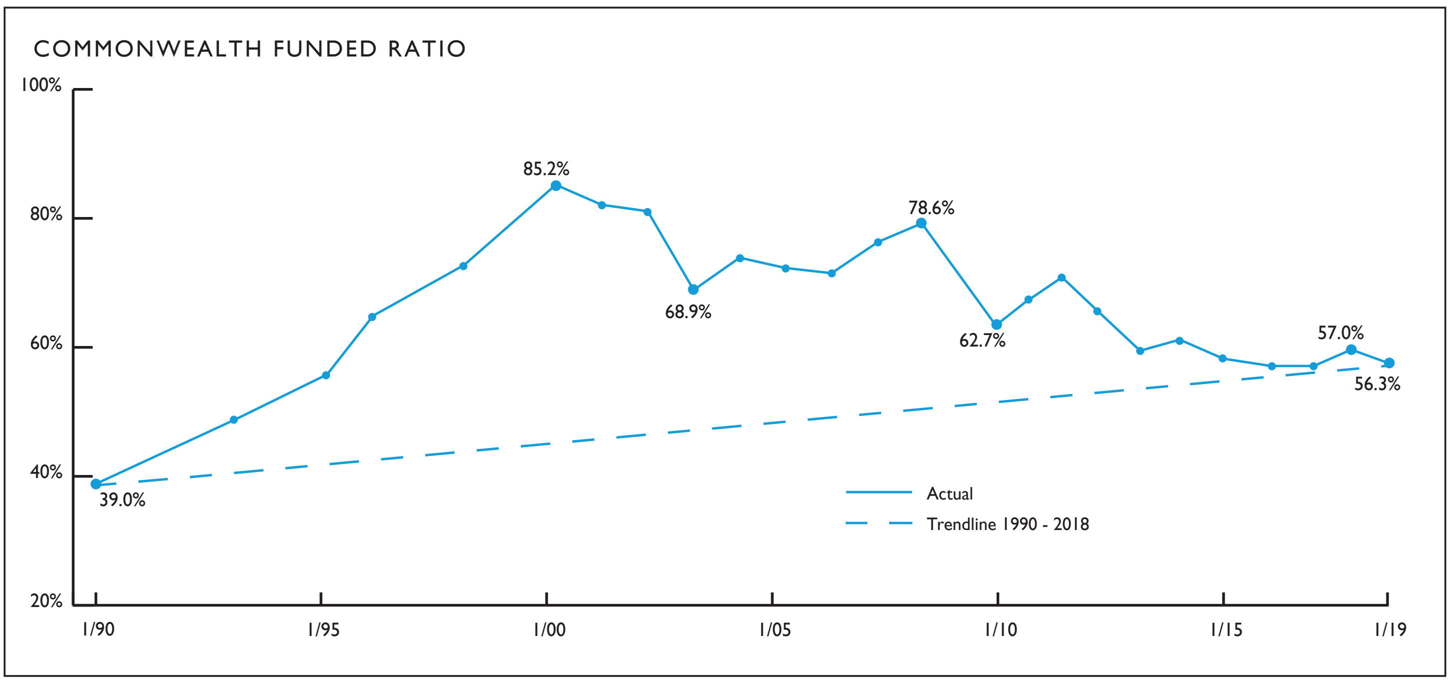
FUNDED RATIO

The chart below shows the Commonwealth's funded ratio progress since 1990. The funded ratio represents the actuarial value of plan assets divided by the actuarial accrued liability. When the funded ratio reaches 100%, a system is said to be "fully funded". In this exhibit, estimates were developed for years prior to 2000 to reflect our implementation of updated actuarial software at that time.

The funded ratio is 56.3%. On a market value basis, the funded ratio is 54.7%.

The funded ratio decreased from 57.0% as of January 1, 2018 to 56.3% as of January 1, 2019. If the 2019 valuation reflected the 2018 valuation assumptions and plan provisions, the funded ratio would have been 56.7%.

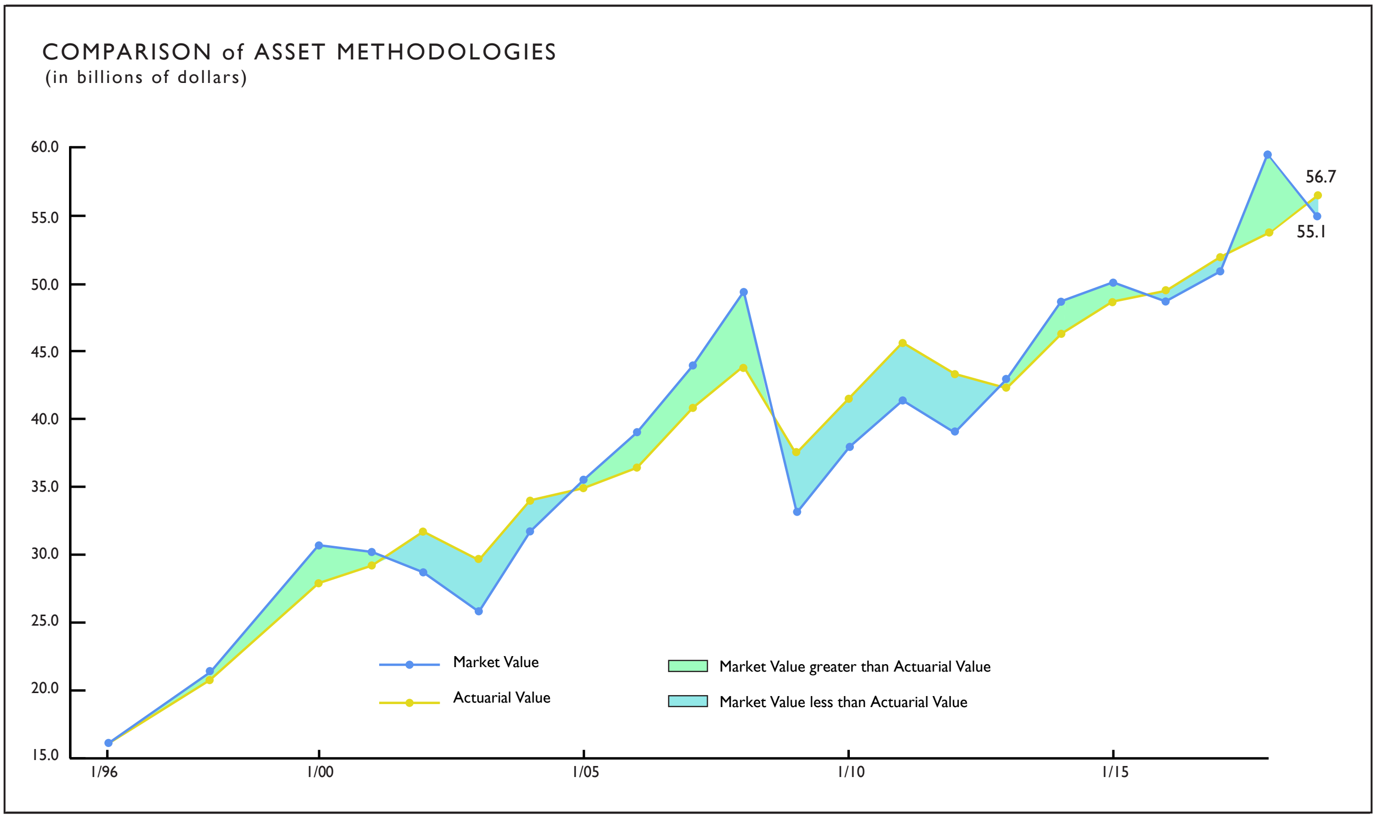
Based on the current funding schedule and the results of this valuation, if going forward, the actuarial assumptions are exactly realized and there are no changes in the assumptions or plan provisions each year, the funded ratio is expected to be 100% in FY37.



2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS *(continued)*
COMPARISON OF MARKET AND ACTUARIAL VALUE OF ASSETS

In valuations prior to 1998, plan assets were determined at market value. As part of the 1998 valuation, this methodology was adjusted to reduce the potential volatility in the market value approach from year to year. The actuarial value of assets recognizes investment gains and losses over a five-year period. Therefore, in some years, the actuarial value will be less than the market value and in other years, the actuarial value will exceed the market value.



2. EXECUTIVE SUMMARY *(continued)*

PART D | RISK

Risk is defined as the potential for differences in future plan measurements resulting from actual future experience deviating from actuarial assumed experience. The plan is subject to a number of risks that could affect its future financial condition. Examples of risks include the following:

Investment risk- the potential that investment returns will be different than expected;

Asset/liability mismatch risk- the potential that changes in asset values are not matched by changes in the value of liabilities;

Interest rate risk- the potential that interest rates will be different than expected;

Longevity and demographic risk- the potential that mortality or other demographic experience will be different than expected;

Contribution risk- the potential that employer contributions to the plan will not be made, or will not be made at the assumed level.

In this section, we provide a brief analysis of several risk measures that we believe are most significant for SRS and TRS. A more detailed risk assessment that includes further scenario testing (assessing the impact of one or several events on the plan's financial condition, for example projecting plan investment returns), stress testing (assessing the impact of an adverse change in one or several factors), sensitivity testing (assessing the impact of a change in an actuarial assumption), or stochastic modeling (generating numerous possible outcomes by allowing for random variations in input items to assess the distribution of the outcomes) may provide a better understanding than the analysis in this section.

Unfunded Actuarial Liability and Funded Ratio

We previously discussed in detail the impact of assumption and plan provision changes on the Unfunded Actuarial Liability and the Funded Ratio (see pages 7-10).

Investment Return Assumption

The investment return assumption of 7.25% is consistent with our 2019 recommendation. Currently 29 systems use an assumption of 7.25% or lower. We expect the number of systems using an assumption of 7.25% or lower to increase as more of the 2019 actuarial valuations are completed.

Funding Schedule and Amortization Basis

Amortization of UAL basis: 8.94% total appropriation increase to FY36

It is important to note that our emphasis for over the past 5 years has been to establish funding schedules that complete the amortization of the UAL no later than FY35. This allows systems some flexibility in the event of another market downturn. In 2011, the Commonwealth adopted a schedule that extended the amortization of the UAL to FY40 due to the 2008 investment loss. In 2014, the schedule reduced the amortization period to FY36. The 2017 schedule maintained the FY36 date by increasing the level of future appropriations.

2. EXECUTIVE SUMMARY *(continued)*

PART D | RISK *(continued)*

A related priority to fully funding the System by FY35 is limiting the amount and period of "negative amortization". Negative amortization occurs while the UAL increases in the funding schedule. The reason it occurs is that the amortization payment for a given year is not large enough to pay the interest on the UAL. Negative amortization often occurs in amortization schedules with annual increasing payments. Negative amortization is acceptable as long as it is only for a limited period of time. We believe the goal for all systems should be to eliminate negative amortization by FY21. The negative amortization for the Commonwealth schedule extends to FY25.

A large number of Massachusetts systems have adopted schedules that increase the total appropriation by a set percentage for a period of time (or the entire length of the schedule). The Commonwealth schedule reflects this methodology. Since the level of annual increase exceeds 6.0%, there is some risk in whether such a level of annual increase is sustainable. However, the Commonwealth has consistently met (and increased as necessary) the higher level of appropriations since the 2011 schedule was adopted.

Maturity and Volatility Measures

There are a number of plan maturity and volatility ratios that can provide significant insight into the level of a plan's risk. To illustrate, we are providing two such measures. In both cases, we show the 10-year history of the ratio. In addition, we comment on how the results compare with local systems. We believe that these measures are more useful when compared to historical averages and the results of other plans. See our comments in PART C with respect to assumption changes and plan amendments over this period, which significantly affect these results.

Retiree Actuarial Liability / Total Actuarial Liability

This ratio measures the percentage of actuarial liability due to the plan's retirees. Higher ratios and/or an increase in this ratio indicate a system that is more mature or becoming more mature. As this ratio increases, it generally indicates the retired population is increasing faster than the active member population and there is a greater likelihood of negative cash flow (benefit payments exceeding employer and employee contributions). Retirees in pay status are more expensive than younger members. As a plan matures, it becomes more sensitive to investment volatility and the plan will have more difficulty recovering from losses even with increases in employer contributions.

SRS Retiree Actuarial Liability / Total Actuarial Liability

Valuation Date										
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0.46	0.48	0.48	0.49	0.49	0.50	0.50	0.53	0.54	0.54	0.55

TRS Retiree Actuarial Liability / Total Actuarial Liability

Valuation Date										
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0.54	0.55	0.56	0.58	0.59	0.59	0.59	0.58	0.58	0.58	0.57

2. EXECUTIVE SUMMARY *(continued)*

PART D | RISK *(continued)*

The ratios for SRS show a steady increase. The ratios for TRS are fairly consistent. Both plans are fairly mature. Public sector plans often have aging populations generating an increase in this ratio. We have found this to be generally true for the systems for which PERAC is the actuary. In 2009, this ratio ranged from .31 to .57. In recent valuations this range has increased to .44 to .64. These plans have consistently been within these ranges. Most systems have seen an increase in this ratio over the past 10-15 years (like SRS) as the number of retirees, and specifically the retiree liability has increased as a percentage of the total. A number of systems have had fairly consistent ratios (like TRS) and a few have had decreasing ratios. Such systems have already reached and or maintained a more mature level.

Actuarial Liability / Pay

This measure reflects how a change in actuarial liability (and therefore UAL) may impact the adequacy of contributions. As this ratio increases, plan contributions (using a traditional amortization schedule) increase as a percentage of pay. Furthermore, like the Retiree Liability ratio noted above, higher ratios exacerbate the impact of investment losses on plan contributions.

SRS Actuarial Liability / Pay

Valuation Date										
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
5.0	5.3	5.5	5.6	5.7	5.7	6.0	6.4	6.5	6.6	6.7

TRS Actuarial Liability / Pay

Valuation Date										
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
6.0	6.1	6.3	6.5	6.8	6.8	7.1	7.3	7.5	7.6	7.6

Both systems show gradually increasing rates. For comparison with other PERAC systems, in 2009, this ratio ranged from 3.8 to 6.5. For recent valuations, this range has increased. The ratios currently range from 5.6 to 8.6. Again, both systems have been consistently within these ranges. These ratios indicate an increased level of risk for the plans.

Impact of Investment Returns on Unfunded Liability and Funded Ratio (Market Value Basis)

We have prepared simple 5-year projections illustrating the potential impact of actual investment returns on funding levels for both SRS and TRS. For these estimates, we used the market value of assets and did not attempt to develop an actuarial value of assets. In projecting the actuarial liability, we assumed the January 1, 2019 actuarial assumptions are exactly realized over the next 5 years and that there are no changes in assumptions over this period.

We first projected the market value of assets assuming the actual return for each of the next 5 years is 7.25% (the assumption used in the valuation). For comparison, we have also shown the results if the return were 3.0% each year. The 3.0% assumption is not intended to be a worst case basis, but only to reflect the impact of a lower short-term return than the current plan assumption. As discussed earlier in the Executive Summary, projected returns are lower over the next 10 years than over the next 30 years.

2. EXECUTIVE SUMMARY *(continued)*

PART D | RISK *(continued)*

State Retirement System Projections

	Valuation Date					
	2019	2020	2021	2022	2023	2024
UAL (in millions)						
7.25%	16.2	16.8	17.4	17.9	18.3	18.6
3.00%	16.2	17.9	19.7	21.4	23.2	24.9
Funded Ratio						
7.25%	61.9%	61.9%	62.1%	62.5%	63.0%	63.7%
3.00%	61.9%	59.4%	57.1%	55.0%	53.1%	51.3%

Massachusetts Teachers' Retirement System Projections

	Valuation Date					
	2019	2020	2021	2022	2023	2024
UAL (in millions)						
7.25%	26.8	27.6	28.4	29.0	29.7	30.2
3.00%	26.8	28.7	30.7	32.7	34.6	36.7
Funded Ratio						
7.25%	50.3%	50.4%	50.7%	51.1%	51.6%	52.3%
3.00%	50.3%	48.4%	46.6%	45.0%	43.5%	42.1%

For this comparison, we assumed that for the 3.0% projections, the appropriation for the next 5 years would remain as in the current funding schedule (and the same as that if the actual returns were 7.25% per year). If actual returns were in fact 3.0% per year, the funding schedule would almost certainly need to be increased before FY24.

This analysis shows that even if the fund exactly meets expectations for the next few years, the UAL will continue to increase. This demonstrates the concept of negative amortization discussed earlier in this section. Note that under the 7.25% analysis, the funded ratio gradually increases over the next few years. The funded ratio will begin to increase more rapidly over the last 12 years of the schedule, assuming that all assumptions are exactly realized.

3. SUMMARY OF VALUATION RESULTS

(Dollars in thousands)

A. Number of Members	State	Mass. Teachers	Boston Teachers	Local COLA	Total
Active	87,969	94,103	6,358		188,430
Vested Terminated	4,119	0	0		4,119
Retired/ Beneficiaries	64,758	67,110	4,790		136,658
Total	156,846	161,213	11,148		329,207
B. Total Payroll	$6,354,473	$7,074,960	$565,022		$13,994,455
C. Normal Cost					
Superannuation	$650,244	$836,797	$69,400		$1,556,441
Death	78,129	26,581	2,167		106,877
Disability	94,710	12,391	1,009		108,110
Termination	107,028	107,904	10,369		225,301
Total Normal Cost	$930,111	$983,673	$82,945		$1,996,729
Expected Employee Contributions	578,733	719,517	57,655		1,355,905
Net Employer Normal Cost	$351,378	$264,156	$25,290		$640,824
Administrative Expenses	$33,400	$27,000	$9,000		$69,400
Optional Retirement Plan Payment	14,600	0	0		14,600
3(8)(c) Amounts Transferred to Other Systems	15,000	4,500	0		19,500
Total Expenses and Transfers	$63,000	$31,500	$9,000		$103,500
Net Normal Cost Plus Expenses & Transfers	$414,378	$295,656	$34,290		$744,324
D. Actuarial Liability					
Active					
Superannuation	$16,855,002	$21,518,721	$1,314,549		$39,688,272
Death	546,299	206,690	14,438		767,427
Disability	457,975	123,927	8,359		590,261
Termination	457,314	538,295	44,347		1,039,956
Total Active	$18,316,590	$22,387,633	$1,381,693		$42,085,916
Vested Terminated (a)	825,378	700,000	105,000		1,630,378
Non-Vested Terminated	208,971	0	0		208,971
Retirees and Survivors	23,244,285	30,776,508	2,574,686	130,000	56,725,479
Total Actuarial Liability	$42,595,224	$53,864,141	$4,061,379	$130,000	$100,650,744
E. Actuarial Value of Assets	27,136,639	27,854,444	1,670,293	0	56,661,376
F. Unfunded Actuarial Liability	$15,458,585	$26,009,697	$2,391,086	$130,000	$43,989,368
G. Funded Ratio: E/D	63.7%	51.7%	41.1%	0.0%	56.3%

(a) Massachusetts Teachers' and Boston teachers' amounts are estimated and includes non-vested terminated members.

4. DEVELOPMENT OF THE ACTUARIAL GAIN OR LOSS *(in millions)*

		State	Mass. Teachers	Boston Teachers	Local COLA	Total
A.	Gain/(loss) on Actuarial Liability					
1.	Actuarial Liability 1/1/18	40,457	51,653	4,075	132	96,317
2.	Total Normal Cost 1/1/18	888	934	75		1,897
3.	Interest on (1) and (2) at 7.35%	3,039	3,865	305	10	7,219
4.	Benefits paid during 2018 [a]	2,225	2,975	250	20	5,470
5.	Interest on (4) assuming mid year payment	82	109	9	1	201
6.	Expected Actuarial Liability before adjustments: (1)+(2)+(3)-(4)-(5)	42,077	53,368	4,196	121	99,762
7.	Increase due to changes in assumptions	434	577	42		1,053
8.	Expected Actuarial Liability 1/1/19 after adjustments: (6)+(7)	42,511	53,945	4,238	121	100,815
9.	Actuarial Liability 1/1/19	42,595	53,864	4,061	130	100,650
10.	Gain/(loss): (8)-(9)	(84)	81	177	(9)	165
B.	Gain/(loss) on assets					
1.	Actuarial Value of Assets (AVA) 1/1/18	26,248	27,058	1,612		54,918
2.	Interest on (1) at 7.35%	1,929	1,989	118		4,036
3.	Net Receipts [b]	714	837	143		1,694
4.	Net Disbursements [b]	1,594	1,860	199		3,653
5.	Net Cash Flow: (3)-(4)	(880)	(1,023)	(56)		(1,959)
6.	Interest on (5) assuming mid-year	(32)	(38)	(2)		(72)
7.	Expected AVA 1/1/19 before method change: (1)+(2)+(5)+(6)	27,265	27,986	1,672		56,923
8.	Increase due to change in methodology	87	91	5		183
9.	Expected AVA 1/1/19 after method change: (7)+(8)	27,352	28,077	1,677		57,106
10.	AVA 1/1/19	27,137	27,854	1,670		56,661
11.	Gain/(loss): (10)-(9)	(215)	(223)	(7)		(445)
C.	Total Gain/(loss): (A10)+(B11)	(299)	(142)	170	(9)	(280)

Figures may not add due to rounding.

[a] Estimated

[b] Amounts actually received or disbursed by the fund.

5. AUDIT INFORMATION

The Commonwealth valuation reports prior to 2015 included information required under Governmental Accounting Standards Board (GASB) Statement No. 27 (GASB 27). The Commonwealth began implementing GASB 27 in Fiscal Year 1996. GASB 27 has been replaced by GASB 68. In addition, GASB 67 replaces the requirements under GASB 25.

GASB 67 reflects plan financial statement reporting and was first effective for the plan year ending June 30, 2014. GASB 68 reflects employer financial statement reporting and was first effective for the fiscal year ending June 30, 2015.

We have not provided any GASB 67 or GASB 68 exhibits for SRS or TRS in this valuation report. These exhibits are provided separately.

6. ASSETS

PART A | STATE AND MASSACHUSETTS TEACHERS'

(Dollars in thousands)

	State	Mass. Teachers
Pension Reserves Investment Trust		
Market Value	$26,384,598	$27,090,335
Actuarial Value	$27,136,639	$27,854,444
Actuarial Value as a Percentage of Market Value	102.9%	102.8%

The actuarial value of assets (AVA) is determined so that 20% of the investment gain and loss in a given year is recognized annually for the next five years. Therefore, these investment gains and losses are fully recognized after five years. In addition to this treatment of gains and losses, we use a "corridor" approach so that the actuarial value of assets can never be too far from the market value of assets. Under our approach for the Commonwealth, the actuarial value cannot be less than 90% nor greater than 110% of the market value. As of January 1, 2019, the AVA is within the specified corridor.

We made a slight modification in the AVA methodology in this valuation. The change was made to mirror the methodology we use in the local system actuarial valuations. The change increased the AVA by approximately $87 million for the SRS and $91 million for the TRS.

PART B | BOSTON TEACHERS

Based on the enactment of Chapter 112 of the Acts of 2010, the assets of the Boston Teachers are maintained by PRIM. The transfer of these assets occurred during 2010. We set the actuarial value of assets to 102.8% of the market value based on the results for SRS and TRS.

Market Value	$1,624,799
Actuarial Value	$1,670,293

The change in methodology described above increased the AVA by approximately $5 million for Boston Teachers.

6. ASSETS *(continued)*

PART C | DEVELOPMENT OF ACTUARIAL VALUE OF ASSETS

(Dollars in thousands)

A. Development of total investment income (incl. appreciation)	State	Mass. Teachers	Total
1. Market value of assets 12/31/17	27,735,916	28,597,562	56,333,478
2a. Net Receipts *	714,056	836,731	1,550,787
b. Net disbursements *	1,593,691	1,860,435	3,454,126
c. Cash flow: (a) – (b)	(879,635)	(1,023,704)	(1,903,339)
3. Market value of assets 12/31/18	26,384,598	27,090,335	53,474,933
4. Investment income including appreciation: (3) – (1) – (2(c))	(471,683)	(483,523)	(955,206)
B. Expected market value development			
1. Market value of assets 1/1/18	27,735,916	28,597,562	56,333,478
2. Cash flow (A2(c))	(879,635)	(1,023,704)	(1,903,339)
3. Expected Return on (1)	2,038,590	2,101,921	4,140,511
4. Expected return on cash flow A2(c) x 0.0735 / 2	(32,327)	(37,621)	(69,948)
5. Expected market value 12/31/18 (1)+(2)+(3)+(4)	28,862,544	29,638,158	58,500,702
C. Gain/(loss) for year: A3-B5	(2,477,946)	(2,547,823)	(5,025,769)
D. Development of Actuarial Value of Assets			
1. Beginning of year market value	26,384,598	27,090,335	53,474,933
2a. Asset gain/(loss) in prior year	(2,477,946)	(2,547,823)	(5,025,769)
b. Asset gain/(loss) in 2nd prior year	2,450,373	2,537,146	4,987,519
c. Asset gain/(loss) in 3rd prior year	122,188	136,381	258,569
d. Asset gain/(loss) in 4th prior year	(1,443,914)	(1,513,452)	(2,957,366)
3. Unrecognized gain/(loss) .8 x [2a] + .6 x [2b] + .4 x [2c] +.2 x [2d]	(752,041)	(764,109)	(1,516,150)
4. Beginning of year actuarial value of assets: [1] - [3]	27,136,639	27,854,444	54,991,083
5. Actuarial value / Market value	102.9%	102.8%	102.8%
6. Adjusted actuarial value: (4) but not less than 90% nor greater than 110% of market value	27,136,639	27,854,444	54,991,083

*Reflects actual cash flow of PRIT Fund

7. SYSTEM MEMBERSHIP

PART A | STATE ACTIVE MEMBERS

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the State Retirement System.

	Actives	Vested Terminations
Number of Members	87,969	4,119
Average Age	47.0	53.2
Average Service	12.5	14.9
Average Salary	$72,235	$65,508
Average Annuity Savings Fund Balance	$67,586	$69,929

Age by Service Distribution of Active Members

Years of Service

Present Age	0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30+	Total
0 - 24	2,056	4						2,060
25 - 29	6,222	931	6					7,159
30 - 34	5,512	3,156	963	11				9,642
35 - 39	3,816	2,478	2,861	490	8			9,653
40 - 44	2,717	1,830	2,231	1,832	531	10		9,151
45 - 49	2,425	1,680	2,220	1,966	2,074	737	51	11,153
50 - 54	2,121	1,651	2,078	1,769	1,925	1,813	1,221	12,578
55 - 59	1,757	1,486	1,863	1,649	1,545	1,563	2,730	12,593
60 - 64	1,025	1,054	1,357	1,341	1,238	1,070	1,922	9,007
65+	419	569	862	724	653	521	1,225	4,973
Total	28,070	14,839	14,441	9,782	7,974	5,714	7,149	87,969

7. SYSTEM MEMBERSHIP *(continued)*

PART A | STATE ACTIVE MEMBERS *(continued)*

Salary by Age Distribution of Active Members

Present Age	Number of Members	Total Salary	Average Salary
0 - 24	2,060	$90,687,905	$44,023
25 - 29	7,159	$376,356,500	$52,571
30 - 34	9,642	$589,737,478	$61,163
35 - 39	9,653	$658,160,254	$68,182
40 - 44	9,151	$663,190,395	$72,472
45 - 49	11,153	$850,330,177	$76,242
50 - 54	12,578	$985,105,039	$78,320
55 - 59	12,593	$991,491,860	$78,734
60 - 64	9,007	$731,407,305	$81,204
65+	4,973	$418,006,178	$84,055
Total	87,969	$6,354,473,093	$72,235

7. SYSTEM MEMBERSHIP *(continued)*

PART B | STATE RETIREES AND SURVIVORS

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Number of Members	54,241	594	3,311	6,612	64,758
Average Age	72.1	64.9	64.9	75.0	71.9
Average Annual Benefit	$37,744	$20,798	$43,228	$20,266	$36,084

Benefit by Retirement Type

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Annuity	$409,364,530	$2,087,259	$11,520,335	$21,328,177	$444,300,301
Pension	$1,637,900,548	$10,266,887	$131,608,741	$112,673,169	$1,892,449,345
Total	$2,047,265,078	$12,354,146	$143,129,076	$134,001,346	$2,336,749,646

7. SYSTEM MEMBERSHIP *(continued)*

PART B | STATE RETIREES & SURVIVORS *(continued)*

Benefit by Age Distribution

Present Age	Number of Members	Total Benefits	Average Benefits
Less than 40	182	$4,893,286	$26,886
40 – 44	151	$5,162,799	$34,191
45 – 49	680	$26,710,792	$39,281
50 – 54	1,549	$61,915,430	$39,971
55 – 59	4,033	$151,673,403	$37,608
60 – 64	8,674	$338,839,123	$39,064
65 – 69	13,362	$539,366,222	$40,366
70 – 74	13,334	$508,104,632	$38,106
75 – 79	9,143	$320,131,834	$35,014
80 – 84	6,106	$189,137,566	$30,976
85 – 89	4,287	$118,680,043	$27,684
90+	3,257	$72,134,516	$22,148
Totals	64,758	$2,336,749,646	$36,084

7. SYSTEM MEMBERSHIP *(continued)*

PART C | MASSACHUSETTS TEACHERS' ACTIVE MEMBERS

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the TRS. We made several assumptions about missing, questionable, or unavailable data.

Until the January 1, 2006 actuarial valuation, we had estimated the total creditable service for each member for the actuarial valuation. The estimate was based on either the employment date (date of hire as a teacher) or the adjusted employment date and was set equal to the greater of the two calculated service amounts. We used this methodology, which we believed was conservative, because we had no way to assess additional costs for members who buy back service near retirement. In 2006, we compared the service estimated for valuation purposes with actual service for over 6,800 members who retired in 2004 and 2005. We found that, in total, our methodology slightly understated service. To estimate this additional cost, we increased the plan liabilities as of January 1, 2006. We have continued using this methodology in each valuation.

For members with a date of birth and/or date of hire that seemed questionable, we assumed (based on credited service or date of birth) the member was hired at age 30 (or at a younger age, if the member was under 30).

Based on our experience with prior years' data, buyback issues, and questions to TRS regarding specific members, we made several adjustments. Members whose pay was less than $5,000 were assumed to be inactive. For members with pay between $5,000 and $10,000, we used an estimated pay of $50,000. For members with submitted pay over $150,000, we compared this year's figure to the pay used in last year's valuation. We adjusted this year's figure based on the amount contributed if we believed it was overstated.

Determining valuation pay for members with reported pay less than $10,000 is difficult. Although we make the assumptions outlined above, we know there will always be a significant number of members that fall into this category for a variety of reasons including leaves of absence and part time employment. We believe our overall assumption is reasonable but know some members that we have deemed inactive are active members. To reflect this uncertainty, we made an additional increase to the calculated plan liabilities consistent with last year.

We increased the normal cost by 2.0% and the active actuarial liability by 1.0% to reflect the service buyback and various data issues.

Pay for all members hired in 2018 was annualized.

Because we could not determine the number of vested terminations, we estimated a combined inactive (terminated vested plus terminated with an ASF balance) liability. This is the same methodology we have used in prior valuations.

7. SYSTEM MEMBERSHIP *(continued)*

PART C | MASSACHUSETTS TEACHERS' ACTIVE MEMBERS *(continued)*

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the Massachusetts Teachers' Retirement System.

	Actives
Number of Members	94,103
Average Age	43.6
Average Service	13.2
Average Salary	$75,183
Average Annuity Savings Fund Balance	$77,776

Age by Service Distribution of Active Members

Years of Service

Present Age	0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30+	Total
0 - 24	2,247	1						2,248
25 - 29	8,219	1,672	2					9,893
30 - 34	4,651	6,373	1,863	1				12,888
35 - 39	2,314	2,924	6,779	1,683	4			13,704
40 - 44	1,531	1,510	3,209	5,638	1,168	5		13,061
45 - 49	1,281	1,304	1,896	3,535	4,674	892	32	13,614
50 - 54	876	1,110	1,819	2,242	2,604	1,965	746	11,362
55 - 59	453	614	1,492	2,005	1,628	1,007	2,215	9,414
60 - 64	181	303	736	1,368	1,284	718	1,403	5,993
65+	48	96	227	393	344	204	614	1,926
Total	21,801	15,907	18,023	16,865	11,706	4,791	5,010	94,103

7. SYSTEM MEMBERSHIP *(continued)*

PART C | MASSACHUSETTS TEACHERS' ACTIVE MEMBERS *(continued)*

Salary by Age Distribution of Active Members

Present Age	Number of Members	Total Salary	Average Salary
0 - 24	2,248	$103,939,350	$46,236
25 - 29	9,893	$531,926,017	$53,768
30 - 34	12,888	$821,133,600	$63,713
35 - 39	13,704	$1,024,803,563	$74,781
40 - 44	13,061	$1,050,256,871	$80,412
45 - 49	13,614	$1,124,180,510	$82,575
50 - 54	11,362	$941,577,688	$82,871
55 - 59	9,414	$797,388,116	$84,702
60 - 64	5,993	$512,710,124	$85,551
65+	1,926	$167,044,313	$86,731
Total	94,103	$7,074,960,153	$75,183

7. SYSTEM MEMBERSHIP *(continued)*

PART D | MASSACHUSETTS TEACHERS' RETIREES AND SURVIVORS

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Number of Members	62,660	386	299	3,765	67,110
Average Age	72.8	67.3	71.7	76.8	73.0
Average Annual Benefit	$46,713	$22,934	$43,431	$21,470	$45,145

Benefit by Retirement Type

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Annuity	$575,056,722	$1,704,255	$1,162,357	$14,410,469	$592,333,804
Pension	$2,351,966,516	$7,148,094	$11,823,494	$66,424,529	$2,437,362,632
Total	$2,927,023,238	$8,852,349	$12,985,851	$80,834,998	$3,029,696,436

7. SYSTEM MEMBERSHIP *(continued)*

PART D | MASSACHUSETTS TEACHERS' RETIREES & SURVIVORS *(continued)*

Benefit by Age Distribution

Present Age	Number of Members	Total Benefits	Average Benefits
Less than 40	27	$391,964	$14,517
40 – 44	38	$489,870	$12,891
45 – 49	88	$1,408,447	$16,005
50 – 54	199	$4,326,464	$21,741
55 – 59	1,444	$56,772,929	$39,316
60 – 64	6,816	$335,732,846	$49,257
65 – 69	17,722	$894,250,068	$50,460
70 – 74	18,247	$882,874,907	$48,385
75 – 79	10,362	$451,232,518	$43,547
80 – 84	5,941	$221,144,756	$37,223
85 – 89	3,794	$122,086,858	$32,179
90+	2,432	$58,984,808	$24,254
Totals	67,110	$3,029,696,436	$45,145

7. SYSTEM MEMBERSHIP *(continued)*

PART E | BOSTON TEACHERS' ACTIVE MEMBERS

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the Boston Retirement System.

	Actives
Number of Members	6,358
Average Age	42.4
Average Service	10.5
Average Salary	$88,868
Average Annuity Savings Fund Balance	$86,747

Age by Service Distribution of Active Members

Years of Service

Present Age	0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30+	Total
0 - 24	122							122
25 - 29	704	93						797
30 - 34	509	449	70					1,028
35 - 39	251	346	406	60	1			1,064
40 - 44	124	188	278	249	30	1		870
45 - 49	108	130	154	202	153	30	3	780
50 - 54	69	109	91	123	128	93	29	642
55 - 59	58	103	84	88	66	75	86	560
60 - 64	20	63	58	68	56	42	52	359
65+	6	39	18	22	17	11	23	136
Total	1,971	1,520	1,159	812	451	252	193	6,358

7. SYSTEM MEMBERSHIP *(continued)*

PART E | BOSTON TEACHERS' ACTIVE MEMBERS *(continued)*

Salary by Age Distribution of Active Members

Present Age	Number of Members	Total Salary	Average Salary
0 - 24	122	$6,780,471	$55,578
25 - 29	797	$52,550,104	$65,935
30 - 34	1,028	$82,665,213	$80,414
35 - 39	1,064	$97,411,266	$91,552
40 - 44	870	$83,512,480	$95,991
45 - 49	780	$75,301,580	$96,540
50 - 54	642	$63,405,086	$98,762
55 - 59	560	$55,050,100	$98,304
60 - 64	359	$35,247,314	$98,182
65+	136	$13,098,685	$96,314
Total	6,358	$565,022,299	$88,868

7. SYSTEM MEMBERSHIP *(continued)*

PART F | BOSTON TEACHERS' RETIREES AND SURVIVORS

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Number of Members	4,358	47	75	310	4,790
Average Age	72.9	66.5	72.4	74.7	73.0
Average Annual Benefit	$55,456	$25,268	$50,691	$24,932	$53,109

Benefit by Retirement Type

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Annuity	$48,372,384	$265,378	$394,086	$1,434,805	$50,466,653
Pension	$193,303,712	$922,230	$3,407,770	$6,294,087	$203,927,799
Total	$241,676,096	$1,187,608	$3,801,856	$7,728,892	$254,394,452

7. SYSTEM MEMBERSHIP *(continued)*

PART F | BOSTON TEACHERS' RETIREES & SURVIVORS *(continued)*

Benefit by Age Distribution

Present Age	Number of Members	Total Benefits	Average Benefits
Less than 40	8	$241,377	$30,172
40 - 44	3	$55,495	$18,498
45 - 49	6	$243,814	$40,636
50 - 54	17	$401,762	$23,633
55 - 59	122	$5,366,053	$43,984
60 - 64	493	$28,999,249	$58,822
65 - 69	1,149	$70,092,468	$61,003
70 - 74	1,361	$76,884,103	$56,491
75 - 79	764	$38,424,827	$50,294
80 - 84	403	$17,447,325	$43,294
85 - 89	284	$10,386,815	$36,573
90+	180	$5,851,164	$32,506
Totals	4,790	$254,394,452	$53,109

8. VALUATION COST METHODS

PART A | ACTUARIAL COST METHOD

The Actuarial Cost Method which was used to determine pension liabilities in this valuation is known as the *Entry Age Normal Cost Method***.** Under this method, the *Normal Cost* for each active member on the valuation date is determined as the level percent of salary, which, if paid annually from the date the employee first became a retirement system member, would fully fund by retirement, death, disability or termination, the projected benefits which the member is expected to receive. The *Actuarial Liability* for each member is determined as the present value as of the valuation date of all projected benefits which the member is expected to receive, minus the present value of future annual Normal Cost payments expected to be made to the fund. Since only active members have a Normal Cost, the Actuarial Liability for inactives, retirees, and survivors is simply equal to the present value of all projected benefits. The *Unfunded Actuarial Liability* is the Actuarial Liability less current assets.

The Normal Cost for a member will remain a level percent of salary for each year of membership, except for changes in provisions of the plan or the actuarial assumptions employed in projection of benefits and present value determinations. The Normal Cost for the entire system will also be changed by the addition of new members or the retirement, death, disability, or termination of members. The Actuarial Liability for a member will increase each year to reflect the additional accrual of Normal Cost. It will also change if the plan provisions or actuarial assumptions change.

Differences each year between the actual experience of the plan and the experience projected by the actuarial assumptions are reflected by adjustments to the Unfunded Actuarial Liability. An experience difference which increases the Unfunded Actuarial Liability is an *Actuarial Loss* and one which decreases the Unfunded Actuarial Liability is called an *Actuarial Gain.*

PART B | ASSET VALUATION METHOD

The actuarial value of assets is determined in accordance with the deferred recognition method under which 20% of the gains or losses occurring in the prior year are recognized, 40% of those occurring 2 years ago are recognized, etc., so that 100% of gains or losses occurring 5 years ago are recognized. The actuarial value of assets will be adjusted, if necessary, in order to remain between 90% and 110% of the market value. The actuarial value of assets as of January 1, 2019 is 102.8% of the market value.

9. ACTUARIAL ASSUMPTIONS

Investment Return

7.25% per year net of investment expenses (*prior assumption: 7.35%*)

The investment return assumption is a long-term assumption and is based on capital market expectations by asset class, historical returns, and professional judgment. We considered analysis prepared by PRIM's investment advisor using a building block approach which included expected returns by asset class, risk analysis, and the determination of a 30-year expected target rate of return.

Interest Rate Credited to the Annuity Savings Fund

3.5% per year

Assumed Rate of Cost of Living Increases (COLA)

3.0% per year (on the first $13,000 of an allowance, $14,000 for Boston Teachers)

Mortality

State: Pre-retirement mortality reflects RP-2014 Blue Collar Employees table projected generationally with Scale MP-2016 set forward 1 year for females.

Teachers: Pre-retirement mortality reflects RP-2014 White Collar Employees table projected generationally with Scale MP-2016 (gender distinct).

State: Post-retirement mortality reflects RP-2014 Blue Collar Healthy Annuitant table projected generationally with Scale MP-2016 set forward 1 year for females.

Teachers: Post-retirement mortality reflects RP-2014 White Collar Healthy Annuitant table projected generationally with Scale MP-2016 (gender distinct).

State: For disabled retirees, mortality reflects the post-retirement mortality described in the previous paragraph, set forward 1 year.

Teachers: For disabled members, the mortality rate is assumed to be in accordance with the RP-2014 White Collar Healthy Annuitant Table projected generationally with Scale MP-2016 (gender distinct).

It is assumed that 75% of pre-retirement deaths are job-related for Group 1 and 2 members and 90% are job-related for Group 4 members. For members retired under an Accidental Disability, 40% of deaths are assumed to be from the same cause as the disability.

The mortality assumptions reflect our recent experience analysis published in 2014 (based on the years 2006-2011), updated to reflect actual experience from 2012 through 2016 for post-retirement mortality, and professional judgment. This assumption reflects observed current mortality as well as expected mortality improvement.

9. ACTUARIAL ASSUMPTIONS *(continued)*

Salary Increase

Based on an analysis of past experience. Annual rates are based on service as shown below.

Service	Groups 1& 2	Group 3	Group 4
0	7.00%	7.00%	9.00%
1	6.50%	7.00%	8.00%
2	6.00%	7.00%	7.50%
3	5.50%	7.00%	7.00%
4	5.50%	6.75%	6.75%
5	5.25%	6.25%	6.25%
6	5.00%	5.25%	5.75%
7	4.75%	4.75%	5.25%
8-12	4.75%	4.75%	4.75%
13-15	4.50%	4.75%	4.75%
16-19	4.25%	4.75%	4.75%
20+	4.00%	4.50%	4.50%

Service	Teachers
0	7.50%
1	7.10%
2	7.00%
3	6.90%
4	6.80%
5	6.70%
6	6.60%
7	6.50%
8	6.30%
9	6.10%
10	5.90%
11	5.70%
12	5.20%
13	4.70%
14	4.35%
15-16	4.20%
17-19	4.10%
20+	4.00%

The salary increase assumption reflects both prior experience (2014 studies) and professional judgment.

9. ACTUARIAL ASSUMPTIONS *(continued)*

Retirement

State

	Group 1		Group 2	Group 3	Group 4
Age	Male	Female			
45	0.000	0.000	0.000	0.020	0.060
46	0.000	0.000	0.000	0.020	0.060
47	0.000	0.000	0.000	0.050	0.060
48	0.000	0.000	0.000	0.050	0.060
49	0.000	0.000	0.000	0.050	0.060
50	0.030	0.030	0.020	0.050	0.060
51	0.030	0.030	0.020	0.060	0.060
52	0.030	0.030	0.020	0.070	0.060
53	0.030	0.030	0.030	0.080	0.075
54	0.030	0.035	0.040	0.090	0.150
55	0.035	0.050	0.075	0.100	0.250
56	0.035	0.050	0.075	0.100	0.150
57	0.040	0.055	0.080	0.110	0.150
58	0.050	0.060	0.100	0.110	0.150
59	0.060	0.065	0.120	0.120	0.150
60	0.090	0.075	0.150	0.140	0.200
61	0.110	0.100	0.150	0.150	0.200
62	0.150	0.150	0.150	0.150	0.200
63	0.150	0.150	0.150	0.150	0.200
64	0.160	0.150	0.200	0.250	0.300
65	0.200	0.200	0.200	0.250	0.500
66	0.200	0.200	0.200	0.250	0.250
67	0.200	0.200	0.200	0.250	0.250
68	0.200	0.200	0.200	0.250	0.250
69	0.200	0.200	0.200	0.250	0.250
70	1.000	1.000	1.000	1.000	1.000

9. ACTUARIAL ASSUMPTIONS *(continued)*

Teachers

Males

	Not in Retirement Plus	
	Less than 20	20+
47	0.000	0.000
48	0.000	0.000
49	0.000	0.000
50	0.000	0.020
51	0.000	0.020
52	0.000	0.020
53	0.000	0.020
54	0.000	0.030
55	0.035	0.030
56	0.035	0.035
57	0.050	0.040
58	0.055	0.050
59	0.060	0.060
60	0.075	0.150
61	0.120	0.250
62	0.140	0.300
63	0.140	0.300
64	0.140	0.300
65	0.300	0.300
66	0.300	0.250
67	0.300	0.250
68	0.300	0.250
69	0.300	0.250
70+	1.000	1.000

	Retirement Plus		
	Less than 20	20-30	30+
47	0.00	0.000	0.00
48	0.00	0.000	0.00
49	0.00	0.000	0.00
50	0.00	0.010	0.02
51	0.00	0.010	0.02
52	0.00	0.010	0.02
53	0.00	0.015	0.02
54	0.00	0.025	0.02
55	0.05	0.030	0.06
56	0.05	0.060	0.20
57	0.05	0.100	0.40
58	0.05	0.150	0.50
59	0.10	0.200	0.50
60	0.10	0.250	0.40
61	0.20	0.300	0.40
62	0.20	0.350	0.35
63	0.25	0.400	0.35
64	0.25	0.400	0.35
65	0.25	0.400	0.35
66	0.30	0.300	0.40
67	0.30	0.300	0.40
68	0.30	0.300	0.40
69	0.30	0.300	0.40
70+	1.00	1.000	1.00

9. ACTUARIAL ASSUMPTIONS *(continued)*

Teachers

Females

	Not in Retirement Plus	
	Less than 20	20+
47	0.000	0.000
48	0.000	0.000
49	0.000	0.000
50	0.000	0.010
51	0.000	0.010
52	0.000	0.015
53	0.000	0.020
54	0.000	0.020
55	0.035	0.040
56	0.035	0.040
57	0.035	0.040
58	0.050	0.060
59	0.065	0.080
60	0.085	0.150
61	0.100	0.200
62	0.120	0.200
63	0.120	0.250
64	0.200	0.300
65	0.300	0.400
66	0.300	0.300
67	0.300	0.300
68	0.300	0.300
69	0.300	0.300
70+	1.000	1.000

	Retirement Plus		
	Less than 20	20-30	30+
47	0.00	0.00	0.000
48	0.00	0.00	0.000
49	0.00	0.00	0.000
50	0.00	0.01	0.015
51	0.00	0.01	0.015
52	0.00	0.01	0.015
53	0.00	0.01	0.015
54	0.00	0.01	0.020
55	0.03	0.03	0.050
56	0.03	0.05	0.150
57	0.04	0.08	0.350
58	0.08	0.10	0.350
59	0.08	0.15	0.350
60	0.10	0.20	0.350
61	0.12	0.25	0.350
62	0.12	0.30	0.350
63	0.15	0.30	0.350
64	0.20	0.30	0.350
65	0.25	0.40	0.350
66	0.25	0.30	0.350
67	0.30	0.30	0.300
68	0.30	0.30	0.300
69	0.30	0.30	0.300
70+	1.00	1.00	1.000

Retirement rates are based on our most recent experience analysis (2014) which reviewed age, service, gender, and job group. The assumption reflects this analysis and professional judgment.

9. ACTUARIAL ASSUMPTIONS *(continued)*

Disability

Based on an analysis of past experience. Sample annual rates are shown below.

Age	Group 1	Group 2	Group 3	Group 4	Teachers
20	0.00010	0.00052	0.0010	0.0020	0.00004
30	0.00010	0.00072	0.0016	0.0021	0.00006
40	0.00068	0.00210	0.0036	0.0071	0.00010
50	0.00133	0.00420	0.0094	0.0110	0.00050
60	0.00120	0.00500	0.0430	0.0080	0.00070

It is also assumed that 75% of disabilities will be job-related for Group 1 and 2 members (other than Teachers), and 95% will be job-related for Group 3 and 4 members, and 35% will be job-related for Teachers.

Disability rates are based on our most recent experience analysis (2014) which reviewed age, gender and job group. The assumption reflects this analysis and professional judgment.

Withdrawal

Rates are based on an analysis of past experience and professional judgment. For Groups 1 and 2, rates are both age and service based for service up to 10 years. After 10 years of service, rates are age based. In addition to being age and service based, Teacher rates are also gender based. For Groups 3 and 4, rates are service based. Sample annual rates are shown below.

Groups 1 & 2

Age	Service		
	0	5	10+
20	0.270	0.000	0.000
30	0.230	0.100	0.045
40	0.160	0.080	0.030
50	0.180	0.060	0.030

Groups 3 & 4

Service	Group 3	Group 4
0	0.007	0.090
5	0.007	0.060
10	0.005	0.035
15	0.005	0.020
20+	0.005	0.015

Teachers

Age	Service					
	0		5		10+	
	Male	Female	Male	Female	Male	Female
20	0.130	0.100	0.055	0.070	0.015	0.050
30	0.150	0.150	0.054	0.088	0.015	0.045
40	0.133	0.105	0.052	0.050	0.017	0.022
50	0.162	0.098	0.070	0.050	0.023	0.020

Members Hired on or After April 2, 2012

Chapter 176 of the Acts of 2011 changed the retirement eligibility for the different job groups. For example, Group 1 eligibility changed from 55 years old with 10 years of service to 60 years old with 10 years of service (Chapter 176 removed the provision that allowed retirement at any age with 20 years of service). Our software system is programmed such that at any given age, a member is assumed to either retire or terminate, but not both. Therefore, we adjusted the retirement and termination rates for members impacted by Chapter 176. For example, for Group 1 members, we removed retirement rates for ages 50-59. Termination rates remain in effect for those years. We will monitor these assumptions going forward.

Family Composition

It is assumed that 80% of plan participants are married and that the male spouse in 3 years older than the female spouse.

Loading and Administrative Expenses

State

We increased the normal cost by 2% and the actuarial accrued liability of active members by $290 million to account for certain Chapter 32 benefits that cannot be readily valued with our software system. Such benefits include, but are not limited to, benefits provided under Sections10, 28M, 28N, 65D, and 100. In addition, we increased the normal cost by 1.5% and the actuarial accrued liability of active members by $140 million to estimate the impact of potential changes in job group status for certain members of DMH and Social Services.

Teachers

We increased the total normal cost by 2% and the actuarial accrued liability of active members by 1% to account for buybacks at retirement and various data issues including the status of members with reported pay of less than $10,000.

Boston Teachers

We increased the total normal cost by 2% and the actuarial accrued liability of active members by 1%. We also reduced the pay provided by 5.1% to reflect the impact of a contract settlement retroactive to 2016.

10. SUMMARY OF PLAN PROVISIONS

ADMINISTRATION

There are 104 contributory retirement systems for public employees in Massachusetts. Each system is governed by a retirement board and all boards, although operating independently, are governed by Chapter 32 of the Massachusetts General Laws. This law in general provides uniform benefits, uniform contribution requirements and a uniform accounting and funds structure for all systems.

PARTICIPATION

Participation is mandatory for all full-time employees. Eligibility with respect to part-time, provisional, temporary, seasonal or intermittent employment is governed by regulations promulgated by the retirement board, and approved by PERAC. Membership is optional for certain elected officials.

There are 4 classes of membership in the Commonwealth. Members of the Massachusetts Teachers' Retirement System and Boston teachers are classified in Group 1.

Group 1:

General employees, including clerical, administrative, technical and all other employees not otherwise classified, as well as all teachers.

Group 2:

Certain specified hazardous duty positions.

Group 3:

Officers and inspectors of the Department of State Police.

Group 4:

Police Officers, firefighters, corrections officers, and other specified hazardous positions.

MEMBER CONTRIBUTIONS

Member contributions vary depending on the most recent date of membership:

Date of Membership	Contribution Rate
Prior to 1975:	5% of regular compensation
1975 - 1983:	7% of regular compensation
1984 to 6/30/96:	8% of regular compensation
7/1/96 to present:	9% of regular compensation
7/1/96 to present:	12% of regular compensation (State Police)
7/1/01 to present:	11% of regular compensation (for teachers hired after 7/1/01 and those accepting provisions of Chapter 114 of the Acts of 2000)
1979 to present:	an additional 2% of regular compensation in excess of $30,000 except for teachers subject to Chapter 114 of the Acts of 2000.

In addition, members of Group 1 who join the system on or after April 2, 2012 will have their withholding rate reduced to 6% after achieving 30 years of creditable service.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

RATE OF INTEREST

Interest on regular deductions made after January 1, 1984 is at a rate established by PERAC in consultation with the Commissioner of Banks. The rate is obtained from the average
rates paid on individual savings accounts by a representative sample of at least 10 financial institutions.

RETIREMENT AGE

There is no mandatory retirement age for employees in Group 1. Most Group 2 and Group 4 members may remain in service after reaching age 65. Some Group 2 and Group 4 members who are employed in certain public safety positions are required to retire at age 65.

SUPERANNUATION RETIREMENT

A person who became a member before April 2, 2012 is eligible for a superannuation retirement allowance (service retirement) upon meeting the following conditions:

- completion of 20 years of service, or
- attainment of age 55 if hired prior to 1978, or if classified in Group 4, or
- attainment of age 55 with 10 years of service, if hired after 1978, and if classified in Group 1 or 2

A person who became a member on or after April 2, 2012 is eligible for a superannuation retirement allowance (service retirement) upon meeting the following conditions:

- attainment of age 60 with 10 years of service if classified in Group 1, or
- attainment of age 55 with 10 years of service if classified in Group 2, or
- attainment of age 55 if hired prior to 1978, or if classified in Group 4.

AMOUNT OF BENEFIT

A member's annual allowance is determined by multiplying average salary by a benefit rate related to the member's age and job classification at retirement, and the resulting product by his or her creditable service. The amount determined by the benefit formula cannot exceed 80% of the member's highest three-year (or five-year salary as discussed below) average salary. For veterans as defined in G.L. c. 32, s. 1, there is an additional benefit of $15 per year for each year of creditable service, up to a maximum of $300.

- Salary is defined as gross regular compensation. For employees who become members after January 1, 2011, regular compensation is limited to 64% of the federal limit found in 26 U.S.C. 401(a)(17). In addition, regular compensation for members who retire after April 2, 2012 will be limited to prohibit "spiking" of a member's salary to increase the retirement benefit.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

• For persons who became members prior to April 2, 2012, average salary is the average annual rate of regular compensation received during the three consecutive years that produce the highest average, or, if greater, during the last three years (whether or not consecutive) preceding retirement.

• For persons who became members on or after April 2, 2012, average salary is the average annual rate of regular compensation received during the 5 consecutive years that produce the highest average, or, if greater, during the last 5 years (whether or not consecutive) preceding retirement.

• The benefit rate varies with the member's retirement age. For persons who became members prior to April 2, 2012 the highest rate of 2.5% applies to Group 1 employees who retire at or after age 65, Group 2 employees who retire at or after age 60, and Group 4 employees who retire at or after age 55. A .1% reduction is applied for each year of age under the maximum age for the member's group. For Group 2 employees who terminate from service under age 55, the benefit rate for a Group 1 employee shall be used.

• For persons who became members on or after April 2, 2012 and retire with less than 30 years of creditable service, the highest rate of 2.5% applies to Group 1 employees who retire at or after age 67, Group 2 employees who retire at or after age 62, and to Group 4 employees who retire at or after age 57. A .15% reduction is applied for each year of age under the maximum age for the member's group.

• For persons who became members on or after April 2, 2012 and retire with more than 30 years of creditable service, the highest rate of 2.5% applies to Group 1 employees who retire at or after age 67, Group 2 employees who retire at or after age 62, and Group 4 employees who retire at or after age 55. A .125% reduction is applied for each year of age under the maximum age for the member's group.

• For a teacher who is subject to the provisions of Chapter 114 of the Acts of 2000 and who has completed at least 30 years of creditable service, the benefit rate is multiplied by the creditable service and the resulting percentage is increased by 2% per year for each year of service in excess of 24. The amount determined cannot exceed 80% of the average salary.

The allowance of state police officers is calculated using a slightly different formula. Information regarding this formula can be obtained directly from the State Retirement Board.

DEFERRED VESTED BENEFIT

A participant who has attained the requisite years of creditable service can elect to defer his or her retirement until a later date. Group 4 employees cannot defer beyond age 65. All participants must begin to receive a retirement allowance or withdraw their accumulated deductions no later than April 15 of the calendar year following the year they reach age 70½.

WITHDRAWAL OF CONTRIBUTIONS

Member contributions may be withdrawn upon termination of employment. The interest rate for employees who first become members on or after January 1, 1984 who voluntarily withdraw their contributions with less than 10 years of service will be 3%. Interest payable on all other withdrawals will be set at regular interest.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

DISABILITY RETIREMENT

The Massachusetts Retirement Plan provides two types of disability retirement benefits:

ORDINARY DISABILITY

Eligibility: Non-veterans who become totally and permanently disabled by reason of a non-job related condition with at least ten years of creditable service.

Veterans with ten years of creditable service who become totally and permanently disabled by reason of a non-job related condition prior to reaching “maximum age”. “Maximum age” applies only to employees classified in Group 4 who are subject to mandatory retirement.

Retirement Allowance: For persons who became members prior to April 2, 2012, the benefit is equal to the accrued superannuation retirement benefit as if the member was age 55. If the member is a veteran, the benefit is 50% of the member’s final rate of salary during the preceding 12 months, plus an annuity based upon accumulated member contributions plus credited interest. If the member is over age 55, he or she will receive not less than the superannuation allowance to which he or she is entitled.

For persons in Group 1 who became members on or after April 2, 2012, the benefit is equal to the accrued superannuation retirement benefit as if the member was age 60. If the member is a veteran, the benefit is 50% of the member’s final rate of salary during the preceding 12 months, plus an annuity based upon accumulated member contributions plus credited interest. If the member is over age 60, he or she will receive not less than the superannuation allowance to which he or she would have been entitled had they retired for superannuation.

For persons in Group 2 and Group 4 who became members on or after April 2, 2012, the benefit is equal to the accrued superannuation retirement benefit as if the member was age 55. If the member is a veteran, the benefit is 50% of the member’s final rate of salary during the preceding 12 months, plus an annuity based upon accumulated member contributions plus credited interest. If the member is over age 55, he or she will receive not less than the superannuation allowance to which he or she is entitled.

ACCIDENTAL DISABILITY

Eligibility: Applies to members who become permanently incapacitated from the essential duties of the position as a result of a personal injury sustained or hazard undergone while in the performance of duties. There are no minimum age or service requirements.

Retirement Allowance: 72% of salary plus an annuity based on accumulated member contributions, with interest. This amount is not to exceed 100% of pay. However, for those who became members in service after January 1, 1988 or who have not been members in service continually since that date, the amount is limited to 75% of pay. There is an additional pension of $924.60 per year, per child who is under 18 at the time of the member’s retirement, with no age limitation if the child is mentally or physically incapacitated from earning. The additional pension may continue up to age 22 for any child who is a full time student at an accredited educational institution. Veterans, as defined in G.L. c. 32, s. 1, receive an additional benefit of $15 per year for each year of creditable service, up to a maximum of $300.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

ACCIDENTAL DEATH

Eligibility: Applies to members who die as a result of a work-related injury or if the member was retired for accidental disability and the death was the natural and proximate result of the injury or hazard undergone on account of which such member was retired.

Allowance: An immediate payment to a named beneficiary equal to the accumulated deductions at the time of death, plus a pension equal to 72% of current salary and payable to the surviving spouse, dependent children or the dependent parent, plus a supplement of $924.60 per year, per child, payable to the spouse or legal guardian until all dependent children reach age 18 or 22 if a full time student, unless mentally or physically incapacitated.

The surviving spouse of a member of a police or fire department or any corrections officer who, under specific and limited circumstances detailed in the statute, suffers an accident and is killed or sustains injuries resulting in his death, may receive a pension equal to the maximum salary for the position held by the member upon his death.

In addition, an eligible family member of a firefighter, public prosecutor, police officer or corrections officer killed in the line of duty may receive a one-time payment of $300,000 from the State Retirement Board.

DEATH AFTER ACCIDENTAL DISABILITY RETIREMENT

Effective November 7, 1996, Accidental Disability retirees were allowed to select Option C at retirement and provide a benefit for an eligible survivor. For Accidental Disability retirees prior to November 7, 1996, who could not select Option C, if the member's death is from a cause unrelated to the condition for which the member received accidental disability benefits, a surviving spouse will receive an annual allowance of $12,000.

DEATH IN ACTIVE SERVICE *(OPTION D)*

Allowance: An immediate allowance equal to that which would have been payable had the member retired and selected Option C on the day before his or her death. For a member who became a member prior to April 2, 2012 whose death occurred prior to the member's superannuation retirement age, the age 55 benefit rate is used. For a member classified in Group 1 who became a member on or after April 2, 2012 whose death occurred prior to the member's superannuation retirement age, the age 60 benefit rate is used. If the member died after age 60, the actual age is used. The minimum annual allowance payable to the surviving spouse of a member-in-service who dies with at least two years of creditable service is $9,000, provided that the member and the spouse were married for at least one year and living together on the member's date of death.

The surviving spouse of such a member-in-service receives an additional allowance equal to the sum of $1,440 per year for the first child and $1,080 per year for each additional child until all dependent children reach age 18 or 22 if a full-time student, unless mentally or physically incapacitated.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

COST OF LIVING

A cost of living adjustment (COLA) is determined based upon the increase in the Consumer Price Index (CPI) used for indexing Social Security benefits, but cannot exceed 3.0% on the first $13,000 of a retiree's benefit.

METHODS OF PAYMENT

A member may elect to receive his or her retirement allowance in one of 3 forms of payment.

Option A: Total annual allowance, payable in monthly installments, commencing at retirement and terminating at the member's death.

Option B: A reduced annual allowance, payable in monthly installments, commencing at retirement and terminating at the death of the member, provided, however, that if the total amount of the annuity portion received by the member is less than the amount of his or her accumulated deductions, including interest, the difference or balance of his accumulated deductions will be paid in a lump sum to the retiree's beneficiary or beneficiaries of choice.

Option C: A reduced annual allowance, payable in monthly installments, commencing at retirement. At the death of the retired employee, 2/3 of the allowance is payable to the member's designated beneficiary (who may be the spouse, or former spouse who remains unmarried for a member whose retirement becomes effective on or after February 2, 1992, child, parent, sister, or brother of the employee) for the life of the beneficiary. For members who retired on or after January 12, 1988, if the beneficiary predeceases the retiree, the benefit payable increases (or "pops up") based on the factor used to determine the Option C benefit at retirement. For members who retired prior to January 12, 1988, if the System has accepted Section 288 of Chapter 194 of the Acts of 1998 and the beneficiary predeceases the retiree, the benefit payable "pops up" in the same fashion. The Option C became available to accidental disability retirees on November 7, 1996.

ALLOCATION OF PENSION COSTS

If a member's total creditable service was partly earned by employment in more than one retirement system, the cost of the "pension portion" is allocated between the different systems pro rata based on the member's service within each retirement system. If a member received regular compensation concurrently from two or more systems on or after January 1, 2010, and was not vested in both systems as of January 1, 2010, such a pro-ration will not be undertaken. This is because such a person will receive a separate retirement allowance from each system.

11. GLOSSARY OF TERMS

ACTUARIAL ACCRUED LIABILITY

That portion of the Actuarial Present Value of pension plan benefits which is not provided by future Normal Costs or employee contributions. It is the portion of the Actuarial Present Value attributable to service rendered as of the Valuation Date.

ACTUARIAL ASSUMPTIONS

Assumptions, based upon past experience or standard tables, used to predict the occurrence of future events affecting the amount and duration of pension benefits, such as: mortality, withdrawal, disablement and retirement; changes in compensation; rates of investment earnings and asset appreciation or depreciation; and any other relevant items.

ACTUARIAL COST METHOD (OR FUNDING METHOD)

A procedure for allocating the Actuarial Present Value of all past and future pension plan benefits to the Normal Cost and the Actuarial Accrued Liability.

ACTUARIAL GAIN OR LOSS (OR EXPERIENCE GAIN OR LOSS)

A measure of the difference between actual experience and that expected based upon the set of Actuarial Assumptions, during the period between two Actuarial Valuation dates.

Note: The effect on the Accrued Liability and/or the Normal Cost resulting from changes in the Actuarial Assumptions, the Actuarial Cost Method or pension plan provisions would be described as such, rather than an Actuarial Gain (Loss).

ACTUARIAL PRESENT VALUE

The dollar value on the valuation date of all benefits expected to be paid to current members based upon the Actuarial Assumptions and the terms of the Plan.

AMORTIZATION PAYMENT

That portion of the pension plan appropriation which represents payments made to pay interest on and reduce the Unfunded Accrued Liability.

ANNUAL STATEMENT

The statement submitted to PERAC each year that describes the asset holdings and Fund balances as of December 3l as well as the transactions during the calendar year that affected the financial condition of the retirement system.

ANNUITY RESERVE FUND

The fund into which total accumulated deductions, including interest, are transferred at the time a member retires, and from which annuity payments are made.

11. GLOSSARY OF TERMS *(continued)*

ANNUITY SAVINGS FUND

The fund in which employee contributions plus interest credited are held for active and inactive members.

ASSETS

The value of securities held by the plan.

COST OF BENEFITS

The estimated payment from the pension system for benefits for the fiscal year.

FUNDING SCHEDULE

The schedule, based upon the most recently approved actuarial valuation, which sets forth the amount which would be appropriated to the pension system in accordance with Section 22C of M.G.L. Chapter 32.

GASB

Governmental Accounting Standards Board

NORMAL COST

Total Normal Cost is that portion of the Actuarial Present Value of pension plan benefits, which is to be paid in a single fiscal year. The Employee Normal Cost is the amount of the expected employee contributions for the fiscal year. The Employer Normal Cost is the difference between the Total Normal Cost and the Employee Normal Cost.

PENSION FUND

The fund into which appropriation amounts, as determined by PERAC are paid and from which pension benefits are paid.

PENSION RESERVE FUND

The fund that shall be credited with all amounts set aside by a system for the purpose of establishing a reserve to meet future pension liabilities. These amounts would include excess interest earnings.

NORMAL COST

Total Normal Cost is that portion of the Actuarial Present Value of pension plan benefits, which is to be paid in a single fiscal year. The Employee Normal Cost is the amount of the expected employee contributions for the fiscal year. The Employer Normal Cost is the difference between the Total Normal Cost and the Employee Normal Cost.

11. GLOSSARY OF TERMS *(continued)*

PENSION FUND

The fund into which appropriation amounts, as determined by PERAC are paid and from which pension benefits are paid.

PENSION RESERVE FUND

The fund that shall be credited with all amounts set aside by a system for the purpose of establishing a reserve to meet future pension liabilities. These amounts would include excess interest earnings.

SPECIAL FUND FOR MILITARY SERVICE CREDIT

The fund which is credited with an amount paid by the retirement board equal to the amount which would have been contributed by a member during a military leave of absence as if the member had remained in active service of the retirement board. In the event of retirement or a non-job related death, such amount is transferred to the Annuity Reserve Fund. In the event of termination prior to retirement or death, such amount shall be transferred to the Pension Fund.

UNFUNDED ACCRUED LIABILITY

The excess of the Actuarial Accrued Liability over the Assets.

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