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MISSOURI STATE EMPLOYEES' RETIREMENT SYSTEM

ACTUARIAL VALUATION REPORT AS OF JUNE 30, 2020

CONTRIBUTION RATE FOR FISCAL YEAR ENDING JUNE 30, 2022

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September 8, 2020

Board of Trustees
Missouri State Employees' Retirement System
907 Wildewood Drive
Jefferson City, MO 65102

Dear Members of the Board:

At your request, we performed an actuarial valuation of the Missouri State Employees' Retirement System (MOSERS) as of June 30, 2020 for the purpose of determining the employer required contribution rate for the fiscal year ending June 30, 2022. This report provides valuation results for the Missouri State Employees' Plan (MSEP). The major findings of the valuation are contained in this report, which reflects the benefit provisions in place on June 30, 2020. There have been no changes to the plan provisions or actuarial methods since the prior valuation, but the set of economic assumptions have changed since the last valuation.

In July 2018 after extensive analysis, the MOSERS Board adopted a plan to phase-in a change in the set of economic assumptions over a three-year period (2018 through 2020 valuations). The scheduled economic assumption changes included price inflation, cost of living adjustments, general wage growth, payroll growth, and the investment return assumption. The nominal investment return assumption decreased from 7.50% to 7.25% in the June 30, 2018 actuarial valuation, then to 7.10% in the June 30, 2019 actuarial valuation, and finally to 6.95% in the June 30, 2020 actuarial valuation. The assumption changes are discussed in further detail in the Executive Summary section of this report.

In preparing our report, we relied, without audit, on information (some oral and some in writing) supplied by the System's staff. This information includes, but is not limited to, statutory provisions, member data and financial information. We found this information to be reasonably consistent and comparable with the information received in the prior year. The valuation results depend on the integrity of this information. If any of this information is inaccurate or incomplete, our results may be different and our calculations may need to be revised.

We further certify that all costs, liabilities, rates of interest and other factors for MSEP have been determined on the basis of actuarial assumptions and methods which are individually reasonable (taking into account the experience of each Plan and reasonable expectations); and which, in combination, offer the best estimate of anticipated experience affecting MSEP. Nevertheless, the emerging costs will vary from those presented in this report to the extent actual experience differs from that projected by the actuarial assumptions. The MOSERS Board has the final decision regarding the appropriateness of the assumptions and adopted them as indicated in Appendix D.

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 the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements.

The actuarial computations presented in this report are for purposes of determining the funding amounts for MSEP as set out in the Missouri state statutes. The calculations in the enclosed report have been made on a basis consistent with our understanding of MOSERS' funding policy. Determinations for purposes other than meeting these requirements may be significantly different from the results contained in this report. Accordingly, additional determinations may be needed for other purposes. For example, actuarial computations for purposes of fulfilling financial accounting requirements for the System under Governmental Accounting Standards No. 67 and No. 68 will be presented in separate reports.

The consultants who worked on this assignment are pension actuaries with substantive experience valuing public retirement systems. Cavanaugh Macdonald's advice is not intended to be a substitute for qualified legal or accounting counsel.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein. We are available to answer any questions on the material contained in the report or to provide explanations or further details as may be appropriate.

We respectfully submit the following report and look forward to discussing it with you.

Sincerely,

Patrice A. Beckham, FSA, EA, FCA, MAAA
Principal and Consulting Actuary

Bryan K. Hoge, FSA, EA, FCA, MAAA
Consulting Actuary

This report presents the results of the June 30, 2020 actuarial valuation of the Missouri State Employees' Plan (MSEP). The primary purposes of performing the actuarial valuation are to:

- Determine the employer contribution rate, as defined in the Missouri state statutes and set out in the Board's funding policy, for the fiscal year ending June 30, 2022;
- Disclose asset and liability measurements as well as the current funded status of MSEP on the valuation date;
- Compare the actual and expected experience of MSEP during the plan year ended June 30, 2020;
- Assess and disclose the key risks associated with funding the System; and
- Analyze and report on trends in MSEP contributions, assets and liabilities over the past several years.

Changes Since the Prior Valuation

In July 2018 after extensive analysis, the MOSERS Board adopted a plan to phase-in a change in the set of economic assumptions over a three-year period (2018 through 2020 valuations). The scheduled economic assumption changes included price inflation, cost of living adjustments, general wage growth, payroll growth, and the investment return assumption. The nominal investment return assumption decreased from 7.50% to 7.25% in the June 30, 2018 actuarial valuation, then to 7.10% in the June 30, 2019 actuarial valuation, and finally to 6.95% in the June 30, 2020 actuarial valuation. The MOSERS board confirmed the final step in the phase-in of the set of economic assumptions shown below for the June 30, 2020 actuarial valuation.

Economic Assumption	Effective June 30, 2018	Effective June 30, 2019	Effective June 30, 2020
1. Investment Return	7.25%	7.10%	6.95%
2. Inflation	2.50%	2.35%	2.25%
3. Cost-of-Living Adjustment (COLA)	2.00%	1.88%	1.80%
4. General Wage Growth	2.75%	2.60%	2.50%
5. Payroll Growth	2.50%	2.35%	2.25%

The net impact of the scheduled change in the set of economic assumptions was an increase of $125 million in the actuarial accrued liability and an increase of 0.46% in the employer contribution rate.

Another change reflected in the June 30, 2020 valuation was the programming of our valuation software for the cost of living adjustment for MSEP members who work beyond normal retirement age. These members receive a benefit adjustment upon retirement equal to the COLAs granted between age 65 and the date of retirement (not to exceed 65%). Periodically, the valuation software used to calculate the liabilities is updated with additional features and enhancements to accommodate some of the more complex benefit provisions. As the result of a recent update, the valuation programming was modified to more directly reflect the Formula 1 cost-of-living adjustment formula for MSEP members retiring after their normal retirement date. The impact of this programming refinement was a decrease in the actuarial accrued liability of $121 million and a decrease in the employer contribution rate of 0.45%.

Key Valuation Results

The actuarial valuation results provide a "snapshot" view of the System's financial condition on June 30, 2020. The unfunded actuarial accrued liability (UAAL) for MSEP increased from $5.175 billion last year to $5.547 billion this year and the funded ratio decreased from 62.9% to 61.1%. In addition, the employer contribution rate increased from 22.88% of pay last year to 23.51% of pay in this year's valuation, an increase of 0.63% of pay. This change was impacted by various events over the past year. The most significant impact was the investment return on the actuarial assets of 3.9% which was lower than the expected return of 7.10% for the year ended June 30, 2020. This unfavorable experience increased the employer contribution rate by 0.86%. Additional components of change were the change in the economic assumptions (0.46% increase) and the COLA programming refinements (0.45% decrease). The effective employee contribution rate also increased from the prior valuation by 0.14% due to the higher percentage of active members covered by the MSEP 2011 Plan, which lowered the employer contribution rate.

The valuation results reflect net unfavorable experience of $321 million for the past plan year as demonstrated by an UAAL that was higher than expected (actual UAAL of $5.547 billion compared to an expected UAAL of $5.226 billion). The unfavorable experience was due to the combined impact of an actuarial loss on the actuarial value of assets ($274 million) and a net actuarial loss on liabilities ($47 million). The most significant sources of liability loss were larger than expected salary increases and more retirements than expected. Partially offsetting this unfavorable actuarial experience was an actuarial gain from lower COLAs than anticipated by the actuarial assumption.

A summary of the key results from the June 30, 2020 actuarial valuation, compared to the prior valuation, is shown in the following table. Further detail on the changes and actuarial experience affecting the valuation results can be found in the following sections of this Executive Summary.

	June 30, 2020	June 30, 2019
Unfunded Actuarial Accrued Liability ($M)	$5,547	$5,175
Funded Ratio (Actuarial Assets)	61.10%	62.92%
Normal Cost Rate	8.53%	8.61%
UAAL Amortization Rate	16.78%	15.93%
Total Actuarial Required Contribution	25.31%	24.54%
Member Contribution Rate	(1.80%)	(1.66%)
Employer Contribution Rate	23.51%	22.88%

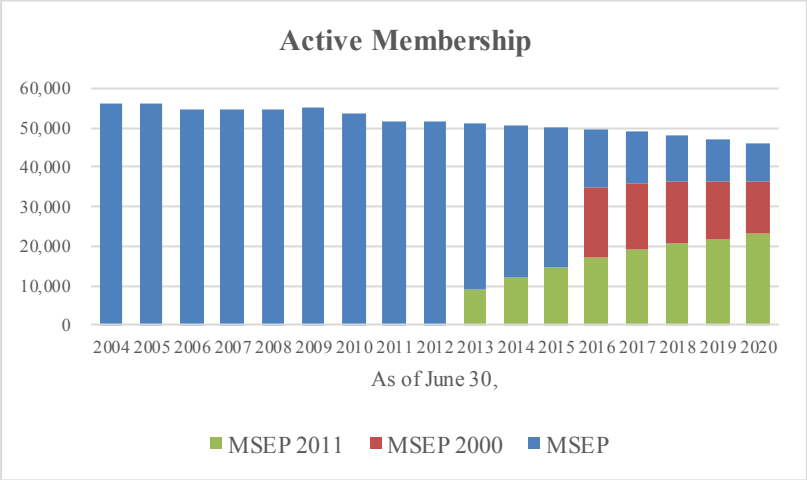
Experience for the Last Plan Year

Numerous factors contributed to the change in the MSEP assets, liabilities, and actuarial required contribution rate between June 30, 2019 and June 30, 2020. The components are examined in the following discussion.

Membership

There was a decline of 1.8% in the number of active members in the current valuation (45,999 compared to 46,864 in the prior valuation). As shown in the following graph, the active membership has declined about 18% over the last 16 years from 55,914 active members in the 2004 valuation to 45,999 in the current

valuation. A decline in the size of the active membership puts a strain on the system's contribution rate because covered payroll generally does not increase, as assumed, and consequently, the UAAL amortization payment is higher as a percent of payroll. Note that while the UAAL amortization contribution rate is higher when covered payroll does not increase as assumed, the dollar amount of the UAAL amortization payment is the same.



Note: Split between MSEP and MSEP 2000 is not available prior to June 30, 2016.
MSEP 2011 active counts are not available for June 30, 2011 or June 30, 2012.

The percentage of active members covered by the MSEP 2011 Plan has increased each year as actives covered by the MSEP or MSEP 2000 Plans leave covered employment and are replaced by new hires. The number of active members covered by the MSEP 2011 Plan increased from 21,893 in the 2019 valuation (about 47%) to 23,075 (about 50% of total) in the 2020 valuation. Because the benefit structure is different for MSEP 2011 members, including an employee contribution rate of 4%, the ongoing cost of the System declines as a larger percentage of active members are covered by MSEP 2011.

As is expected in a mature retirement system, the number of members receiving benefits increased from 49,696 last year to 50,857 in the current valuation. In addition, the average benefit amount for this group increased (1.5%), which is to be expected.

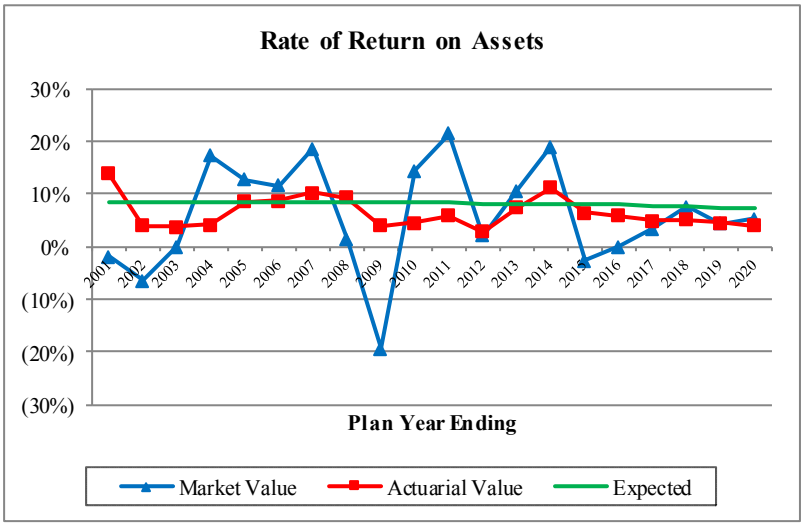
System Assets

As of June 30, 2020, MSEP had net assets of $7.911 billion, when measured on a market value basis, a decrease of $5 million from the prior year value of $7.916 billion. However, the market value of assets is not used directly in the calculation of the unfunded actuarial accrued liability and the employer actuarial contribution rate. An asset valuation method, which smoothes the effect of market fluctuations, is applied to determine the value of assets used in the valuation, called the actuarial value of assets. The current asset valuation method was implemented in the June 30, 2018 valuation. Under this method, the difference between the dollar amount of the actual and assumed investment return on the market value of assets is recognized evenly over a closed five-year period. In addition, to transition from the prior to the new smoothing method, the total unrecognized investment experience as of June 30, 2017 ($927 million) was established on a schedule to evenly recognize the amount over a closed seven-year period beginning June 30, 2018.

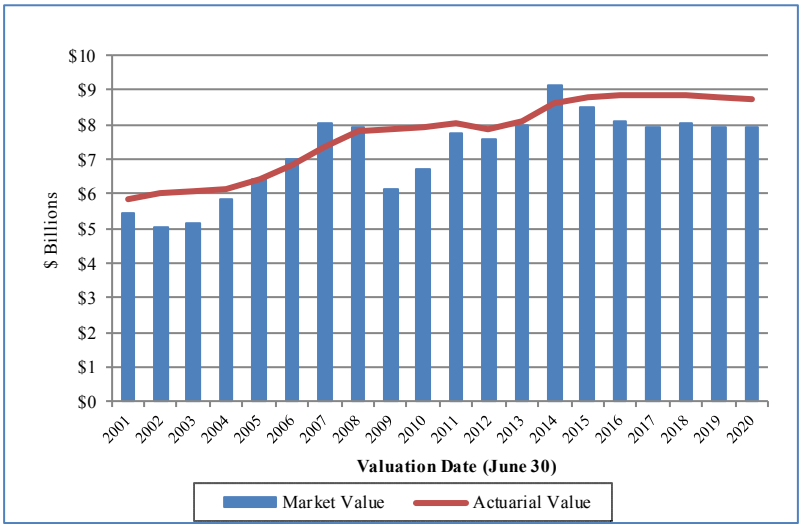
In the current valuation, the actuarial value of assets for MSEP is $8.711 billion, a decrease of $71 million from the prior year. The components of the change in the asset values are shown in the following table.

	Market Value ($M)		Actuarial Value ($M)	
Net Assets, June 30, 2019	$	7,916.47	$	8,782.38
- Employer and Member Contributions	+	476.09	+	476.09
- Benefit Payments	-	873.82	-	873.82
- Net Investment Income	+	400.49	+	334.97
- Administrative Expenses	-	8.40	-	8.40
Net Assets, June 30, 2020	$	7,910.83	$	8,711.22
Estimated Net Rate of Return		5.2%		3.9%

Due to the scheduled recognition of the current and prior investment experience in the asset smoothing method, the estimated rate of return on the actuarial value of assets for FY 2020 was 3.9%, which is lower than the investment return assumption of 7.10% for the period July 1, 2019 to June 30, 2020. As a result, there was an actuarial loss on the smoothed value of assets of $274 million. The investment return on the market value of assets for the year ending June 30, 2020 of 5.2%, as reported by MOSERS, was below the assumed rate of return. As a result, it produced an investment income shortfall for the year ended June 30, 2020 of $147 million. There is currently a net deferred investment loss of $800 million (actuarial value of assets exceeds market value). Please see Section 3 of this report for more detailed information on the market and actuarial value of assets.



The rate of return of the actuarial value of assets has been less volatile than the market value return, illustrating the benefit of using an asset smoothing method. However, during this time period, the rate of return on actuarial assets has been at or below the assumed rate of return for most years, resulting in actuarial losses.



An asset smoothing method is used to mitigate the volatility in the market value of assets. By using a smoothing method, the actuarial (or smoothed) value can be, and actually should be, both above or below the pure market value.

Note the asset smoothing method changed with the 2018 valuation.

System Liabilities

The actuarial accrued liability is that portion of the present value of future benefits that will not be paid by future normal costs. The difference between this liability and the actuarial value of assets as of the valuation date is called the unfunded actuarial accrued liability. The dollar amount of the UAAL is reduced if the contributions to the System exceed the normal cost for the year plus interest on the prior year's UAAL.

The UAAL, using both the actuarial and market value of assets, is shown as of June 30, 2020 in the following table:

	Actuarial Value of Assets	Market Value of Assets
Actuarial Accrued Liability	$14,258,408,888	$14,258,408,888
Value of Assets	8,711,224,151	7,910,830,533
Unfunded Actuarial Accrued Liability	$5,547,184,737	$6,347,578,355
Funded Ratio	61.10%	55.48%

See Section 4 of the report for the detailed development of the UAAL.

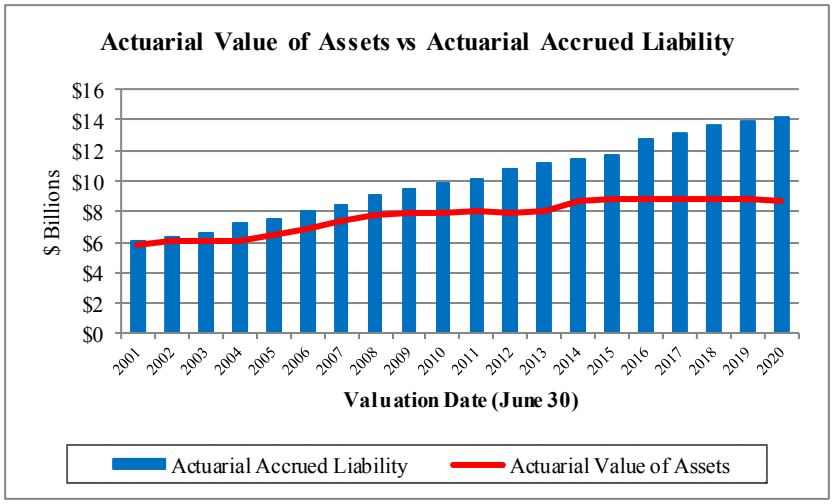
The net change in the UAAL from June 30, 2019 to June 30, 2020 was an increase of $372.0 million. The components of this net change are shown in the following table:

	($ Millions)
Unfunded Actuarial Accrued Liability, June 30, 2019	$5,175.2
- Expected increase due to amortization method	62.0
- Investment experience	274.4
- Liability experience	46.9
- Change to economic assumptions	124.8
- Refinement of COLA programming	(121.3)
- Other experience	(14.8)
Unfunded Actuarial Accrued Liability, June 30, 2020	$5,547.2

As shown above, various components impacted the dollar amount of the UAAL. The UAAL is amortized as a level-percent of payroll. This methodology results in dollar payment amounts that are lower in the early part of the amortization period but increase each year in the future with the assumed payroll growth assumption (currently 2.25%). Given the amortization period and the actuarial assumptions, the current amortization payment is less than the interest on the UAAL. As a result, even if all assumptions are met the dollar amount of the UAAL is expected to increase as evidenced in the first row of this table.

Actuarial gains (losses), which result from actual experience that is more (less) favorable than anticipated based on the actuarial assumptions in place in the prior valuation, are reflected in the UAAL and are measured as the difference between the expected UAAL and the actual UAAL, taking into account any changes due to actuarial assumptions and methods, benefit provision changes or valuation programming updates. Overall, MSEP experienced a net actuarial loss of $321.3 million, the result of an actuarial loss of $274.4 million on actuarial assets and a $46.9 million actuarial loss on System liabilities. The liability loss was the net result of various components of actuarial gains and losses for the year ending June 30, 2020. The most significant sources of liability loss were larger than expected salary increases and more retirements than expected. A breakdown of the components of actuarial gains and losses can be found in Table 7 of this report.

As the following graph of historical actuarial assets and actuarial accrued liabilities shows, the System's liabilities have grown faster than the System's assets since FY 2009. Some of the growth is due to significant changes in the actuarial assumptions during this timeframe, including lowering the investment return assumption from 8.50% to 6.95%. As a result, the unfunded portion of the actuarial accrued liability has increased.

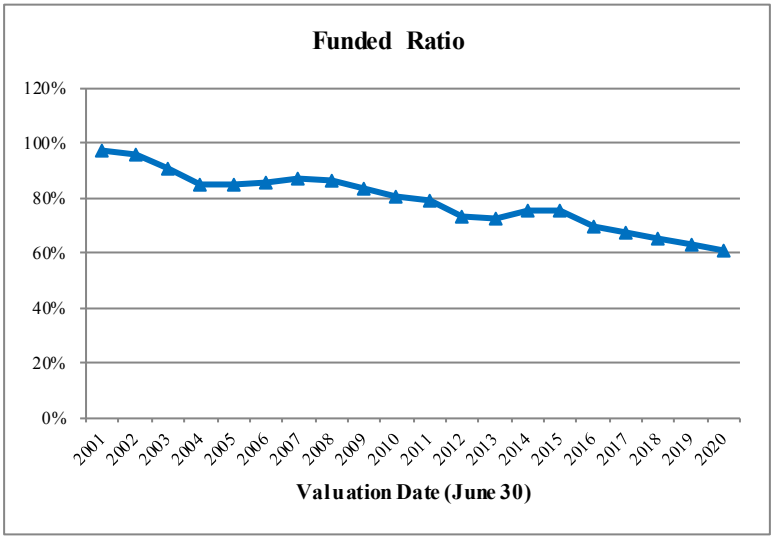


An evaluation of the UAAL on a pure dollar basis may not provide a complete analysis since only the difference between the assets and liabilities (which are both very large numbers) is reflected. Another way to evaluate the UAAL and the progress made in its funding is to track the funded ratio, the ratio of the actuarial value of assets to the actuarial accrued liability. The funded status information, using both the actuarial value of assets and the market value of assets, is shown below (in millions).

	6/30/2015	6/30/2016	6/30/2017	6/30/2018	6/30/2019	6/30/2020
Using Actuarial Value of Assets:						
- Funded Ratio	75.0%	69.6%	67.5%	64.9%	62.9%	61.1%
- UAAL ($M)	$2,936	$3,873	$4,280	$4,782	$5,175	$5,547
Using Market Value of Assets:						
- Funded Ratio	72.6%	63.6%	60.4%	59.0%	56.7%	55.5%
- UAAL ($M)	$3,211	$4,641	$5,207	$5,578	$6,041	$6,348

Note that the funded ratio does not indicate whether or not the System assets are sufficient to settle benefits earned to date. The funded ratio, by itself, also may not be indicative of future funding requirements. As shown in the table above, the funded ratios differ using the market value of assets.

The funded ratio over a longer period is shown in the following graph:



As the graph above shows, the System's funded ratio has declined over the past 20 years. It is important to note that historical trends are not simply a reflection of past investment performance and other actuarial experience. Changes to actuarial assumptions and methods, benefit provisions and the System's funding policy have also had a significant impact on valuation results over time. The Board adopted new assumptions several times during this period which had the general impact of decreasing the funded ratio.

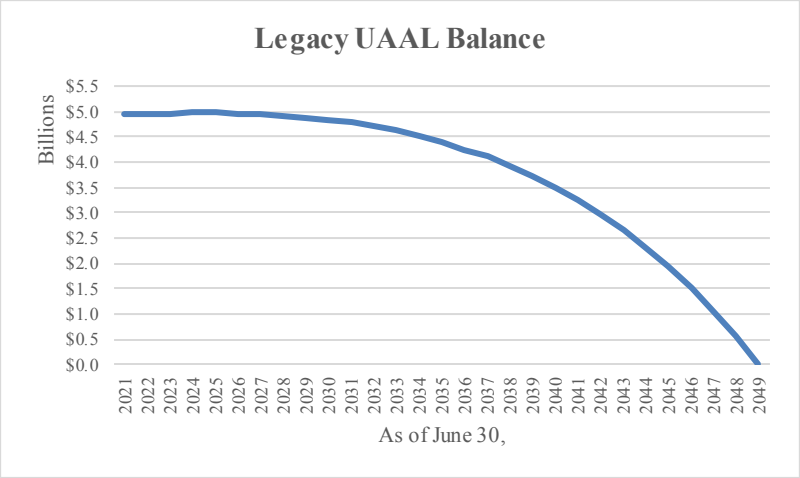
Actuarial Required Contribution Rate

The System is funded by contributions from employers (actuarially determined) and from employees hired after December 31, 2010 (4.00% of pay). Under the Entry Age Normal cost method, the actuarial contribution rate consists of two components:

- A "normal cost" for the portion of projected liabilities allocated by the actuarial cost method to service of members during the year following the valuation date.
- An "unfunded actuarial accrued liability contribution" for the excess of the portion of projected liabilities allocated to service to date over the actuarial value of assets.

Under the System's current funding policy, the UAAL contribution rate is determined by amortizing the UAAL using the layered amortization method. To implement this method, the projected UAAL developed in the June 30, 2018 valuation was amortized as a level-percent of payroll over a closed, 30-year period. In subsequent years (starting with the 2019 valuation), changes to the projected UAAL that are generated by actuarial experience that is different than expected or changes in assumptions and methods will be amortized as a level–percent of payroll over separate closed, 30-year periods beginning on that date. Any change in the UAAL due to changes in the benefit provisions will be amortized over a closed 20-year period, as required by statute. Note that the use of closed amortization periods for each layer will eventually result in the System being fully funded if the full actuarial contribution is made and all actuarial assumptions are met in the future.

The level-percent of payroll methodology for UAAL payments results in dollar payment amounts that are lower than the level-dollar payment method in the early portion of the amortization period, but increase each year in the future with the assumed payroll growth assumption (currently 2.25%). Because the UAAL contribution rate is determined as a level-percent of payroll, the dollar amount of the UAAL contribution is scheduled to increase 2.25% each year in the future, even if all actuarial assumptions are met. If covered payroll increases, as expected based on the assumption, the contribution rate will remain stable. However, if actual payroll increases are lower than 2.25% the UAAL contribution rate will increase. Note that with this payment methodology the dollar amount of the UAAL is expected to hold steady for about eight years before starting to decline as illustrated in the following graph of the legacy UAAL base:



See Section 5 of the report for the detailed development of the employer contribution rate, which is summarized in the following table:

Contribution Rates	June 30 Valuation* 2020	2019
1. Normal Cost Rate	8.53%	8.61%
2. UAAL Contribution Rate	16.78%	15.93%
3. Total Actuarial Required Contribution Rate	25.31%	24.54%
4. Member Contribution Rate	(1.80%)	(1.66%)
5. Employer Contribution Rate	23.51%	22.88%

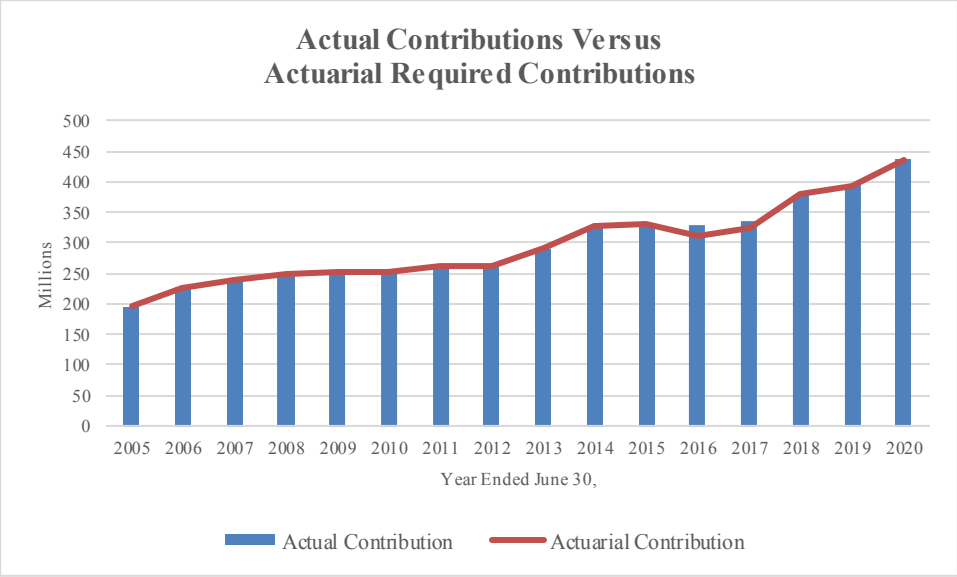
*Note different assumptions were used in the two valuation reports so results are not directly comparable.

The total actuarial contribution rate in the June 30, 2020 valuation is 25.31%. The member contribution rate (as a percentage of total payroll) is anticipated to be 1.80%, resulting in an employer contribution rate for the fiscal year ending June 30, 2022 of 23.51%.

The following table shows the reconciliation of the Computed Employer Contribution Rate from the June 30, 2019 to June 30, 2020 valuation:

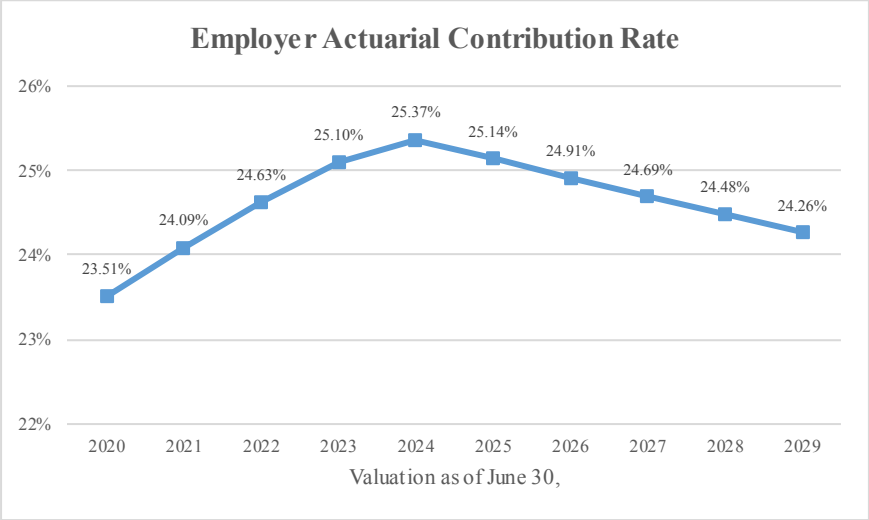
	% of Payroll
6/30/2019 Computed Employer Contribution Rate	**22.88%**
Asset (Gain)/Loss	0.86%
Liability (Gain)/Loss	0.15%
Change to Economic Assumptions	0.46%
Refinement of COLA programming	(0.45%)
Projected Payroll Higher than Expected	(0.04%)
Change in Normal Cost Rate	(0.15%)
Change in Effective Member Contribution Rate	(0.14%)
Other Experience	(0.06%)
6/30/2020 Computed Employer Contribution Rate	**23.51%**

MOSERS covered employers have historically contributed the full actuarial contribution as shown in the graph below which compares the actuarially determined employer contribution and actual contribution amounts:



The computed employer contribution rate, which is determined based on the snapshot of the System taken on each valuation date, is anticipated to increase over the short-term as the deferred investment experience is recognized through the asset smoothing method. Anticipated increases in member contributions, as a percentage of total payroll, will provide a small offset to the increase in the employer contribution rate. To the extent the size of the active group continues to decline in future years, there will be a slower increase in the effective member contribution rate. Future experience (both investment and demographic), which is not modeled here, will also have an impact on the ultimate level of MSEP contributions. The following graph of the projected employer contribution rate over the next ten years reflects the impact due to the recognition of the current deferred investment experience ($800 million). Once the deferred investment experience is recognized, the employer contribution rate begins to decline due to the normal cost rate

decreasing from more MSEP 2011 members in the System as well as increases in the effective employee contribution rate.



The net deferred investment loss (actuarial value of assets minus the market value) is $800 million as of June 30, 2020. Absent favorable investment experience in future years, the deferred investment loss will eventually be reflected in the actuarial value of assets in future years. While the use of an asset smoothing method is a common procedure for public retirement systems, it is important to recognize the potential impact of the deferred investment experience. This is accomplished by comparing the key valuation results from the June 30, 2020 actuarial valuation using both the actuarial and market value of assets (see table below):

	Using Actuarial Value of Assets	Using Market Value of Assets
Actuarial Accrued Liability	$14,258,408,888	$14,258,408,888
Asset Value	(8,711,224,151)	(7,910,830,533)
Unfunded Actuarial Accrued Liability	$5,547,184,737	$6,347,578,355
Funded Ratio	61.1%	55.5%
Normal Cost Rate	8.53%	8.53%
UAAL Contribution Rate	16.78%	19.27%
Total Contribution Rate	25.31%	27.80%
Member Contribution Rate	(1.80%)	(1.80%)
Employer Contribution Rate	23.51%	26.00%

A typical retirement plan faces many different risks. The term "risk" is most commonly associated with an outcome with undesirable results. However, in the actuarial world risk can be translated as uncertainty. The actuarial valuation process uses many actuarial assumptions to project how future contributions and investment returns will meet the cash flow needs for future benefit payments. Of course, we know that actual experience will not unfold exactly as anticipated by the assumptions and that uncertainty, whether favorable or unfavorable, creates risk. Actuarial Standard of Practice Number 51 defines risk as the potential of actual future measurements to deviate from expected results due to actual experience that is different than the actuarial assumptions. Risk evaluation is an important part of managing a defined benefit plan. Please see Section 7 of this report for an in-depth discussion of the specific risks facing MOSERS.

The next page contains a comprehensive summary of valuation results for the current and prior year. Detailed exhibits deriving the results can be found in the following sections.

SUMMARY OF PRINCIPAL RESULTS
($ in millions)

Valuation Date Contribution for Fiscal Year Ending	June 30, 2020 June 30, 2022	June 30, 2019 June 30, 2021	% Change
Computed Employer Contribution			
Annual Amount (Estimated)	$495.9	$471.4	5.2%
Percentage of Covered Payroll	23.51%	22.88%	2.8%
Benefit Payments During Prior Year	$874	$852	2.6%
Membership			
Number of			
- Active Members	45,999	46,864	(1.8%)
- Retirees and Beneficiaries	50,857	49,696	2.3%
- Terminated Vested Members	16,300	16,016	1.8%
- Leave-of-Absence Members	247	175	41.1%
- Long Term Disability Members	651	682	(4.5%)
- Terminated Nonvested Members	21,735	18,852	15.3%
- Total	135,789	132,285	2.6%
- Reported Payroll	$1,981	$1,931	2.6%
Assets			
Market Value (MVA)	$7,911	$7,916	(0.1%)
Actuarial Value (AVA)	$8,711	$8,782	(0.8%)
Ratio - Actuarial Value to Market Value	110.11%	110.94%	
Return on Market Value*	5.2%	4.3%	
Return on Actuarial Value	3.9%	4.5%	
Actuarial Information			
Actuarial Accrued Liability (AAL)	$14,258	$13,958	2.1%
Unfunded Actuarial Accrued Liability (UAAL)	$5,547	$5,175	7.2%
Funded Ratio (Actuarial Value of Assets)	61.1%	62.9%	(2.9%)
Ratio of AVA to Payroll	4.4	4.5	
Ratio of AAL to Payroll	7.2	7.2	
Normal Cost Rate	8.53%	8.61%	(0.9%)
UAAL Contribution Rate	16.78%	15.93%	5.3%
Total Contribution Rate	25.31%	24.54%	3.1%
Member Contribution Rate	(1.80%)	(1.66%)	8.4%
Employer Contribution Rate	23.51%	22.88%	2.8%

* As reported by MOSERS.

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This report presents the actuarial valuation results of the Missouri State Employees' Retirement System as of June 30, 2020. This valuation was prepared at the request of the MOSERS Board.

Please pay particular attention to our actuarial certification letter, where the guidelines employed in the preparation of this report are outlined. We also comment on the sources and reliability of both the data and the actuarial assumptions upon which our findings are based. Those comments are the basis for our certification that this report is complete and accurate to the best of our knowledge and belief.

A summary of the findings which result from this valuation is presented in the previous section. Section 3 describes the assets and investment experience of the System. Sections 4 and 5 describe how the obligations of the System are to be met under the System's funding policy. Section 6 contains projections of future valuation results, assuming all actuarial assumptions are met. Section 7 discloses key maturity measurements and discusses the key risks facing the funding of the System. Section 8 includes some historical funding information that was required by the Governmental Accounting Standards Board (GASB) in the past.

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In many respects, an actuarial valuation can be thought of as an inventory process. The inventory is taken as of the actuarial valuation date, which for this valuation is June 30, 2020. On that date, the assets available for the payment of benefits are appraised. The assets are compared with the liabilities of the System, which are generally in excess of assets. The actuarial process then leads to a method of determining the contributions needed by members and the employer in the future to balance the System assets and liabilities.

Market Value of Assets

The current market value represents the "snapshot" or "cash-out" value of System assets as of the valuation date. In addition, the market value of assets provides a basis for measuring investment performance from time to time. Table 1 shows a summary of changes to both the market and the actuarial value assets for the year beginning June 30, 2019 and ending June 30, 2020.

Actuarial Value of Assets

Neither the market value of assets, representing a "cash-out" value of System assets, nor the book values of assets, representing the cost of investments, may be the best measure of the System's ongoing ability to meet its obligations.

To arrive at a suitable value of assets for the actuarial valuation, a technique for determining the actuarial value of assets is used which dampens swings in the market value while still indirectly recognizing market values.

Table 2 shows the development of the actuarial value of assets (AVA) as of the valuation date.

TABLE 1
ASSET SUMMARY

	Market Value	Actuarial Value
1. Assets at June 30, 2019	7,916,465,279	8,782,383,977
2. Contributions		
State Contributions	436,895,653	436,895,653
Employee Contributions	35,141,960	35,141,960
Member Purchases of Service Credit	1,388,992	1,388,992
Service Transfer Contributions	2,664,796	2,664,796
Total	476,091,401	476,091,401
3. Investment Income, Net of Investment Expenses	400,488,255	334,963,175
4. Benefit Payments and Transfers Out		
Monthly Benefit Payments	800,896,058	800,896,058
BackDROP and Lump Sum Payments	63,666,199	63,666,199
Inactive Vested Lump Sum Payments	245,297	245,297
Service Transfer Payments	3,784,195	3,784,195
Contribution Refunds	5,224,489	5,224,489
Total	873,816,238	873,816,238
5. Administrative and Misc. Expenses	8,398,164	8,398,164
6. Assets at June 30, 2020 (1) + (2) + (3) - (4) - (5)	7,910,830,533	8,711,224,151
7. Rate of Return, Net of Investment Expenses*	5.2%	3.9%

* Based on the approximation formula: (2 x I) / (A+B-I), where
I = Investment Increment
A = Beginning of year asset value
B = End of year asset value

Market Value return reported by MOSERS

TABLE 2
DEVELOPMENT OF ACTUARIAL VALUE OF ASSETS

Under the current asset smoothing method, the difference between the dollar amount of actual and assumed investment return on the market value of assets will be recognized evenly over a closed five-year period. The method was first implemented with the June 30, 2018 valuation. Deferred asset experience as of June 30, 2017 is recognized evenly over a closed seven-year period, beginning June 30, 2018.

Fiscal Year End June 30,	2018	2019	2020	2021
A. Market Value of Assets, Beginning of Year	$ 7,941,650,400	$ 8,034,508,424	$ 7,916,465,279	$ NA
B. Contributions During Year	413,179,927	429,323,185	476,091,401	NA
C. Benefit Payments and Expenses During Year	896,510,729	861,022,406	882,214,402	NA
D. Expected Rate of Return	7.50%	7.25%	7.10%	6.95%
E. Expected Net Investment Income	577,826,541	567,126,565	547,898,876	NA
F. Expected Market Value of Assets, End of Year	8,036,146,139	8,169,935,768	8,058,241,154	NA
G. Market Value of Assets, End of Year	8,034,508,424	7,916,465,279	7,910,830,533	NA
H. Excess/(Shortfall) of Net Investment Income	$ (1,637,715)	$ (253,470,489)	$ (147,410,621)	$ NA

The table below shows the development of gain/(loss) to be recognized in the current year:

Plan Year Ended	Asset Gain/(Loss)	Gain/(Loss) Recognized in Prior Years	Gain/(Loss) Recognized This Year		Gain/(Loss) Deferred to Future Years
6/30/2017	(927,023,550)	(264,863,872)	(132,431,936)	*	(529,727,742)
6/30/2018	(1,637,715)	(655,086)	(327,543)		(655,086)
6/30/2019	(253,470,489)	(50,694,098)	(50,694,098)		(152,082,293)
6/30/2020	(147,410,621)	0	(29,482,124)		(117,928,497)
Total	(1,329,542,375)	(316,213,056)	(212,935,701)		(800,393,618)

A. Market Value of Assets as of June 30, 2020	$	7,910,830,533
B. Total Deferred Investment Experience	$	(800,393,618)
C. Actuarial Value of Assets as of June 30, 2020 (A. - B.)	$	8,711,224,151
D. Ratio of Actuarial Value to Market Value		110.1%

* The unrecognized investment experience as of June 30, 2017 will be recognized over a closed seven-year period.

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In the previous section, an analysis of System's current assets was given as of June 30, 2020. In this section, the discussion will focus on the commitments (future benefit payments) of the System, which are referred to as its liabilities.

Table 3 contains an analysis of the actuarial present value of all future benefits (PVFB) for contributing members, inactive members, retirees and their beneficiaries. The liabilities summarized in Table 3 include the actuarial present value of all future benefits expected to be paid with respect to each member. For an active member, this value includes measures of both benefits already earned and future benefits expected to be earned. For all members, active and retired, the value extends over benefits earnable and payable for the rest of their lives and, if an optional benefit is chosen, for the lives of their surviving spouses.

The actuarial assumptions used to determine liabilities are based on the results of the latest experience study. These assumptions are outlined in Appendix D.

The Board's funding policy amortizes the UAAL using a "layered" bases methodology. Under this method, the "Legacy UAAL", as determined in the June 30, 2018 valuation, is amortized over a closed 30-year period (see Table 4). Subsequent changes in the UAAL due to actuarial gains/losses or assumption changes are separately financed by establishing amortization bases and payments, as a level percentage of payroll, over closed 30-year periods. Any change in the System's benefit structure shall be amortized over a closed period of 20 years, as set out in state statutes. The total UAAL amortization payment is the sum of the payments for each of the amortization bases. Note that the use of closed amortization periods will result in the System being fully funded at the end of the amortization period if all actuarial assumptions are met.

All liabilities reflect the benefit provisions in place as of June 30, 2020, as amended by any legislation in the 2020 Legislative Session.

Actuarial Accrued Liability

A fundamental principle in financing the liabilities of a retirement program is that the cost of its benefits should be related to the period in which benefits are earned, rather than to the period of benefit distribution. An actuarial cost method is a mathematical technique that allocates the present value of future benefits into annual costs. In order to do this allocation, it is necessary for the funding method to "breakdown" the present value of future benefits into two components:

(1) that which is attributable to the past and
(2) that which is attributable to the future.

Actuarial terminology calls the part attributable to the past the "past service liability" or the "actuarial accrued liability." The portion allocated to the future is known as the present value of future normal costs, with the specific piece of it allocated to the current year being called the "normal cost." Table 5 contains the actuarial balance sheet for the System. The Entry Age Normal actuarial cost method is used to develop the actuarial accrued liability. Tables 6 and 7 show the gain/(loss) analysis in total and by source for the System. Table 8 shows historical data for gain/(loss) experience by source.

TABLE 3
UNFUNDED ACTUARIAL ACCRUED LIABILITY
As of June 30, 2020

	(1) Actuarial Present Value	(2) Present Value of Future Normal Cost Contributions	(3) = (1) - (2) Actuarial Accrued Liabilities
Active Members			
Service retirement benefits based on service rendered before and likely to be rendered after valuation date	$5,340,667,720	$756,900,070	$4,583,767,650
Disability benefits likely to be paid to present active members who become totally and permanently disabled	163,130,395	104,867,857	58,262,538
Survivor benefits likely to be paid to widows and children of present active members who die before retiring	63,683,397	18,041,815	45,641,582
Separation benefits likely to be paid to present active members	225,729,919	164,638,374	61,091,545
Active Member Totals	$5,793,211,431	$1,044,448,116	$4,748,763,315
Members on Leave of Absence & LTD Service retirement benefits based on service rendered before the valuation date			89,435,430
Terminated Vested Members Service retirement benefits based on service rendered before the valuation date			690,065,179
Retired Lives			8,701,290,590
Pending Refunds			28,854,374
Total Actuarial Accrued Liability			$14,258,408,888
Actuarial Value of Assets			8,711,224,151
Unfunded Actuarial Accrued Liability			$5,547,184,737
Funded Ratio			61.1%

TABLE 4
AMORTIZATION SCHEDULE FOR LEGACY UAAL

This amortization schedule for the outstanding balance of the legacy UAAL as of June 30, 2021 reflects the underlying assumptions used in this valuation including an investment return assumption of 6.95% and the assumed payroll growth of 2.25%. Any change in these assumptions in the future, will impact the projected UAAL amortization schedule for the legacy UAAL.

As of June 30	Outstanding Balance (BOY)	Amortization Years Remaining	Contributions ($M)
2021	4,933	28	313
2022	4,952	27	320
2023	4,965	26	327
2024	4,971	25	335
2025	4,971	24	342
2026	4,962	23	350
2027	4,945	22	358
2028	4,919	21	366
2029	4,882	20	374
2030	4,834	19	383
2031	4,775	18	391
2032	4,702	17	400
2033	4,615	16	409
2034	4,513	15	418
2035	4,394	14	428
2036	4,257	13	437
2037	4,101	12	447
2038	3,923	11	457
2039	3,723	10	467
2040	3,499	9	478
2041	3,247	8	489
2042	2,968	7	500
2043	2,657	6	511
2044	2,313	5	522
2045	1,934	4	534
2046	1,516	3	546
2047	1,056	2	559
2048	552	1	571
2049	0	0	0

TABLE 5
ACTUARIAL BALANCE SHEET

ASSETS		
Actuarial Value of Assets		$ 8,711,224,151
Unfunded Actuarial Accrued Liability		5,547,184,737
Present Value of Future Normal Costs		1,044,448,116
Total Assets		$ 15,302,857,004
LIABILITIES		
Present Value of Future Benefits		
Active members		
Retirement	$ 5,340,667,720	
Withdrawal	225,729,919	
Death	63,683,397	
Disability	163,130,395	
Total		$ 5,793,211,431
Inactive members		
Currently receiving benefits	8,701,290,590	
Not currently receiving benefits	808,354,983	
Total		$ 9,509,645,573
Total Liabilities		$ 15,302,857,004

TABLE 6
ANALYSIS OF GAIN/(LOSS)

	(1) Actuarial Accrued Liabilities	(2) Valuation Assets	(3) = (1) - (2) UAAL
(1) Value at start of year	$ 13,957,626,309	$ 8,782,383,977	5,175,242,332
(2) Total normal cost from last valuation	148,981,819	0	148,981,819
(3) Actual contributions (Employer and Member)	0	472,037,613	(472,037,613)
(4) Benefit payments	(873,816,238)	(873,816,238)	0
(5) Administrative expenses	0	(8,398,164)	8,398,164
(6) Service Purchases/Transfers	4,053,788	4,053,788	0
(7) Interest on (1), (2), (3), (4), (5) and (6) at 7.10%	971,222,036	609,379,103	361,842,933
(8) Expected value before changes	$ 14,208,067,714	$ 8,985,640,079	$ 5,222,427,635
(9) Change in actuarial assumptions	124,766,739	0	124,766,739
(10) Refinement of COLA programming	(121,303,254)	0	(121,303,254)
(11) Expected value after changes: (8) + (9) + (10)	$ 14,211,531,199	$ 8,985,640,079	$ 5,225,891,120
(12) Actual value at end of year	14,258,408,888	8,711,224,151	5,547,184,737
(13) Gain / (Loss)	$ (46,877,689)	$ (274,415,928)	$ (321,293,617)
(14) Gain / (Loss) as percent of expected actuarial accrued liability: $14,208,067,714	(0.3%)	(1.9%)	(2.3%)

TABLE 7
GAIN/(LOSS) ANALYSIS BY SOURCE

Type of Activity	Gain or (Loss) for Year Ended 6/30/2020	
Age & Service Retirements. If members retire at older ages or with lower final average pay than assumed, there is a gain. If younger ages or higher average pays, a loss.	($19,200,000)	(0.1%)
Death-in-Service Benefits. If survivor claims are less than assumed, there is a gain. If more claims, there is a loss.	7,100,000	0.0%
Withdrawal From Employment. If more liabilities are released by withdrawals than assumed, there is a gain. If smaller releases, a loss.	(4,100,000)	(0.0%)
Long Term Disability. The occurrence of a gain or loss depends upon the age at disability and the incidence of disability.	(3,100,000)	(0.0%)
Salary Increases. If there are smaller salary increases than assumed, there is a gain. If greater increases, a loss.	(60,600,000)	(0.4%)
Investment Income. If there is greater investment return on assets than assumed, there is a gain. If less return, a loss.	(274,400,000)	(1.9%)
Retiree Mortality. If more deaths than assumed, there is a gain. if fewer deaths, a loss.	9,100,000	0.1%
COLAs. If Cost of Living Adjustments are less than expected, a gain; if more a loss.	20,200,000	0.1%
Other. Miscellaneous gains and losses resulting from data adjustments, timing of financial transactions, valuation methods, etc.	3,700,000	0.0%
Gain (or Loss) During Year From Experience	($321,300,000)	(2.3%)

TABLE 8
HISTORICAL EXPERIENCE GAINS AND LOSSES BY SOURCE

Year Ending June 30	Gain (Loss) By Risk Area									Total Exper. Gain (Loss)	Exper. Gain (Loss) as % of AAL	Accrued Liability Beginning of Year
	Salary Increases	Investments	Age & Service Retirement	Disability	Death In-Service	Withdrawal	Death Retired Lives&	COLAs	Other			
1998	(56.9)	325.9	9.6	0.2	(0.3)	(1.7)	16.3		(48.3)	244.8	5.5	4,484
1999	(21.9)	299.8	(1.3)	(0.3)	(0.9)	1.7	10.5		(58.1)	229.5	4.7	4,919
2000*	(6.4)	162.0	1.7	(0.5)	(0.7)	8.9	18.5		(34.7)	148.8	2.7	5,506
2001*	(23.2)	(67.9)	(59.8)	(1.0)	(0.2)	(28.2)	(13.1)		(66.1)	(259.5)	(4.4)	5,921
2002	115.0	(284.6)	(14.4)	(0.5)	(1.3)	(21.4)	37.1		(62.6)	(232.8)	(3.8)	6,065
2003	7.7	(314.1)	(27.2)	(0.6)	(2.6)	(14.6)	9.6		(63.1)	(404.9)	(6.5)	6,294
2004*	(40.0)	(240.1)	(51.5)	(1.4)	(1.3)	(6.7)	(4.3)		(53.8)	(399.1)	(6.0)	6,662
2005	(3.4)	(196.6)	3.1	(2.0)	(1.7)	(0.9)	(11.7)		(35.5)	(248.7)	(3.4)	7,230
2006	(29.5)	38.0	(1.7)	(2.3)	(2.4)	15.5	(21.1)		(3.6)	(7.1)	(0.1)	7,578
2007	(11.5)	179.4	(17.3)	(2.1)	(2.4)	3.8	(29.7)		(43.0)	77.2	1.0	8,013
2008*	(10.5)	78.3	(22.9)	(2.0)	(3.4)	6.6	8.7		(49.8)	5.0	0.1	8,500
2009*	(15.9)	(354.3)	8.8	(1.5)	0.0	(31.3)	(39.8)		(37.6)	(471.6)	(5.2)	9,128
2010	23.2	(313.6)	(19.0)	8.4	8.0	(30.6)	4.7		(56.9)	(375.8)	(3.9)	9,495
2011	49.6	(204.0)	(52.8)	10.8	7.5	(21.0)	32.7		(60.4)	(237.6)	(2.4)	9,853
2012*	12.3	(447.2)	(24.3)	8.3	8.9	8.1	10.3		(53.6)	(477.2)	(4.7)	10,124
2013**	60.4	(313.7)	6.7	11.1	7.4	2.0	(7.7)	(3.1)	(70.4)	(307.3)	(2.8)	10,794
2014	52.6	249.5	(6.9)	(4.2)	(2.5)	(12.7)	6.3	18.0	(68.3)	231.8	2.1	11,135
2015	51.4	(137.9)	(29.1)	(1.6)	(0.5)	15.6	18.9	30.0	(54.0)	(107.2)	(0.9)	11,495
2016***	(59.3)	(320.4)	7.5	(1.2)	3.0	(8.3)	16.9	50.3	(70.0)	(381.5)	(3.3)	11,728
2017*	17.0	(232.1)	(53.3)	(0.6)	6.2	(28.2)	14.3	68.3	(2.2)	(210.5)	(1.6)	12,751
2018***	85.3	(202.1)	(51.8)	(0.9)	7.2	(38.0)	20.1	43.3	17.9	(119.0)	(0.9)	13,152
2019*	24.9	(241.2)	(26.4)	(2.3)	7.1	1.5	6.4	29.5	(44.2)	(244.7)	(1.8)	13,613
2020*	**(60.6)**	**(274.4)**	**(19.2)**	**(3.1)**	**7.1**	**(4.1)**	**9.1**	**20.2**	**3.7**	**(321.3)**	**(2.3)**	**13,958**

* Revision in assumptions.
** Revision in asset valuation method.
*** Revision in assumptions & asset valuation method.
& Prior to the 2013 valuation, this amount included COLAs.

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The previous two sections were devoted to a discussion of the assets and liabilities the Missouri State Employees' Retirement System. Table 5 indicates that current assets fall short of meeting the present value of future benefits (total liability). This is expected in all but a completely closed fund, where no further contributions are anticipated. In an active system, there will almost always be a difference between the actuarial value of assets and total liabilities. This deficiency has to be made up by future contributions and investment returns. An actuarial valuation sets out a schedule of future contributions that will fund this deficiency in an orderly fashion.

The method used to determine the incidence of the contributions in various years is called the actuarial cost method. Under an actuarial cost method, the contributions required to meet the difference between current assets and current liabilities are allocated each year between two elements: (1) the normal cost rate and (2) the unfunded actuarial accrued liability contribution rate.

The term "fully funded" is often applied to a system in which contributions at the normal cost rate are sufficient to pay for the benefits of existing employees as well as for those of new employees. More often than not, systems are not fully funded, either because of past benefit improvements that have not been completely funded or because of actuarial deficiencies that have occurred because experience has not been as favorable as anticipated by the actuarial assumptions. Under these circumstances, an unfunded actuarial accrued liability (UAAL) exists. Likewise, when the actuarial value of assets is greater than the actuarial accrued liability, a surplus exists.

Description of Contribution Rate Components

The Entry Age Normal (EAN) actuarial cost method is used for the valuation. Under that method, the normal cost for each year from entry age to assumed exit age is a constant percentage of the member's year by year projected compensation. The portion of the present value of future benefits not provided by the present value of future normal costs is the actuarial accrued liability. The unfunded actuarial accrued liability represents the difference between the actuarial accrued liability and the actuarial value of assets as of the valuation date. The UAAL is calculated each year and reflects experience gains and losses.

In general, contributions are computed in accordance with a level percent-of-payroll funding objective. The contribution rate based on the June 30, 2020 actuarial valuation will be used to determine the employer contribution rate for the plan year ending June 30, 2022. In this context, the term "contribution rate" means the percentage, which is applied to a particular active member payroll to determine the actual employer contribution amount (i.e., in dollars) for the group.

Contribution Rate Summary

Table 9 shows the development of the June 30, 2021 projected UAAL. In Table 10, the amortization payment related to the UAAL is developed. Table 11 develops the computed employer contribution rate for the Plan and the estimated amount of required State contributions. Table 12 shows estimated contribution amounts for each department if the employer contributions are paid early on July 15, September 1 or November 1. Amounts are shown for both the UAAL payment only and the total employer contribution.

The contribution rates shown in this report are based on the actuarial assumptions and cost methods described in Appendix D.

TABLE 9
PROJECTED UAAL AS OF JUNE 30, 2021

(1) Unfunded Actuarial Accrued Liability at June 30, 2020	$5,547,184,737
(2) Expected Contribution Rate for Year Ending June 30, 2021*	24.54%
(3) Normal Cost Rate for Year Ending June 30, 2021	8.53%
(4) Contribution Rate Applied to UAAL [(2) - (3)]	16.01%
(5) Projected Payroll for the Year After the Valuation Date	$2,062,946,218
(6) Expected UAAL Contribution [(4) * (5)]	$330,277,690
(7) Interest on (1) and (6) to June 30, 2021 at 6.95%	$374,244,962
(8) Projected UAAL at June 30, 2021 [(1) - (6) + (7)]	$5,591,152,009

*The Total Contribution Rate was the employer rate of 22.88% plus the weighted average member rate of 1.66% of payroll.

TABLE 10
UAAL CONTRIBUTION RATE

Amortization Base	Original Amount	Remaining Payments	Projected June 30, 2021 Balance	Annual Payment*
2018 Legacy UAAL	$ 4,861,507,879	28	$ 4,933,020,619	$ 313,172,577
2019 Assumption Changes	74,340,841	29	74,870,139	4,671,645
2019 Experience Base	259,714,456	29	261,563,593	16,320,690
2020 Assumption Changes	124,766,739	30	124,766,739	7,659,491
2020 Experience Base	$ 196,930,919	30	196,930,919	12,089,685
Total			**$ 5,591,152,009**	**$ 353,914,088**

* Payment amount reflects mid-year timing.

1. Total UAAL Amortization Payments	$ 353,914,088
2. Expected Payroll for FYE 2022	$ 2,109,362,508
3. UAAL Amortization Payment Rate (1) / (2)	16.78%

TABLE 11
COMPUTED EMPLOYER CONTRIBUTION RATE FOR THE FISCAL YEAR ENDING JUNE 30, 2022

ACTUARIAL VALUATION RESULTS AS OF JUNE 30, 2020

	Percent of Payroll		
	MSEP & MSEP 2000	MSEP 2011	Weighted Average
A. Normal Cost			
(1) Service retirement benefits	6.61 %	5.15 %	5.94 %
(2) Termination benefits	0.98	1.57	1.25
(3) Survivor benefits	0.13	0.15	0.14
(4) Disability benefits	0.77	0.80	0.79
(5) Administrative expenses	0.41	0.41	0.41
(6) Total	8.90	8.08	8.53
B. Less Member Contributions	0.00	4.00	1.80
C. Employer Normal Cost [A(6) - B]	8.90	4.08	6.73
D. Unfunded Actuarial Accrued Liabilities (UAAL) (level percent-of-payroll amortization with layered bases)			16.78
E. TOTAL COMPUTED EMPLOYER CONTRIBUTION RATE [C. + D.]			**23.51 %**
F. ESTIMATED EMPLOYER CONTRIBUTION ($Millions)#			**$495.9**

Illustrative only. Estimated employer contribution amounts (shown in millions) are based on the greater of the Total Computed Employer Contribution Rate and the Policy Minimum Contribution Rate shown and the valuation payroll projected two years to the applicable fiscal year using the valuation assumption of 2.25% per year.

TABLE 12
EARLY PAYMENT AMOUNTS BY DEPARTMENT FOR FISCAL YEAR 2022
(UAAL PAYMENT ONLY)

Section 104.436, RSMo. describes the certified contribution rate a department shall pay in accordance with its ordinary course payrolls during each fiscal year. Per a Board Rule adopted during 2020, a department may elect to pre-pay the amount for the unfunded actuarial accrued liabilities (UAAL) only or the total contribution which also includes the normal cost rate, at July 15, September 1, or November 1. At the end of the fiscal year, actual payroll will be compared to assumed payroll and an adjustment will be made to the total contributions paid, as either an additional amount paid by the department or a credit to reduce future payments.

This exhibit is for informational purposes only and all payment amounts should be confirmed with MOSERS. Payment amounts are adjusted to payment dates using the assumed rate of return (6.95%) used in the actuarial funding valuation and assuming all scheduled payments are made prior to the one-time payment date.

				One-Time Payment, adjusted for expected payroll contributions to date:			
Department	**Expected Payroll for FY 2022**	**Total FY 2022 UAAL Payments**	**FY 2022 UAAL Contribution Rate**	**July 15**	**September 1**	**November 1**	**Additional Payroll Contributions**
State of Missouri	1,759,377,321	295,192,702	16.78%	274,313,816	240,545,613	194,603,610	6.73%
Environmental Improvement & Energy Resource Authority	263,672	44,240	16.78%	41,111	36,050	29,165	6.73%
Missouri Agriculture & Small Business Development Authority	224,588	37,682	16.78%	35,017	30,706	24,842	6.73%
Missouri Consolidated Health Care Plan (MCHCP)	2,974,263	499,029	16.78%	463,733	406,647	328,981	6.73%
Missouri Development Finance Board	563,384	94,526	16.78%	87,840	77,027	62,316	6.73%
Missouri Housing Development Commission	5,915,995	992,600	16.78%	922,394	808,846	654,364	6.73%
Missouri Public Entity Risk Management Fund	681,267	114,305	16.78%	106,220	93,144	75,355	6.73%
Missouri Technology Corporation	48,817	8,191	16.78%	7,612	6,675	5,400	6.73%
Missouri Wine and Grape Board	250,775	42,076	16.78%	39,100	34,287	27,738	6.73%
Harris Stowe State University	10,513,336	1,763,954	16.78%	1,639,190	1,437,405	1,162,874	6.73%
Lincoln University	15,879,235	2,664,258	16.78%	2,475,816	2,171,041	1,756,392	6.73%
Missouri Southern State University	20,718,547	3,476,209	16.78%	3,230,338	2,832,681	2,291,665	6.73%
Missouri State University	104,516,082	17,535,968	16.78%	16,295,655	14,289,649	11,560,457	6.73%
Missouri Western State University	18,876,026	3,167,067	16.78%	2,943,061	2,580,769	2,087,866	6.73%
Northwest Missouri State University	33,768,495	5,665,762	16.78%	5,265,024	4,616,897	3,735,112	6.73%
Southeast Missouri State University	44,210,271	7,417,709	16.78%	6,893,057	6,044,517	4,890,070	6.73%
State Technical College of Missouri	9,591,963	1,609,363	16.78%	1,495,533	1,311,432	1,060,961	6.73%
Truman State University	30,557,529	5,127,018	16.78%	4,764,386	4,177,887	3,379,949	6.73%
University of Central Missouri	50,430,942	8,461,429	16.78%	7,862,955	6,895,020	5,578,135	6.73%
Total	2,109,362,508	353,914,088	16.78%	328,881,858	288,396,293	233,315,252	6.73%

TABLE 12
EARLY PAYMENT AMOUNTS BY DEPARTMENT FOR FISCAL YEAR 2022

(continued)

(TOTAL EMPLOYER CONTRIBUTION)

Department	Expected Payroll for FY 2022	Total FY 2022 Payments	FY 2022 Contribution Rate	One-Time Payment, adjusted for expected payroll contributions to date: July 15	September 1	November 1	Additional Payroll Contributions
State of Missouri	1,759,377,321	413,629,609	23.51%	384,373,719	337,057,072	272,682,267	0.00%
Environmental Improvement & Energy Resource Authority	263,672	61,989	23.51%	57,605	50,513	40,866	0.00%
Missouri Agriculture & Small Business Development Authority	224,588	52,801	23.51%	49,066	43,026	34,809	0.00%
Missouri Consolidated Health Care Plan (MCHCP)	2,974,263	699,249	23.51%	649,791	569,802	460,975	0.00%
Missouri Development Finance Board	563,384	132,452	23.51%	123,084	107,932	87,318	0.00%
Missouri Housing Development Commission	5,915,995	1,390,850	23.51%	1,292,476	1,133,371	916,908	0.00%
Missouri Public Entity Risk Management Fund	681,267	160,166	23.51%	148,838	130,516	105,588	0.00%
Missouri Technology Corporation	48,817	11,477	23.51%	10,665	9,352	7,566	0.00%
Missouri Wine and Grape Board	250,775	58,957	23.51%	54,787	48,043	38,867	0.00%
Harris Stowe State University	10,513,336	2,471,685	23.51%	2,296,864	2,014,118	1,629,440	0.00%
Lincoln University	15,879,235	3,733,208	23.51%	3,469,159	3,042,104	2,461,090	0.00%
Missouri Southern State University	20,718,547	4,870,930	23.51%	4,526,411	3,969,207	3,211,125	0.00%
Missouri State University	104,516,082	24,571,731	23.51%	22,833,780	20,022,928	16,198,732	0.00%
Missouri Western State University	18,876,026	4,437,754	23.51%	4,123,873	3,616,222	2,925,557	0.00%
Northwest Missouri State University	33,768,495	7,938,973	23.51%	7,377,452	6,469,283	5,233,709	0.00%
Southeast Missouri State University	44,210,271	10,393,835	23.51%	9,658,682	8,469,692	6,852,059	0.00%
State Technical College of Missouri	9,591,963	2,255,071	23.51%	2,095,571	1,837,604	1,486,639	0.00%
Truman State University	30,557,529	7,184,075	23.51%	6,675,948	5,854,134	4,736,048	0.00%
University of Central Missouri	50,430,942	11,856,314	23.51%	11,017,721	9,661,432	7,816,187	0.00%
Total	2,109,362,508	495,911,126	23.51%	460,835,492	404,106,351	326,925,750	0.00%

The June 30, 2020 valuation results present the System's financial status at a single point in time and contribution requirements for a single fiscal year. Historical valuation results allow analysis of past trends, but no insight into future trends. A projection model provides insight into the longer term trend of (1) the projected Employer contributions; (2) the projected System funded status (ratio of actuarial assets over liabilities); (3) net cash flow patterns; and (4) the unfunded actuarial accrued liability (actuarial accrued liability minus actuarial assets). Projections can also be used to demonstrate how sensitive the valuation results are to the key variables being modeled. Such sensitivity analysis can be found in Section 7 of this report.

For MSEP, projections are particularly important and insightful due to the multiple-tiered benefit structure. The current valuation produces a normal cost and actuarial accrued liability based on the composition of active members on the valuation date, June 30, 2020. Without a tiered structure, systems can assume that the normal cost, as a percentage of payroll, will remain relatively level. However, since all new employees are covered under a lower cost benefit structure, until all new employees are covered under MSEP 2011 benefits, the normal cost percentage will continue to decrease. In addition, MSEP 2011 members are the only group making employee contributions so projections allow for the projected payroll to be segregated by tier so that total future contributions reflect an estimate of the amounts to be contributed by employees.

The member data (active and in-pay status) is projected for each year in the future using current assumptions. After the first year, a new-member profile is used to estimate the demographics of new employees replacing members who are projected to terminate, retire, die or become disabled in future years. ***For this modeling, the number of active members is assumed to remain level over the projection period.*** To the extent that assumption does not occur, i.e., the size of the active membership declines or increases, the actual valuation results are expected to be different than those shown here.

The projections in this section assume that all actuarial assumptions are met in all future years, including the investment return assumption, and that the Employer makes contributions equal to the full amount of the actuarially determined contribution, as calculated by the valuation, based on the Board's Funding Policy. The projections are based on the current plan provisions and assume that all new members joining after June 30, 2020 will make employee contributions and participate in the MSEP 2011 plan.

The projections do not predict the System's financial condition or its ability to pay benefits in the future and do not provide any guarantee of future financial soundness of the System nor do they, on their own, indicate future funding requirements. Over time, a defined benefit plan's total cost will depend on a number of factors, including the amount of benefits paid, the number of people paid benefits, plan expenses and the amount of earnings on assets invested to pay benefits. These amounts, and other variables, are uncertain and unknowable at the time the projections were prepared. Because not all of the assumptions will unfold exactly as expected, actual results will differ from the projections shown.

TABLE 13
PROJECTION OF FUTURE ACTUARIAL VALUATION RESULTS
AS OF JUNE 30, 2020

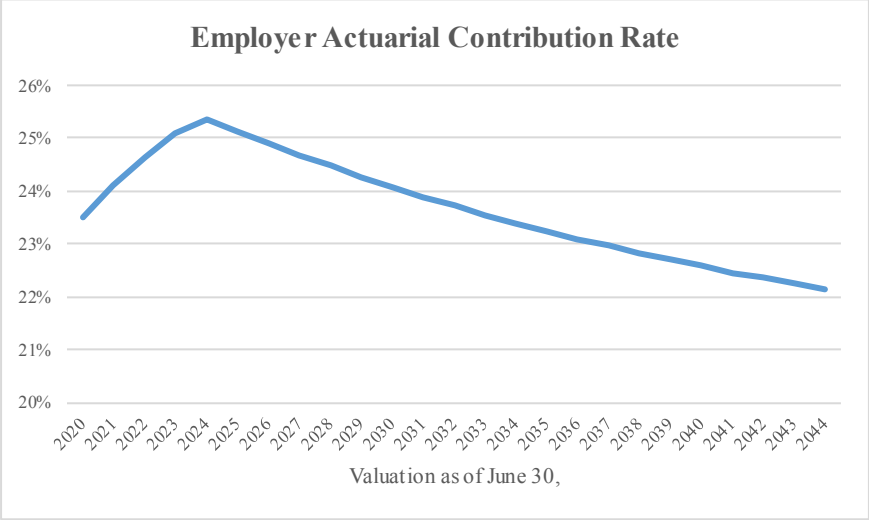
Projection Based on Assumptions Outlined in Appendix D (Amounts in thousands)											
Valuation as of June 30, (1)	Covered Payroll at Valuation (2)	Actuarial Accrued Liability (AAL) (3)	Actuarial Value of Assets (AVA) (4)	Unfunded AAL (5)	Funded Ratio Using AVA (6)	Normal Cost Rate (7)	UAAL Amortization Payment Rate (8)	Actuarial Contribution Rate (9)	Member Contribution Rate (10)	Employer Actuarial Contribution Rate (11)	Estimated Dollar Amount of Employer Contribution* (12)
2020	$2,062,946	$14,258,409	$8,711,224	$5,547,185	61.1%	8.53%	16.78%	25.31%	1.80%	23.51%	$490,282
2021	2,085,419	14,444,839	8,598,042	5,846,797	59.5%	8.32%	17.76%	26.08%	1.99%	24.09%	509,171
2022	2,113,619	14,612,274	8,483,993	6,128,281	58.1%	8.15%	18.65%	26.80%	2.17%	24.63%	528,401
2023	2,145,354	14,755,835	8,367,162	6,388,673	56.7%	7.98%	19.46%	27.44%	2.34%	25.10%	547,341
2024	2,180,643	14,873,816	8,297,346	6,576,470	55.8%	7.82%	20.05%	27.87%	2.50%	25.37%	562,880
2025	2,218,684	14,965,572	8,386,016	6,579,556	56.0%	7.68%	20.11%	27.79%	2.65%	25.14%	567,807
2026	2,258,579	15,035,535	8,473,562	6,561,973	56.4%	7.54%	20.16%	27.70%	2.79%	24.91%	573,282
2027	2,301,411	15,079,721	8,546,390	6,533,330	56.7%	7.42%	20.20%	27.62%	2.93%	24.69%	579,295
2028	2,346,275	15,098,491	8,605,798	6,492,693	57.0%	7.31%	20.22%	27.53%	3.05%	24.48%	585,894
2029	2,393,356	15,092,955	8,654,121	6,438,834	57.3%	7.20%	20.23%	27.43%	3.17%	24.26%	592,630
2030	2,442,827	15,064,225	8,693,411	6,370,813	57.7%	7.11%	20.24%	27.35%	3.28%	24.07%	600,480
2031	2,494,724	15,015,878	8,728,131	6,287,747	58.1%	7.04%	20.23%	27.27%	3.38%	23.89%	608,911
2032	2,548,811	14,949,518	8,761,688	6,187,830	58.6%	6.97%	20.21%	27.18%	3.46%	23.72%	617,928
2033	2,605,093	14,868,362	8,798,679	6,069,684	59.2%	6.91%	20.18%	27.09%	3.54%	23.55%	627,264
2034	2,663,541	14,774,359	8,842,287	5,932,072	59.8%	6.86%	20.14%	27.00%	3.62%	23.38%	636,934
2035	2,724,269	14,670,650	8,897,223	5,773,427	60.6%	6.82%	20.10%	26.92%	3.68%	23.24%	647,716
2036	2,787,073	14,558,606	8,966,551	5,592,055	61.6%	6.78%	20.06%	26.84%	3.74%	23.10%	658,870
2037	2,852,251	14,441,473	9,055,645	5,385,827	62.7%	6.75%	20.00%	26.75%	3.79%	22.96%	670,395
2038	2,919,837	14,322,993	9,170,264	5,152,729	64.0%	6.72%	19.94%	26.66%	3.83%	22.83%	682,575
2039	2,989,818	14,207,551	9,316,682	4,890,870	65.6%	6.69%	19.88%	26.57%	3.86%	22.71%	695,377
2040	3,061,987	14,099,710	9,501,740	4,597,970	67.4%	6.67%	19.81%	26.48%	3.89%	22.59%	708,484
2041	3,136,273	14,003,792	9,732,189	4,271,603	69.5%	6.64%	19.74%	26.38%	3.92%	22.46%	721,615
2042	3,212,888	13,922,601	10,013,390	3,909,211	71.9%	6.62%	19.67%	26.29%	3.94%	22.35%	735,648
2043	3,291,488	13,859,235	10,350,850	3,508,384	74.7%	6.61%	19.60%	26.21%	3.95%	22.26%	750,646
2044	3,372,174	13,815,605	10,749,685	3,065,920	77.8%	6.58%	19.52%	26.10%	3.96%	22.14%	764,876

* Amounts shown are contributions in the fiscal year ending two years after the valuation date.

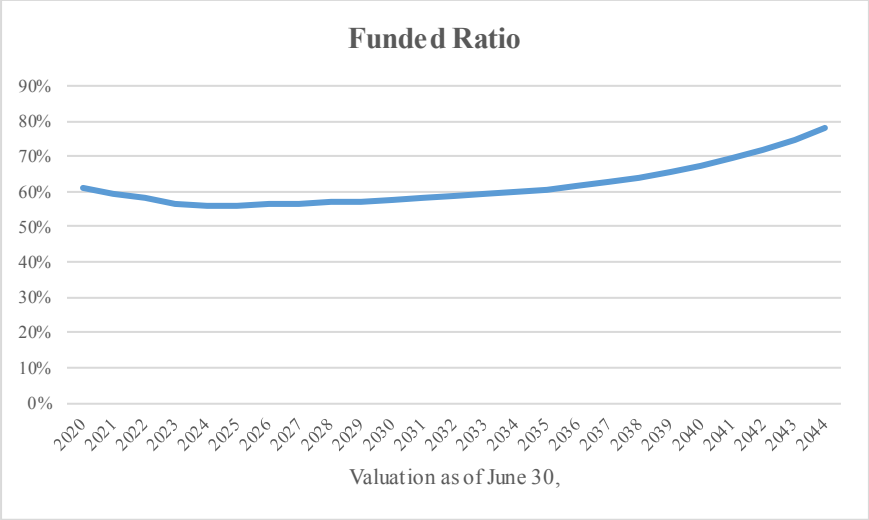
Note: Projections assume the size of the active population remains constant over the projection period and all actuarial assumptions are met in the future.

TABLE 13
PROJECTION OF FUTURE ACTUARIAL VALUATION RESULTS
AS OF JUNE 30, 2020

(continued)



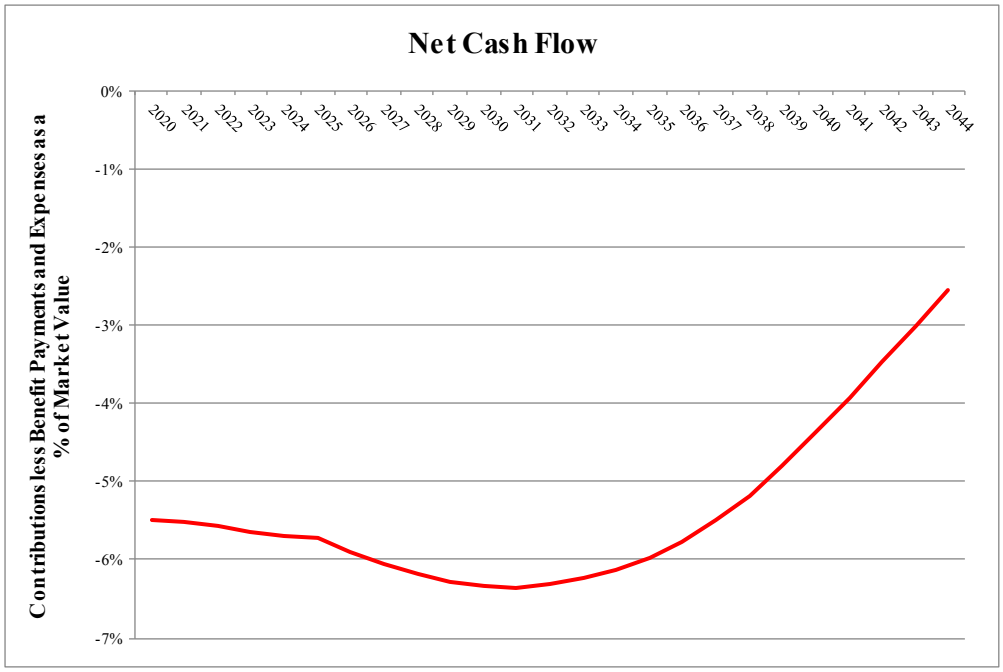
The employer contribution rate is projected to increase until the June 30, 2024 valuation as a result of recognition of the deferred investment experience. After that, the employer contribution rate declines due to more of the membership being in the MSEP 2011 Plan (lower cost and employee contributions).



Even if all assumptions are met in the future, the funded ratio declines as the deferred investment losses are recognized in the asset smoothing method. After 2024, the funded ratio gradually improves over time. With the current amortization policy, the System is not expected to reach full funding by the end of this projection period.

TABLE 14
PROJECTION OF FUTURE NET CASH FLOWS
AS OF JUNE 30, 2020

Projection Based on Assumptions Outlined in Appendix D Amounts in thousands						
Valuation as of June 30, (1)	Total Contributions (2)	Benefit Payments (3)	Administrative Expenses (4)	Net Cash Flows (5)	Market Value of Assets (MVA) (6)	Net Cash Flow as a % of MVA (7)
2020	$506,247	$932,840	$8,587	($435,180)	$7,910,831	(5.50%)
2021	527,819	961,762	8,780	(442,723)	8,010,584	(5.53%)
2022	551,232	994,629	8,978	(452,375)	8,109,471	(5.58%)
2023	574,955	1,028,144	9,180	(462,369)	8,205,248	(5.64%)
2024	598,368	1,060,856	9,386	(471,874)	8,297,346	(5.69%)
2025	618,347	1,087,669	9,598	(478,919)	8,386,016	(5.71%)
2026	627,659	1,116,880	9,814	(499,034)	8,473,562	(5.89%)
2027	637,491	1,144,363	10,034	(516,906)	8,546,390	(6.05%)
2028	648,041	1,169,397	10,260	(531,616)	8,605,798	(6.18%)
2029	658,891	1,191,998	10,491	(543,598)	8,654,121	(6.28%)
2030	670,067	1,209,999	10,727	(550,658)	8,693,411	(6.33%)
2031	682,307	1,225,455	10,968	(554,116)	8,728,131	(6.35%)
2032	695,061	1,236,897	11,215	(553,051)	8,761,688	(6.31%)
2033	708,064	1,245,735	11,468	(549,138)	8,798,679	(6.24%)
2034	721,553	1,250,942	11,726	(541,115)	8,842,287	(6.12%)
2035	735,553	1,254,454	11,989	(530,891)	8,897,223	(5.97%)
2036	750,280	1,254,457	12,259	(516,436)	8,966,551	(5.76%)
2037	765,544	1,250,752	12,535	(497,743)	9,055,645	(5.50%)
2038	781,056	1,242,937	12,817	(474,697)	9,170,264	(5.18%)
2039	797,085	1,231,153	13,105	(447,173)	9,316,682	(4.80%)
2040	813,570	1,215,888	13,400	(415,719)	9,501,740	(4.38%)
2041	830,485	1,198,913	13,702	(382,130)	9,732,189	(3.93%)
2042	847,560	1,180,177	14,010	(346,627)	10,013,390	(3.46%)
2043	865,332	1,160,967	14,325	(309,960)	10,350,850	(2.99%)
2044	883,847	1,142,755	14,648	(273,556)	10,749,685	(2.54%)



RISK MEASURES

Actuarial Standards of Practice are issued by the Actuarial Standards Board and are binding on credentialed actuaries practicing in the United States. These standards generally identify what the actuary should consider, document and disclose when performing an actuarial assignment. In September 2017, Actuarial Standard of Practice Number 51, *Assessment and Disclosure of Risk in Measuring Pension Obligations*, (ASOP 51) was issued as final with application to measurement dates on or after November 1, 2018. This ASOP, which applies to funding valuations, actuarial projections, and actuarial cost studies of proposed plan changes, was first applicable for the June 30, 2019 actuarial valuation for the Missouri State Employees' Retirement System (MOSERS or System).

A typical retirement plan faces many different risks, but the greatest risk is the inability to make benefit payments when due. If plan assets are depleted, benefits may not be paid which could create legal and litigation risk or the plan could become "pay as you go". This risk is why consistent funding of the full actuarial contribution rate, based on reasonable assumptions and methods, is so critical to the successful funding of a retirement system.

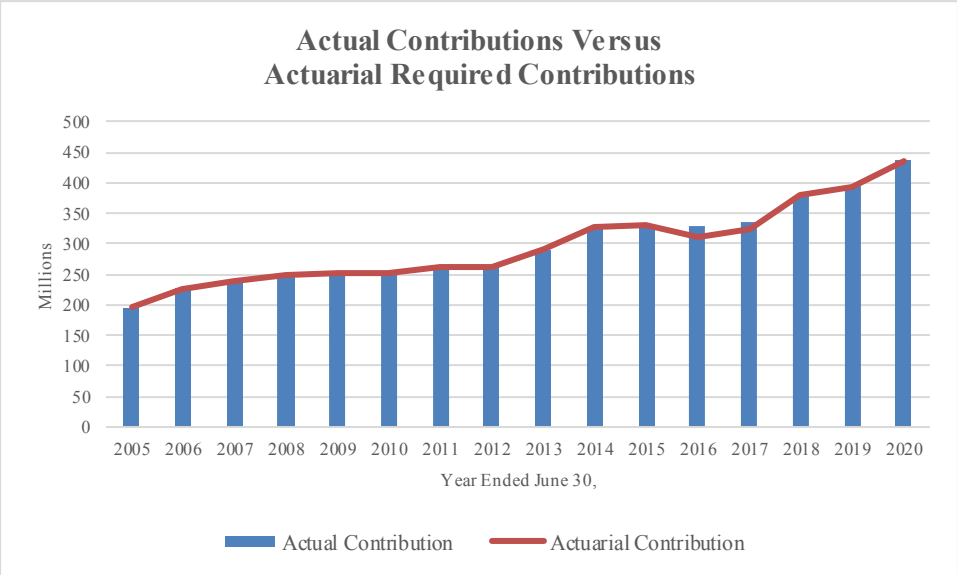
The term "risk" is most commonly associated with an outcome with undesirable results. However, in the actuarial world, risk can be translated as uncertainty. The actuarial valuation process uses many actuarial assumptions to project how future contributions and investment returns will meet the cash flow needs for future benefit payments. Of course, we know that actual experience will not unfold exactly as anticipated by the assumptions and that uncertainty, whether favorable or unfavorable, creates risk. ASOP 51 defines risk as the potential of actual future measurements to deviate from expected results due to actual experience that is different than the actuarial assumptions.

The various risk factors for a given plan can have a significant impact – positive or negative – on the actuarial projection of liability and contribution rates.

There are a number of risks inherent in the funding of a defined benefit plan. These include:

- economic risks, such as investment return and price inflation;
- demographic risks such as mortality, payroll growth, aging population, declining active membership and retirement ages;
- external risks such as the regulatory and political environment.

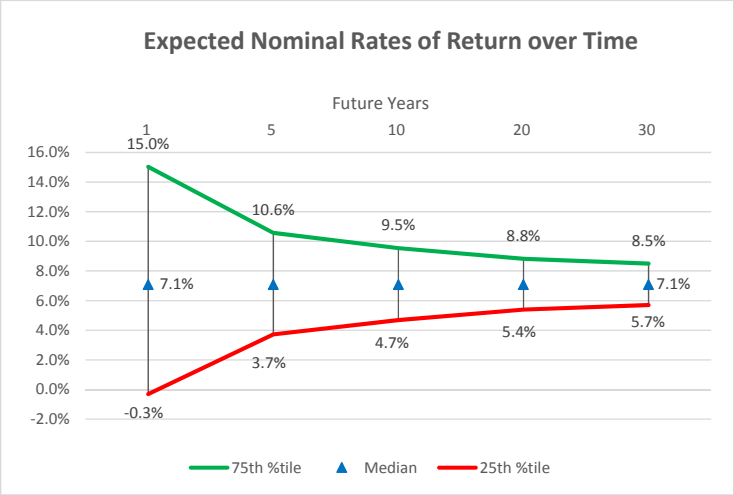
There is typically a direct correlation between healthy, well-funded retirement plans and consistent contributions equal to the full actuarial contribution rate each year. Historically, MOSERS covered employers have contributed the full actuarial rate. However, the System's contributions were slightly above the actuarial rate during FY 2016 and FY 2017 due to minimum contribution rates set in the funding policy. The following graph displays the System's historical contribution levels over the past 16 years.



One of the most positive factors regarding the MOSERS' funding is the commitment by covered employers to make contributions that are at least equal to the actuarial required contribution. This disciplined approach to funding has been illustrated by consistently contributing the full actuarial required contribution amount even with the increases that have occurred in the recent past. Despite the fact the full actuarial contribution rate has been contributed, the MSEP Plan is only 61% funded. Additional analysis of the Plan's historical funding indicates that the funded ratio was close to 100% in 2001. Several factors have occurred since that time which have impacted the funded status of the Plan. The actuarial assumptions have been changed seven times in the last nine years, resulting in an ultimate reduction in the investment return assumption from 8.50% in the 2011 valuation to 6.95% in the 2020 valuation. In addition, actual investment experience over this period has lagged the assumption causing a decline in the funded ratio. However, to the extent the State continues to fund the full actuarial contribution rate in the future, we would expect the funded ratio to steadily improve if the actuarial assumptions are met.

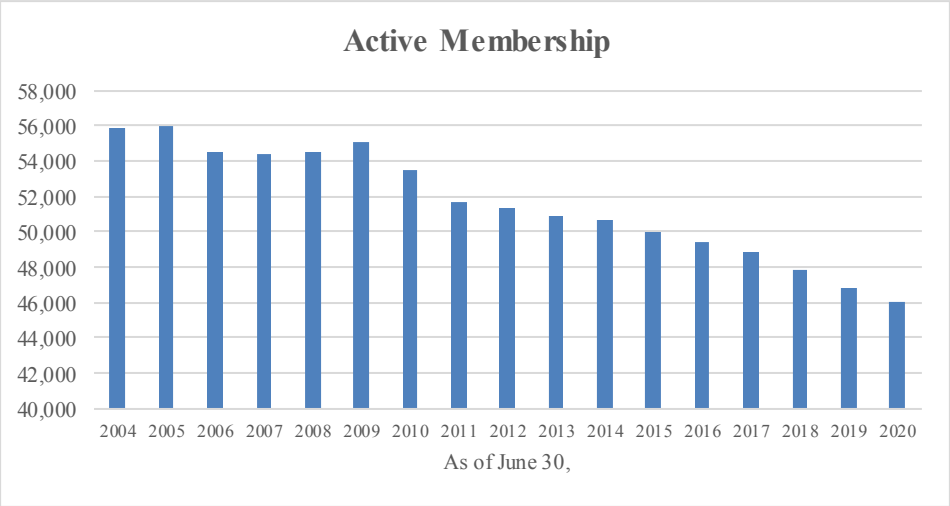
The most significant risk factor for most systems is investment return because of the volatility of returns and the size of plan assets compared to payroll (see Table 15). Given the underlying capital market assumptions provided by MOSERS' investment consultant, Verus, in 2018 when the economic experience study was performed and the System's asset allocation, the distribution of returns over time is illustrated in the graph on the next page.

As the graph illustrates, in any single year the rate of return is expected to fall between 0% and 15% about 50% of the time. This volatility in the investment return creates significant risk to funding a retirement plan because of the volatility it creates in the contribution rate. As Table 15 explains, if the actual return is 10% different than the expected return, it would result in an increase in the actuarial contribution rate of 2.45% once the experience is fully recognized in the asset smoothing method (five years).

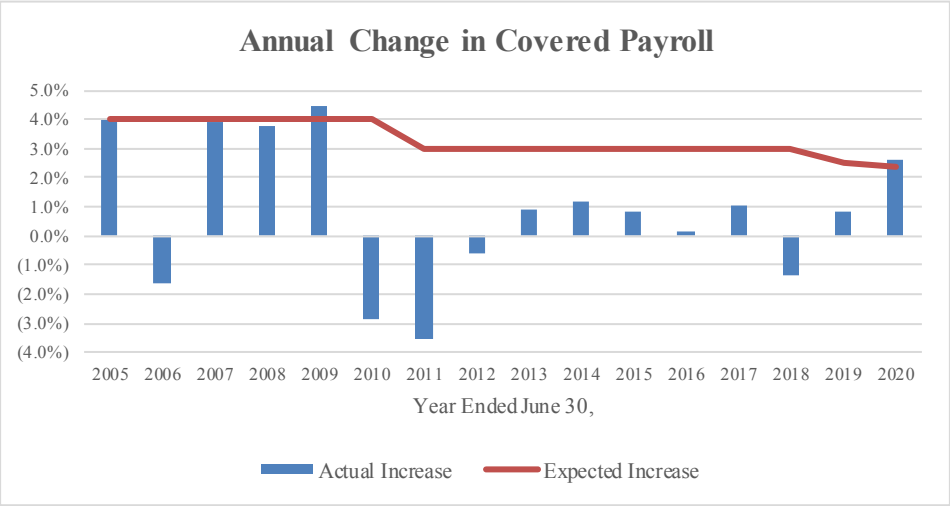


A key demographic risk for all retirement systems, including MOSERS, is improvements in mortality (longevity) greater than anticipated. While the actuarial assumptions reflect small, continuous improvements in mortality experience over time and these assumptions are refined every experience study, the risk arises because there is a possibility of some sudden shift, perhaps from a significant medical breakthrough that could quickly increase liabilities. Likewise, there is some possibility of a significant public health crisis that could result in a significant number of additional deaths in a short time period, which would also be significant, although more easily absorbed. While either of these events could happen, it represents a small probability and thus represents much less risk than the volatility associated with investment returns.

Another funding risk for the MSEP Plan is the decline in the active membership. The active member count has been steadily declining since 2009 as shown in the following graph, with an overall decrease of about 16%. This is important because the unfunded actuarial accrued liability (UAAL) is amortized with payments that are calculated as a level-percent of payroll. When payroll does not grow as expected, the UAAL contribution rate increases because the dollar amount of the UAAL payment is divided by a smaller payroll amount. The reduction in the number of active members also mutes the positive impact of the MSEP 2011 Plan on the employer contribution rate.



The decline in the number of active members over this period, coupled with low salary increases for state employees, has resulted in actual payroll changes that are far below the expected increase (based on the payroll growth assumption). The following graph shows the actual versus expected payroll growth from 2005 through 2020. In the early part of the period, actual increases were reasonably close to the expected increase, but since 2009 – when the number of active members started to decline – actual payroll growth has been low and even negative. While this does not necessarily impact the amount of the UAAL payment directly, it does cause the UAAL contribution rate to be higher.



Many of the public retirement systems were created shortly after World War II. In general, the aging of the population, including the retirement of the baby boomers, along with earlier retirement eligibility has created a shift in the demographics of most systems. This change is not unexpected and has, in fact, been anticipated in the funding of the retirement system. Even though it was anticipated, the demographic shift and maturing of the plans have increased the risk associated with funding the system. The following exhibits summarize certain historical information that indicates how certain key risk metrics have changed over time due to the maturing of the retirement system.

TABLE 15
HISTORICAL ASSET VOLATILITY RATIOS

As a retirement system matures, the size of the market value of assets is expected to increase relative to the covered payroll of active members, on which the System is funded. The size of the plan assets relative to covered payroll, sometimes referred to as the asset volatility ratio, is an important indicator of the contribution risk for the System. The higher this ratio, the more sensitive a plan's contribution rate is to investment return volatility. In other words, it will be harder to recover from investment losses with increased contribution rates.

Valuation Date	Market Value of Assets	Covered Payroll	Asset Volatility Ratio	Change in ACR with a Return 10% Different than Assumed*
6/30/2004	5,859,486,975	1,737,454,454	3.37	2.07%
6/30/2005	6,431,033,445	1,806,600,560	3.56	2.19%
6/30/2006	6,983,737,684	1,777,277,138	3.93	2.41%
6/30/2007	8,056,993,537	1,846,643,330	4.36	2.68%
6/30/2008	7,934,030,312	1,916,527,398	4.14	2.54%
6/30/2009	6,163,086,701	2,002,402,087	3.08	1.89%
6/30/2010	6,727,623,355	1,945,095,321	3.46	2.12%
6/30/2011	7,768,709,373	1,875,569,816	4.14	2.54%
6/30/2012	7,581,882,309	1,864,069,493	4.07	2.50%
6/30/2013	7,993,837,570	1,880,212,950	4.25	2.61%
6/30/2014	9,136,781,826	1,902,719,928	4.80	2.95%
6/30/2015	8,516,654,912	1,918,527,768	4.44	2.73%
6/30/2016	8,109,161,214	1,921,528,936	4.22	2.59%
6/30/2017	7,945,358,298	1,941,969,786	4.09	2.51%
6/30/2018	8,034,508,424	1,915,143,002	4.20	2.58%
6/30/2019	7,916,465,279	1,930,764,635	4.10	2.52%
6/30/2020	7,910,830,533	1,980,910,473	3.99	2.45%

* The impact of asset smoothing is not reflected in the impact on the Actuarial Contribution Rate (ACR). Current year assumptions are used for all years shown.

The assets at June 30, 2020 are about four times the amount of covered payroll. Consequently, underperforming the investment return assumption by 10.00% (i.e., earn -3.05% for one year) is equivalent to about 40% of payroll. While the actual impact of this experience in the first year is mitigated by the asset smoothing method and amortization of the UAAL, this table illustrates the risk associated with volatile investment returns. Such an event in one year would be expected to increase the actuarial contribution rate by 2.45% of payroll once it is fully recognized in the asset smoothing method.

TABLE 15
HISTORICAL ASSET VOLATILITY RATIOS

(continued)

The following graph shows a comparison of MSEP's historical asset volatility ratios and the historical median asset volatility ratio for a group of large public plans that are tracked in the Public Plan Database. The pattern of the change in the asset volatility ratio for MSEP over time is similar to that observed in the Public Plan Database. When asset values drop significantly (like in 2009), the ratio drops as well. MSEP's funded ratio is lower than the median funded ratio for systems in the Public Plan Database. This fact, coupled with the reduction in active members/covered payroll over the last decade, likely explains the lower asset volatility ratio.

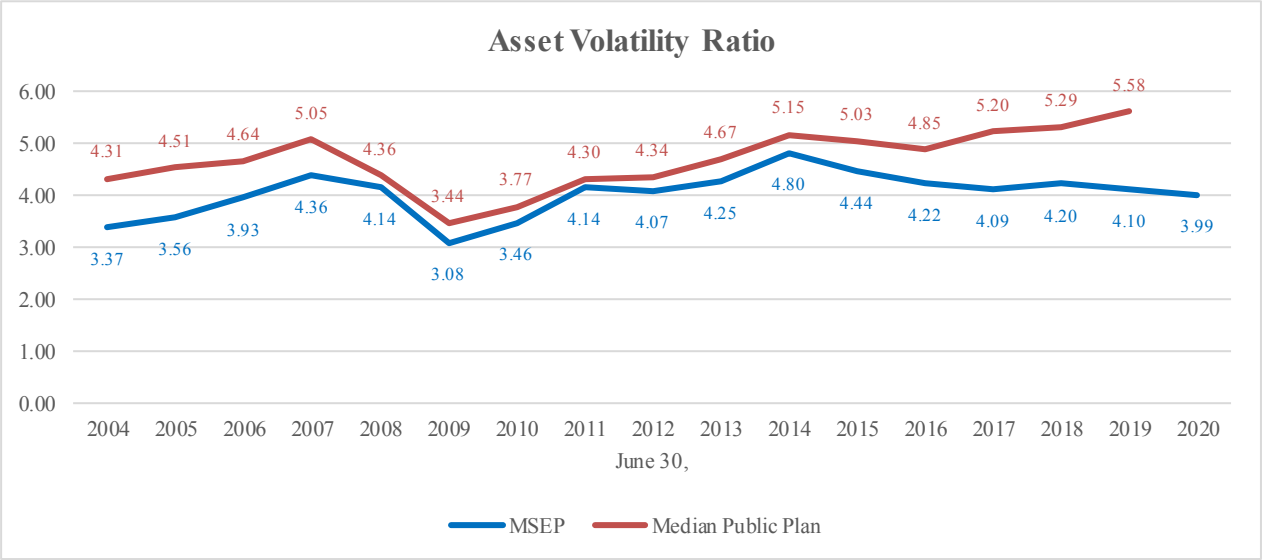


TABLE 16
LIABILITY MATURITY MEASUREMENTS

Most public sector retirement systems have been in operation for many years. As a result, they have aging plan populations, and in some cases declining active populations, resulting in an increasing ratio of retirees to active members and a growing percentage of retiree liability. The retirement of the remaining baby boomers over the next decade is expected to further exacerbate the aging of the retirement system population. With more of the total liability residing with retirees, investment volatility has a greater impact on the funding of the system since it is more difficult to restore the system financially after losses occur when there is comparatively less payroll over which to spread costs.

Projections provide the most effective way of analyzing the impact of these changes on future funding measures, but studying several key metrics from the valuation can also provide some valuable insight.

Fiscal Year End	Retiree Liability (a)	Total Actuarial Accrued Liability (b)	Retiree Percentage (a) / (b)	Covered Payroll (c)	Ratio (b) / (c)
6/30/10	5,012,677,769	9,853,155,445	50.87%	1,945,095,321	5.07
6/30/11	5,357,794,617	10,123,544,043	52.92%	1,875,569,816	5.40
6/30/12	5,749,411,068	10,793,651,577	53.27%	1,864,069,493	5.79
6/30/13	6,062,654,441	11,134,637,484	54.45%	1,880,212,950	5.92
6/30/14	6,347,728,717	11,494,571,835	55.22%	1,902,719,928	6.04
6/30/15	6,695,661,737	11,727,618,410	57.09%	1,918,527,768	6.11
6/30/16	7,305,895,284	12,751,162,753	57.30%	1,921,528,936	6.64
6/30/17	7,559,623,100	13,152,273,895	57.48%	1,941,969,786	6.77
6/30/18	8,073,692,664	13,612,763,961	59.31%	1,915,143,002	7.11
6/30/19	8,430,014,943	13,957,626,309	60.40%	1,930,764,635	7.23
6/30/20	8,701,290,590	14,258,408,888	61.03%	1,980,910,473	7.20

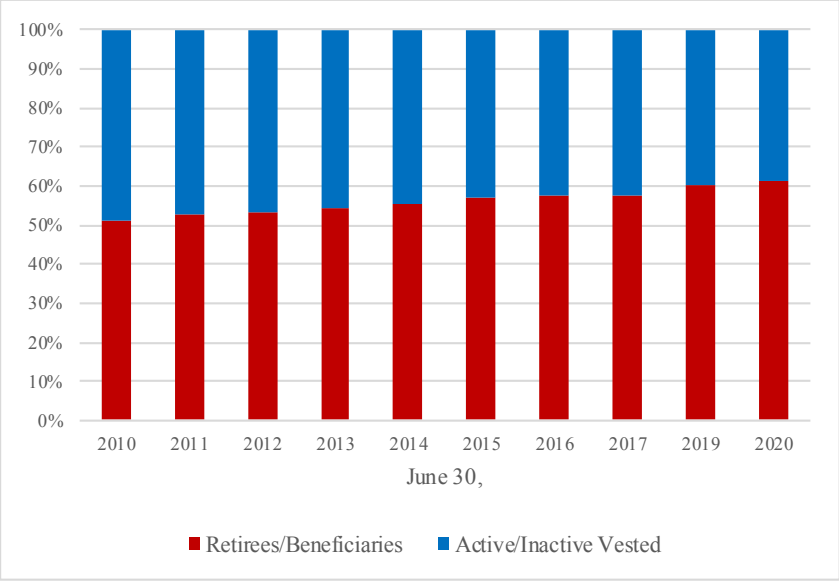
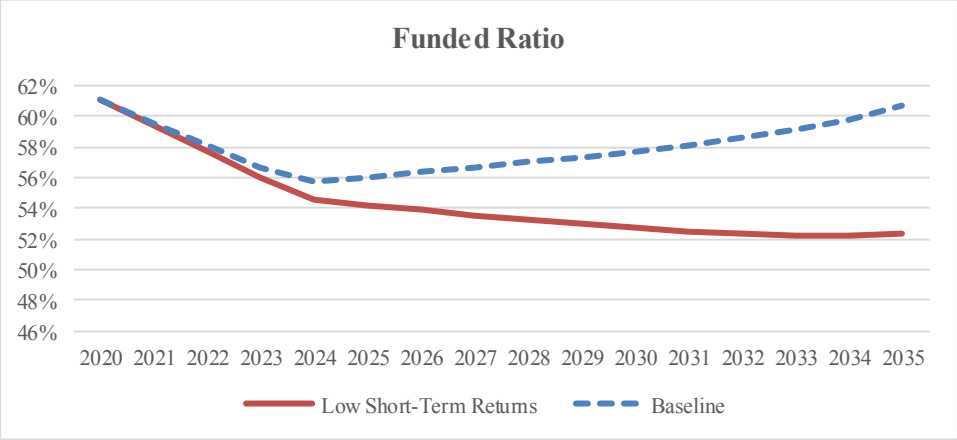


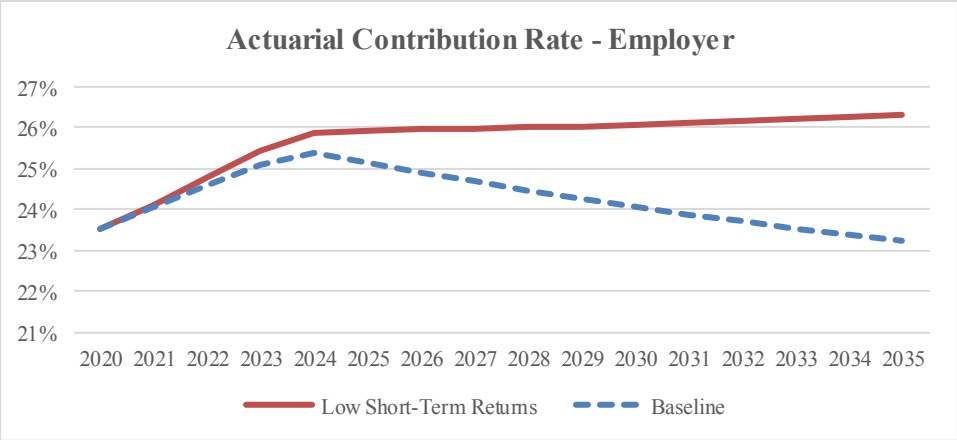
TABLE 17
SCENARIO TESTING

As mentioned earlier, the most significant risk factor for most systems is investment return. There are many different tools that can be useful when assessing investment risk. One of these tools is to perform scenario testing using a projection model. Scenario testing is choosing one set of specific criteria to compare against another set of specific criteria, also known as a "what if" scenario.

Many investment consultants are projecting lower returns over the next ten years compared to the longer term (30+ years). The scenario test below shows results if actual investment returns are 1.0% less than assumed (5.95%) over the next 15 years ("Low Short-Term Returns") compared to if all assumptions are met ("Baseline").



In both scenarios, the funded ratio declines for the next four years as deferred asset losses are recognized. In the scenario with low short-term returns, the funded ratio continues to decline to around 52% (about 8% lower than the baseline scenario), before beginning to increase.

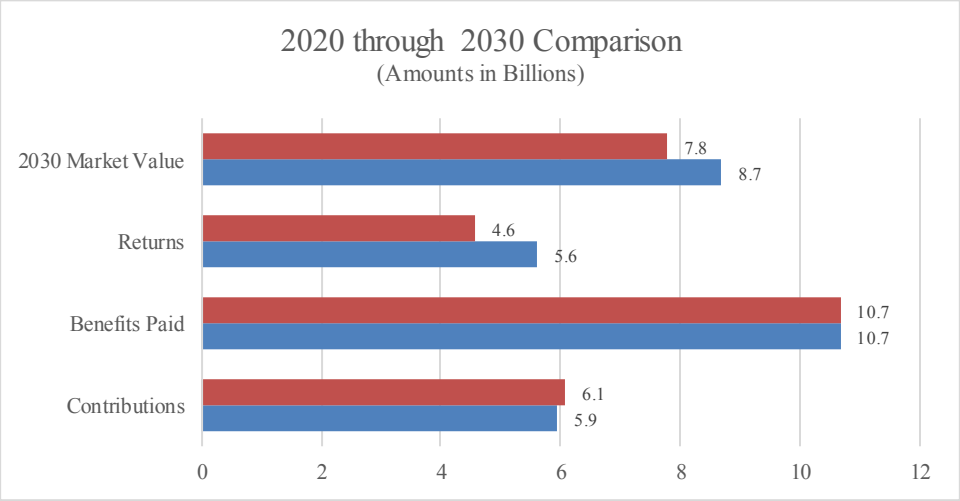


In both scenarios, the employer contribution rate increases for the next four years as deferred asset losses are recognized. In the scenario with low short-term returns, the employer contribution rate remains steady around 26% of pay, while the baseline scenario rate begins to decline due to the normal cost rate decreasing as more MSEP 2011 members are in the System as well as increases in the effective member contribution rate.

TABLE 17
SCENARIO TESTING

(continued)

While it is helpful to see the funded ratio and employer contribution rate trend lines when scenario testing, it can sometimes be difficult to grasp the full impact without analyzing the impact in dollar amounts. The graph below compares the projected 2030 market value of assets under the baseline (blue bars) and the low short-term return scenario (red bars). In addition, the sum over a ten-year period of actual investment returns, benefits paid and contribution to the System are compared.



Under the low short-term return scenario, the 2030 market value of assets is almost $1 billion lower when compared with the baseline. If asset returns are 1.0% lower than assumed for the next ten years, actual investment returns would be $1.0 billion less than assumed. Also note that even though contributions are only slightly higher under the low short-term return scenario ($6.1 billion vs $5.9 billion) over the ten-year period, contributions would continue to be higher in the future as the asset losses flow through the smoothing method.

TABLE 18
COMPARISON OF VALUATION RESULTS UNDER ALTERNATE INVESTMENT RETURN ASSUMPTIONS

($ in millions)

This exhibit compares the key January 1, 2020 valuation results under five (5) different investment return assumptions to illustrate the impact of different assumptions on the funding of the System. Note that only the investment return assumption is changed, as identified in the heading below. All other assumptions are unchanged for purposes of this analysis.

Investment Return Assumption	**5.95%**	**6.45%**	**6.95%**	**7.45%**	**7.95%**
Contributions					
Total Normal Cost	10.78%	9.58%	8.53%	7.63%	6.84%
Member Contributions	(1.80%)	(1.80%)	(1.80%)	(1.80%)	(1.80%)
Employer Normal Cost	8.98%	7.78%	6.73%	5.83%	5.04%
Unfunded Actuarial Accrued Liability	19.45%	18.14%	16.78%	15.37%	13.93%
Total Employer Contribution	28.43%	25.92%	23.51%	21.20%	18.97%
Total Employer Contribution	$599.7	$546.7	$495.9	$447.2	$400.1
Actuarial Accrued Liability	$15,858.9	$15,023.2	$14,258.4	$13,556.9	$12,912.3
Actuarial Value of Assets	$8,711.2	$8,711.2	$8,711.2	$8,711.2	$8,711.2
Unfunded Actuarial Accrued Liability	$7,147.7	$6,312.0	$5,547.2	$4,845.7	$4,201.0
Funded Ratio	54.9%	58.0%	61.1%	64.3%	67.5%

Note: All other assumptions are unchanged for purposes of this sensitivity analysis.

HISTORICAL FUNDING AND OTHER INFORMATION

This section of the report provides a historical perspective on the System's funding and contribution practices, along with other information that may be of interest.

The information required for financial reporting by the System and participating employers is established by the Governmental Accounting Standards Board (GASB). GASB 67 separates accounting and financial reporting from funding requirements by creating disclosure and reporting requirements that are independent of the basis used for funding the System. A separate report that contains all of the information and exhibits of an actuarial nature that are necessary for the System's financial reporting under GASB 67 will be issued in the future.

GASB Statement No. 68 establishes standards for the measurement, recognition, and display of pension expense and related liabilities. Annual pension cost is measured and disclosed on the accrual basis of accounting. A separate report containing all of the pertinent information under GASB 68 reporting will also be prepared in the future.

TABLE 19
SCHEDULE OF FUNDING PROGRESS

Actuarial Valuation Date	Actuarial Value of Assets (a)	Actuarial Accrued Liability (AAL) (b)	Unfunded Actuarial Accrued Liability (UAAL) (b - a)	Funded Ratio (a / b)	Covered Payroll (c)	UAAL as a % of Covered Payroll [(b - a) / c]
June 30, 2004*	$6,118	$7,230	$1,112	84.6%	$1,737	64.0%
June 30, 2005	6,435	7,578	1,143	84.9%	1,807	63.3%
June 30, 2006	6,837	8,013	1,176	85.3%	1,777	66.2%
June 30, 2007	7,377	8,500	1,123	86.8%	1,847	60.8%
June 30, 2008*	7,838	9,128	1,290	85.9%	1,917	67.3%
June 30, 2009*	7,876	9,495	1,619	83.0%	2,002	80.9%
June 30, 2010	7,923	9,853	1,930	80.4%	1,945	99.2%
June 30, 2011	8,022	10,124	2,102	79.2%	1,876	112.0%
June 30, 2012*	7,897	10,794	2,897	73.2%	1,864	155.4%
June 30, 2013*	8,096	11,135	3,039	72.7%	1,880	161.6%
June 30, 2014	8,638	11,495	2,857	75.1%	1,903	150.1%
June 30, 2015	8,792	11,728	2,936	75.0%	1,919	153.0%
June 30, 2016*	8,878	12,751	3,873	69.6%	1,922	201.5%
June 30, 2017*	8,872	13,152	4,280	67.5%	1,942	220.4%
June 30, 2018*	8,830	13,613	4,782	64.9%	1,915	249.7%
June 30, 2019*	8,782	13,958	5,175	62.9%	1,931	268.0%
June 30, 2020*	8,711	14,258	5,547	61.1%	1,981	280.0%

* Revision in actuarial assumptions and methods.
Note: Information before 2017 was produced by prior actuary. Numbers may not add due to rounding.

TABLE 20
SHORT-TERM SOLVENCY TEST

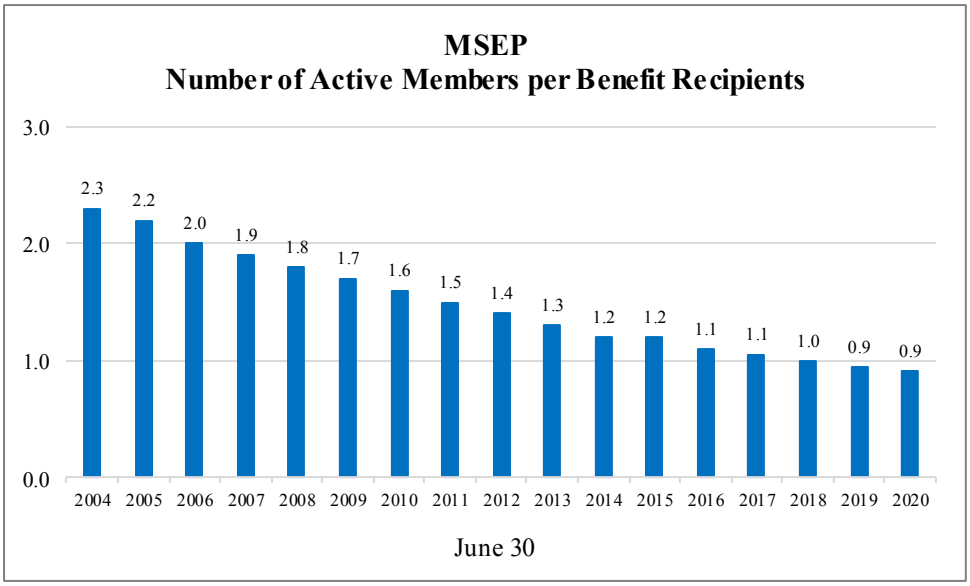
Fiscal Year End	Member Contributions (1)	Current Retirees and Beneficiaries (2)	Active and Inactive Members, Employer Financed Portion (3)	Actuarial Value of Assets Available for Benefits	Percentage of Actuarial Liabilities Covered by Actuarial Value of Assets Available for (1)	(2)	(3)
2010	$ 0	$ 5,012,677,769	$ 4,840,477,676	$ 7,923,377,393	100.0	100.0	60.1
2011	599,761	5,357,794,617	4,765,149,665	8,022,481,408	100.0	100.0	55.9
2012	5,431,451	5,749,411,068	5,038,809,058	7,897,167,203	100.0	100.0	42.5
2013	14,507,994	6,062,654,441	5,057,475,049	8,096,436,929	100.0	100.0	39.9
2014	27,111,467	6,347,728,717	5,119,731,651	8,637,758,955	100.0	100.0	44.2
2015	42,731,658	6,695,631,737	4,989,255,015	8,792,485,658	100.0	100.0	41.2
2016	60,618,379	7,305,895,284	5,384,649,090	8,878,057,191	100.0	100.0	28.1
2017	78,979,370	7,559,623,100	5,513,671,425	8,872,381,848	100.0	100.0	22.4
2018	103,784,514	8,073,692,664	5,435,286,783	8,830,410,210	100.0	100.0	12.0
2019	128,255,311	8,430,014,943	5,399,356,055	8,782,383,977	100.0	100.0	4.2
2020	157,133,312	8,701,290,590	5,399,984,986	8,711,224,151	100.0	98.3	0.0

TABLE 21
HISTORICAL EMPLOYER CONTRIBUTIONS

Fiscal Year Ending	Actuarially Determined Employer Contribution	Actual Dollar Amount	Percent Contributed
June 30, 2005	$195.6	$195.6	100.0%
June 30, 2006	227.2	227.2	100.0%
June 30, 2007	239.5	239.5	100.0%
June 30, 2008	249.8	249.8	100.0%
June 30, 2009	252.1	252.1	100.0%
June 30, 2010	251.2	251.2	100.0%
June 30, 2011	263.4	263.4	100.0%
June 30, 2012	263.4	263.4	100.0%
June 30, 2013	290.3	290.3	100.0%
June 30, 2014	326.4	326.4	100.0%
June 30, 2015	329.8	329.8	100.0%
June 30, 2016	310.1	330.0	106.4%
June 30, 2017	322.8	335.2	103.8%
June 30, 2018	379.6	379.6	100.0%
June 30, 2019	394.2	394.2	100.0%
June 30, 2020	436.9	436.9	100.0%

TABLE 22
HISTORICAL MEMBER STATISTICS

Valuation Date June 30	Active Members				Retired Members			
	Number	Payroll $ Millions	Average Salary $	% Incr.	Number	Active/ Retired	Annual Benefits $ Millions	% Incr.
2004	55,914	$1,737	$31,074		24,757	2.3	$324.6	
2005	55,944	1,807	32,293	3.9	25,780	2.2	348.1	7.2
2006	54,493	1,777	32,615	1.0	27,052	2.0	373.6	7.3
2007	54,363	1,847	33,969	4.2	28,692	1.9	406.4	8.8
2008	54,542	1,917	35,139	3.4	30,132	1.8	434.6	6.9
2009	55,057	2,002	36,370	3.5	31,637	1.7	465.4	7.1
2010	53,478	1,945	36,372	0.0	33,251	1.6	493.7	6.1
2011	51,660	1,876	36,306	(0.2)	35,315	1.5	525.6	6.5
2012	51,332	1,864	36,314	0.0	37,308	1.4	558.6	6.3
2013	50,833	1,880	36,988	1.9	39,139	1.3	589.9	5.6
2014	50,621	1,903	37,588	1.6	41,000	1.2	618.7	4.9
2015	49,980	1,919	38,386	2.1	42,964	1.2	650.9	5.2
2016	49,464	1,922	38,847	1.2	44,828	1.1	680.8	4.6
2017	48,910	1,942	39,705	2.2	46,560	1.1	710.2	4.3
2018	47,806	1,915	40,061	0.9	48,207	1.0	744.9	4.9
2019	46,864	1,931	41,199	2.8	49,696	0.9	779.9	4.7
2020	45,999	1,981	43,064	4.5	50,857	0.9	810.5	3.9



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MEMBER DATA RECONCILIATION

	Active Members	Inactive Vested	Inactive Nonvested	Leave of Absence	Long-term Disability	Retirees and Beneficiaries	Total
As of June 30, 2019	46,864	16,016	18,852	175	682	49,696	132,285
Changes in status:							
a) Retirement	(1,625)	(608)	0	(8)	(78)	2,319	0
b) Death	(73)	(45)	0	0	(13)	(1,538)	(1,669)
c) Non-vested termination	(2,766)	0	2,840	(68)	(6)	0	0
d) Leave of absence	(173)	0	(5)	178	0	0	0
e) Vested termination	(1,246)	1,331	0	(18)	(67)	0	0
f) Contribution refund	(967)	(88)	(1,531)	(17)	(7)	0	(2,610)
g) Beneficiary in receipt	0	0	0	0	0	458	458
h) Long-term disability	(107)	(27)	(2)	(6)	142	0	0
h) Disability retirement	0	0	0	0	0	0	0
i) Return to active service	654	(272)	(318)	(41)	(4)	(19)	0
j) Expired benefit	0	0	0	0	0	(58)	(58)
k) Transfer to MPERS	(55)	(21)	0	0	0	0	(76)
k) Data adjustment	(12)	14	(9)	0	0	(1)	(8)
Total changes in status	(6,370)	284	975	20	(33)	1,161	(3,963)
New entrants	5,505	0	1,908	52	2	0	7,467
Net Change	(865)	284	2,883	72	(31)	1,161	3,504
As of June 30, 2020	45,999	16,300	21,735	247	651	50,857	135,789

SUMMARY OF MEMBERSHIP DATA

A. ACTIVE MEMBERS	June 30, 2020	June 30, 2019	% Change
1. Number of Active Members			
(a) MSEP	9,492	10,621	(10.6)
(b) MSEP 2000	13,432	14,350	(6.4)
(c) MSEP 2011	23,075	21,893	5.4
(d) Total	45,999	46,864	(1.8)
2. Annualized Reported Salary			
(a) MSEP	$ 482,841,171	$ 516,620,685	(6.5)
(b) MSEP 2000	605,329,395	612,236,815	(1.1)
(c) MSEP 2011	892,739,907	801,907,135	11.3
(d) Total	$ 1,980,910,473	$ 1,930,764,635	2.6
3. Accumulated Member Contributions	$ 117,316,579	$ 97,481,815	20.3
4. Active Member Averages			
(a) Age	45.5	45.5	0.0
(b) Service	10.8	10.8	0.0
(c) Compensation	$ 43,064	$ 41,199	4.5
B. INACTIVE MEMBERS			
1. Number of Inactive Members			
(a) Terminated vested	16,300	16,016	1.8
(b) Terminated nonvested (refund only)	21,735	18,852	15.3
(c) Leave of absence	247	175	41.1
(d) Long-term disability	651	682	(4.5)
(e) Total	38,933	35,725	9.0
2. Accumulated Member Contributions	$ 39,816,733	$ 30,773,496	29.4
3. Inactive Member Averages			
(a) Age (vesteds only)	49.0	48.8	0.4
(b) Monthly benefit	$ 526	$ 518	1.5
(c) Accumulated member contributions	$ 1,023	$ 861	18.8
C. RETIREES, DISABLEDS, AND BENEFICIARIES			
1. Number of Members			
(a) Service retirees and disableds	45,177	44,159	2.3
(b) Beneficiaries	5,680	5,537	2.6
(c) Total	50,857	49,696	2.3
2. Total Monthly Benefits			
(a) Service retirees and disableds	$ 61,562,518	$ 59,330,057	3.8
(b) Beneficiaries	5,982,316	5,665,503	5.6
(c) Total	$ 67,544,834	$ 64,995,560	3.9
3. Average Age			
(a) Service retirees and disableds	70.7	70.4	0.4
(b) Beneficiaries	72.3	71.9	0.6
(c) Total	70.8	70.5	0.4

MEMBERSHIP DATA BY GROUP

Valuation Group	Number	Payroll	Group Averages		
			Salary	Age(yrs.)	Service(yrs.)
Regular State Employees	43,661	$ 1,845,831,503	$ 42,276	45.3	10.5
Elected Officials	6	659,976	109,996	47.7	3.3
Legislative Clerks	7	292,357	41,765	67.1	21.6
Legislators	193	6,943,847	35,978	53.2	4.8
Uniformed Water Patrol	10	755,115	75,512	44.0	18.6
Conservation Department	1,323	61,857,763	46,756	44.8	14.5
School-Term Salaried Employees	783	62,661,147	80,027	58.4	22.4
Administrative Law Judges	16	1,908,765	119,298	62.0	25.6
Total MSEP	**45,999**	**$ 1,980,910,473**	**$ 43,064**	**45.5**	**10.8**

The total number of System active members includes 9,492 MSEP members, 13,432 MSEP 2000 members and 23,075 MSEP 2011 members.

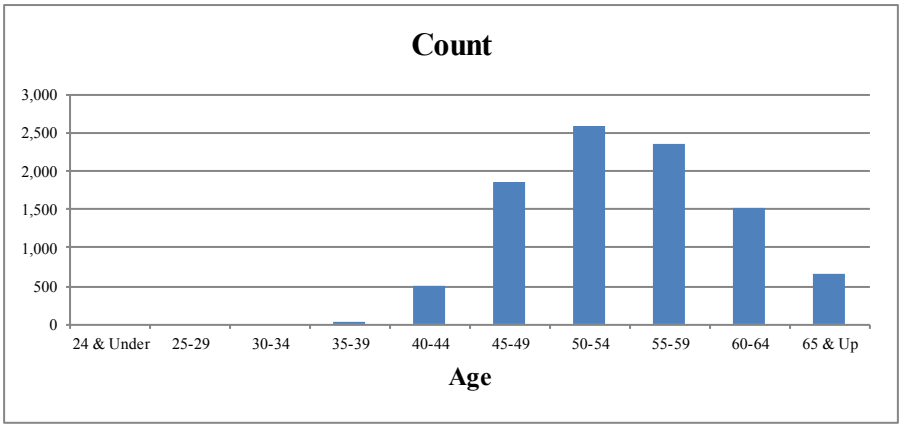
Type of Benefit Payment	No.	Monthly Benefit	Group Averages	
			Benefit	Age(yrs.)
Retirement	45,176	$ 61,562,325	$ 1,363	70.7
Disability	1	193	193	64.0
Survivor of Active Member	1,728	1,621,622	938	63.7
Survivor of Retired Member	3,952	4,360,694	1,103	76.1
Total MSEP	**50,857**	**$ 67,544,834**	**$ 1,328**	**70.8**

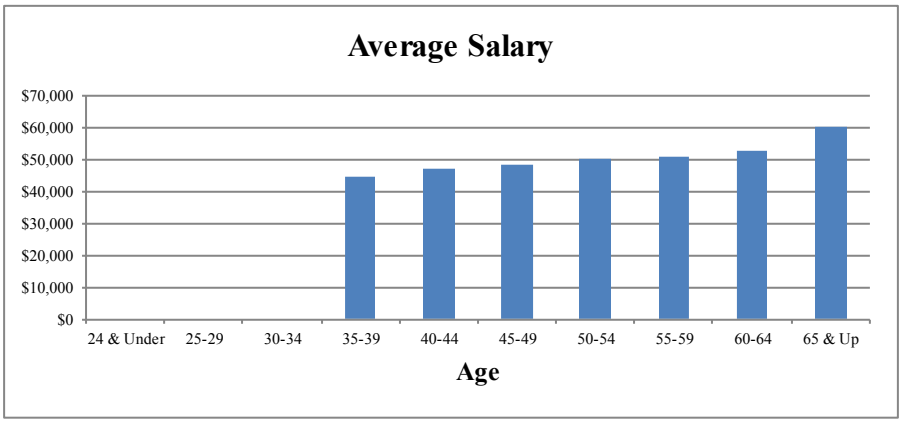
This valuation also includes 16,300 terminated vested members, 21,735 terminated members who have a refund pending, 247 members on leave and 651 members on long-term disability.

ACTIVE MEMBERS
AS OF JUNE 30, 2020

MSEP

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
24 & Under	0	0	0	$ 0	$ 0	$ 0
25-29	0	0	0	0	0	0
30-34	0	0	0	0	0	0
35-39	3	18	21	154,598	782,747	937,345
40-44	151	364	515	7,489,627	16,638,874	24,128,501
45-49	639	1,216	1,855	32,764,560	57,076,821	89,841,381
50-54	932	1,662	2,594	50,690,190	79,380,763	130,070,953
55-59	926	1,423	2,349	52,557,231	66,770,797	119,328,028
60-64	648	862	1,510	39,295,948	40,153,617	79,449,565
65 & Up	292	356	648	20,770,844	18,314,554	39,085,398
Total	3,591	5,901	9,492	$ 203,722,998	$ 279,118,173	$ 482,841,171

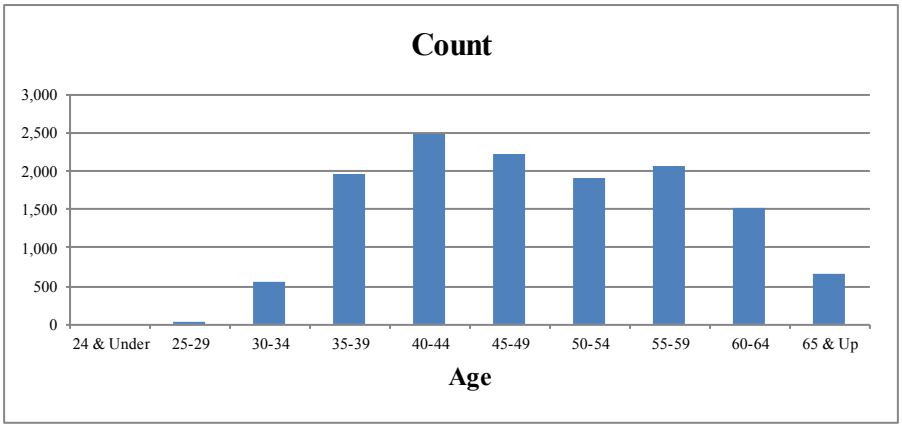


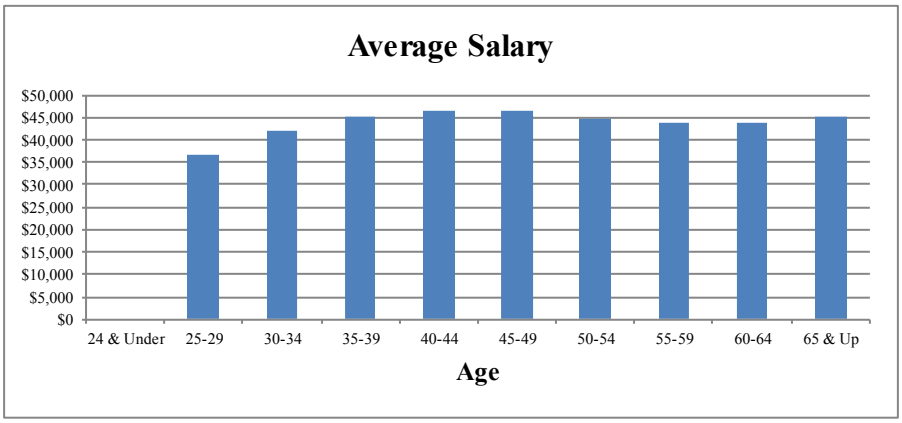


ACTIVE MEMBERS
AS OF JUNE 30, 2020

MSEP 2000

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
24 & Under	0	0	0	$ 0	$ 0	$ 0
25-29	5	7	12	166,995	274,172	441,167
30-34	221	341	562	9,549,804	14,011,878	23,561,682
35-39	757	1,198	1,955	35,601,960	52,962,068	88,564,028
40-44	966	1,524	2,490	46,451,111	69,022,642	115,473,753
45-49	851	1,381	2,232	43,268,466	60,508,427	103,776,893
50-54	751	1,170	1,921	36,828,508	49,209,734	86,038,242
55-59	799	1,265	2,064	38,432,890	52,005,863	90,438,753
60-64	574	957	1,531	27,807,623	39,182,173	66,989,796
65 & Up	317	348	665	15,408,532	14,636,549	30,045,081
Total	5,241	8,191	13,432	$ 253,515,889	$ 351,813,506	$ 605,329,395

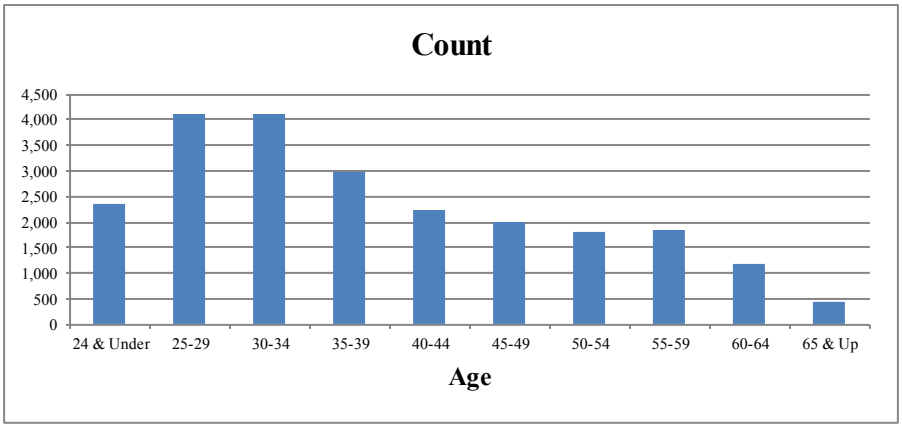


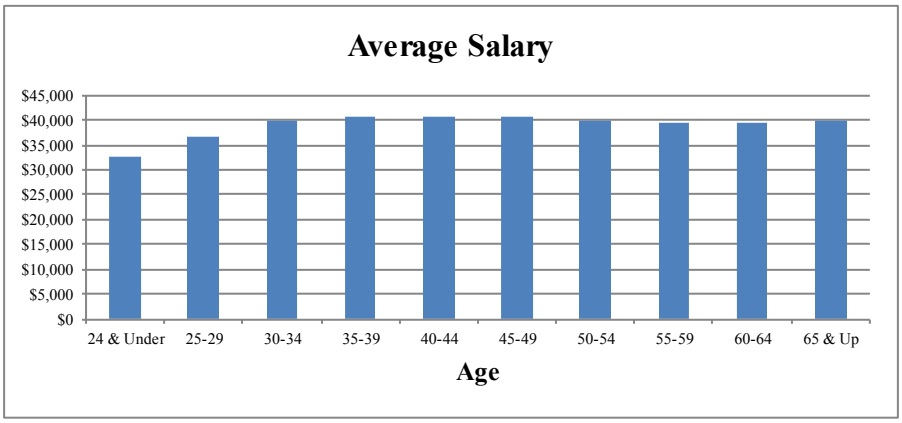


ACTIVE MEMBERS
AS OF JUNE 30, 2020

MSEP 2011

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
24 & Under	952	1,409	2,361	$ 33,321,298	$ 43,615,768	$ 76,937,066
25-29	1,678	2,416	4,094	64,212,865	85,487,129	149,699,994
30-34	1,641	2,467	4,108	68,859,911	93,929,809	162,789,720
35-39	1,101	1,871	2,972	48,797,899	72,398,667	121,196,566
40-44	804	1,422	2,226	35,959,133	54,493,707	90,452,840
45-49	661	1,331	1,992	29,837,018	50,746,977	80,583,995
50-54	605	1,216	1,821	26,182,601	46,501,700	72,684,301
55-59	643	1,218	1,861	27,951,921	45,484,599	73,436,520
60-64	445	749	1,194	19,293,797	27,861,007	47,154,804
65 & Up	227	219	446	9,708,691	8,095,410	17,804,101
Total	8,757	14,318	23,075	$ 364,125,134	$ 528,614,773	$ 892,739,907

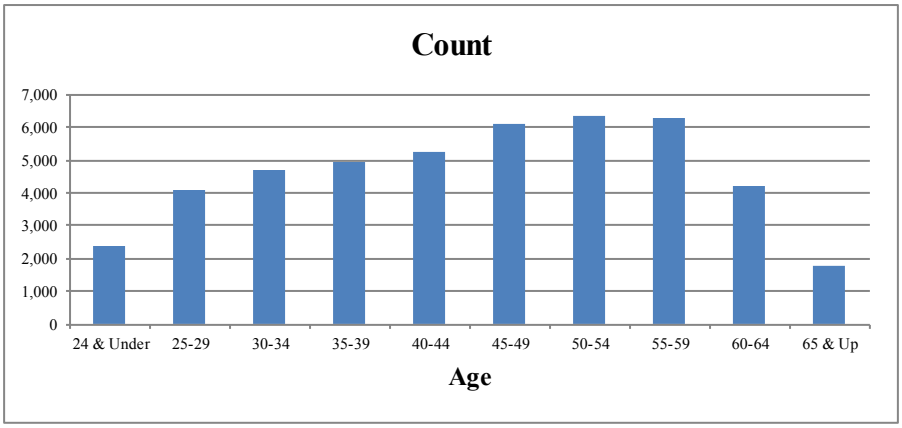


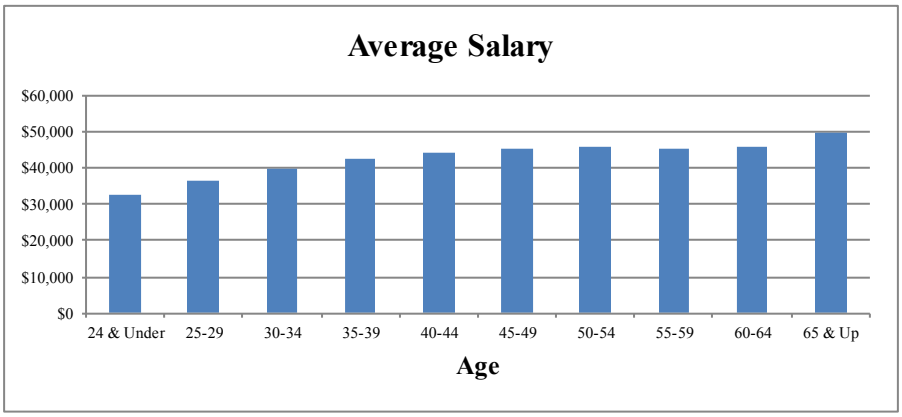


ACTIVE MEMBERS
AS OF JUNE 30, 2020

TOTAL

	Count of Members			Reported Annualized Earnings for Current Members		
Age	Male	Female	Total	Male	Female	Total
24 & Under	952	1,409	2,361	$ 33,321,298	$ 43,615,768	$ 76,937,066
25-29	1,683	2,423	4,106	64,379,860	85,761,301	150,141,161
30-34	1,862	2,808	4,670	78,409,715	107,941,687	186,351,402
35-39	1,861	3,087	4,948	84,554,457	126,143,482	210,697,939
40-44	1,921	3,310	5,231	89,899,871	140,155,223	230,055,094
45-49	2,151	3,928	6,079	105,870,044	168,332,225	274,202,269
50-54	2,288	4,048	6,336	113,701,299	175,092,197	288,793,496
55-59	2,368	3,906	6,274	118,942,042	164,261,259	283,203,301
60-64	1,667	2,568	4,235	86,397,368	107,196,797	193,594,165
65 & Up	836	923	1,759	45,888,067	41,046,513	86,934,580
Total	17,589	28,410	45,999	$ 821,364,021	$ 1,159,546,452	$ 1,980,910,473





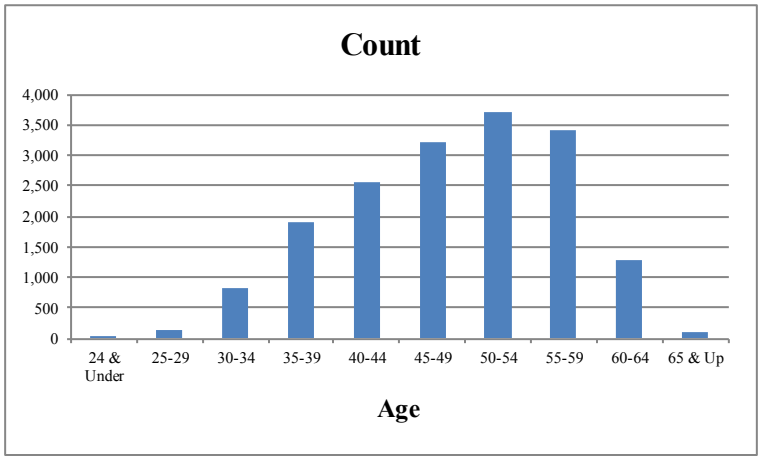
AGE AND SERVICE DISTRIBUTION
AS OF JUNE 30, 2020

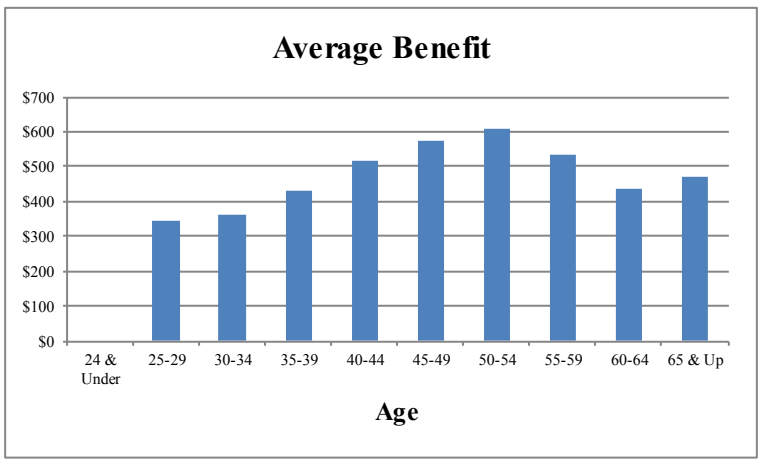
Age		0-4	5-9	10-14	15-19	20-24	25-29	30-34	Over 34	Total
24 &	Number	2,348	13	0	0	0	0	0	0	2,361
Under	Total Salary	$ 76,500,599	$ 436,467	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 76,937,066
	Average Sal.	$ 32,581	$ 33,574	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 32,587
25-29	Number	3,501	603	2	0	0	0	0	0	4,106
	Total Salary	$ 126,386,659	$ 23,697,096	$ 57,406	$ 0	$ 0	$ 0	$ 0	$ 0	$ 150,141,161
	Average Sal.	$ 36,100	$ 39,299	$ 28,703	$ 0	$ 0	$ 0	$ 0	$ 0	$ 36,566
30-34	Number	2,690	1,624	349	7	0	0	0	0	4,670
	Total Salary	$ 102,859,298	$ 68,901,990	$ 14,324,774	$ 265,340	$ 0	$ 0	$ 0	$ 0	$ 186,351,402
	Average Sal.	$ 38,238	$ 42,427	$ 41,045	$ 37,906	$ 0	$ 0	$ 0	$ 0	$ 39,904
35-39	Number	2,013	1,344	1,170	404	17	0	0	0	4,948
	Total Salary	$ 80,255,299	$ 58,328,477	$ 53,071,744	$ 18,235,806	$ 806,613	$ 0	$ 0	$ 0	$ 210,697,939
	Average Sal.	$ 39,869	$ 43,399	$ 45,360	$ 45,138	$ 47,448	$ 0	$ 0	$ 0	$ 42,582
40-44	Number	1,575	1,066	1,001	1,118	451	20	0	0	5,231
	Total Salary	$ 62,709,708	$ 47,707,383	$ 45,185,514	$ 51,910,035	$ 21,717,916	$ 824,538	$ 0	$ 0	$ 230,055,094
	Average Sal.	$ 39,816	$ 44,754	$ 45,140	$ 46,431	$ 48,155	$ 41,227	$ 0	$ 0	$ 43,979
45-49	Number	1,462	957	879	1,002	1,323	432	24	0	6,079
	Total Salary	$ 60,018,987	$ 41,737,450	$ 38,675,031	$ 47,054,946	$ 63,495,277	$ 21,987,221	$ 1,233,357	$ 0	$ 274,202,269
	Average Sal.	$ 41,053	$ 43,613	$ 43,999	$ 46,961	$ 47,993	$ 50,896	$ 51,390	$ 0	$ 45,106
50-54	Number	1,296	892	816	871	1,180	944	316	21	6,336
	Total Salary	$ 51,711,714	$ 37,802,566	$ 35,249,223	$ 39,550,737	$ 57,765,416	$ 49,096,807	$ 16,421,502	$ 1,195,531	$ 288,793,496
	Average Sal.	$ 39,901	$ 42,380	$ 43,198	$ 45,408	$ 48,954	$ 52,009	$ 51,967	$ 56,930	$ 45,580
55-59	Number	1,283	951	862	964	1,067	609	432	106	6,274
	Total Salary	$ 52,695,752	$ 38,600,046	$ 36,233,907	$ 42,072,214	$ 52,052,314	$ 31,827,286	$ 24,092,284	$ 5,629,498	$ 283,203,301
	Average Sal.	$ 41,072	$ 40,589	$ 42,035	$ 43,643	$ 48,784	$ 52,262	$ 55,769	$ 53,108	$ 45,139
60-64	Number	783	670	652	676	664	361	249	180	4,235
	Total Salary	$ 32,294,367	$ 27,411,692	$ 27,279,091	$ 29,122,927	$ 32,124,176	$ 20,362,375	$ 15,269,942	$ 9,729,595	$ 193,594,165
	Average Sal.	$ 41,244	$ 40,913	$ 41,839	$ 43,081	$ 48,380	$ 56,405	$ 61,325	$ 54,053	$ 45,713
65 &	Number	258	323	266	281	238	145	116	132	1,759
Up	Total Salary	$ 11,072,752	$ 13,979,301	$ 11,505,761	$ 12,522,506	$ 11,871,398	$ 8,966,595	$ 7,793,874	$ 9,222,393	$ 86,934,580
	Average Sal.	$ 42,918	$ 43,280	$ 43,255	$ 44,564	$ 49,880	$ 61,839	$ 67,189	$ 69,867	$ 49,423
Total	Number	17,209	8,443	5,997	5,323	4,940	2,511	1,137	439	45,999
	Total Salary	$ 656,505,135	$ 358,602,468	$ 261,582,451	$ 240,734,511	$ 239,833,110	$ 133,064,822	$ 64,810,959	$ 25,777,017	$ 1,980,910,473
	Average Sal.	$ 38,149	$ 42,473	$ 43,619	$ 45,225	$ 48,549	$ 52,993	$ 57,002	$ 58,718	$ 43,064

INACTIVE VESTED MEMBERS
AS OF JUNE 30, 2020

	Count of Members*			Monthly Deferred Benefits*		
Age	Male	Female	Total	Male	Female	Total
24 & Under	27	15	42	$ 1,327	$ 4,015	$ 5,342
25-29	77	71	148	23,630	27,445	51,075
30-34	351	471	822	137,139	158,378	295,517
35-39	771	1,137	1,908	352,237	471,279	823,516
40-44	929	1,621	2,550	505,533	809,587	1,315,120
45-49	1,179	2,034	3,213	717,376	1,133,439	1,850,815
50-54	1,324	2,381	3,705	891,376	1,373,506	2,264,882
55-59	1,169	2,234	3,403	710,987	1,113,328	1,824,315
60-64	436	856	1,292	216,387	347,113	563,500
65 & Up	46	69	115	25,343	28,701	54,044
Total	6,309	10,889	17,198	$ 3,581,335	$ 5,466,791	$ 9,048,126

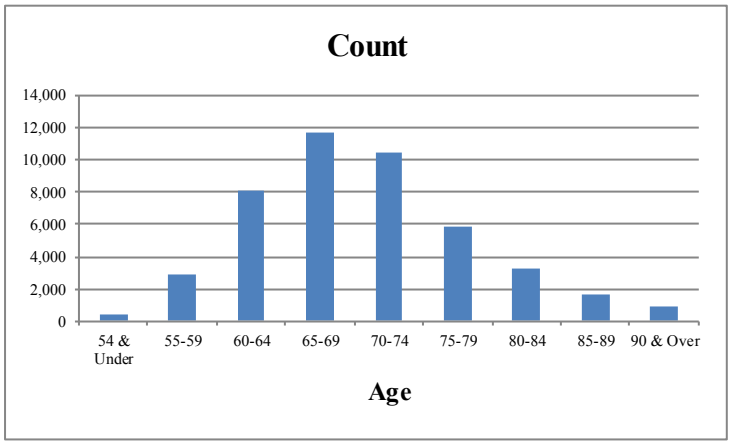
* There are 247 members currently on leave and 651 members on LTD. Their counts and estimated deferred monthly benefits are included.

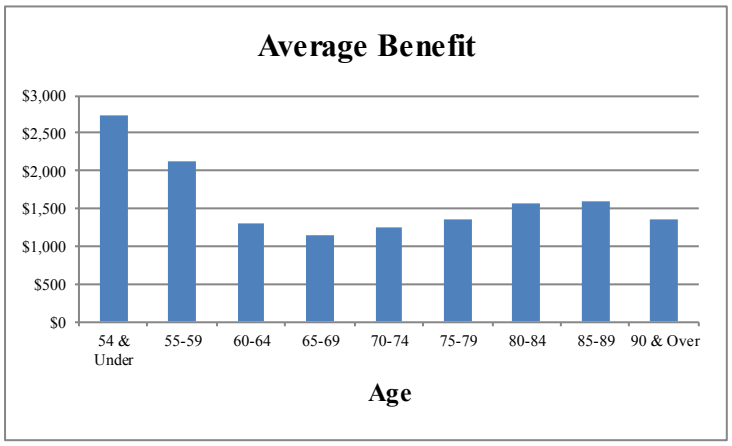




RETIRED AND DISABLED MEMBERS
AS OF JUNE 30, 2020

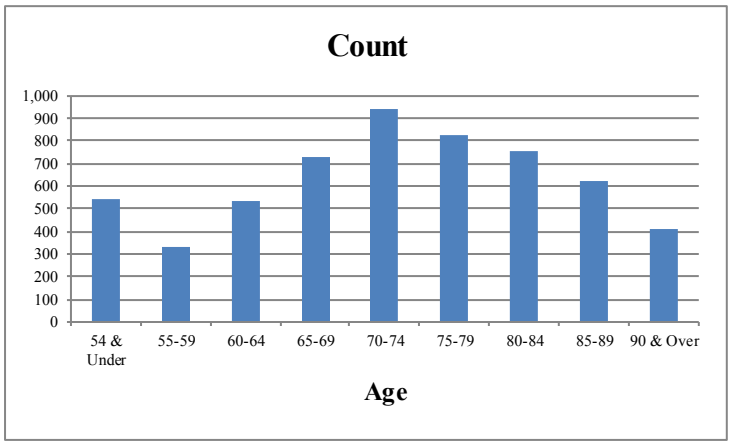
	Count of Members			Monthly Benefits		
Age	Male	Female	Total	Male	Female	Total
54 & Under	153	289	442	$ 418,125	$ 787,570	$ 1,205,695
55-59	1,013	1,897	2,910	2,215,696	3,941,860	6,157,556
60-64	2,804	5,287	8,091	3,929,329	6,633,811	10,563,140
65-69	4,453	7,160	11,613	5,773,919	7,703,988	13,477,907
70-74	4,174	6,211	10,385	6,243,099	6,846,405	13,089,504
75-79	2,391	3,484	5,875	4,139,328	3,888,896	8,028,224
80-84	1,247	2,042	3,289	2,678,415	2,480,508	5,158,923
85-89	604	1,042	1,646	1,366,551	1,256,441	2,622,992
90 & Over	250	676	926	494,336	764,241	1,258,577
Total	17,089	28,088	45,177	$ 27,258,798	$ 34,303,720	$ 61,562,518

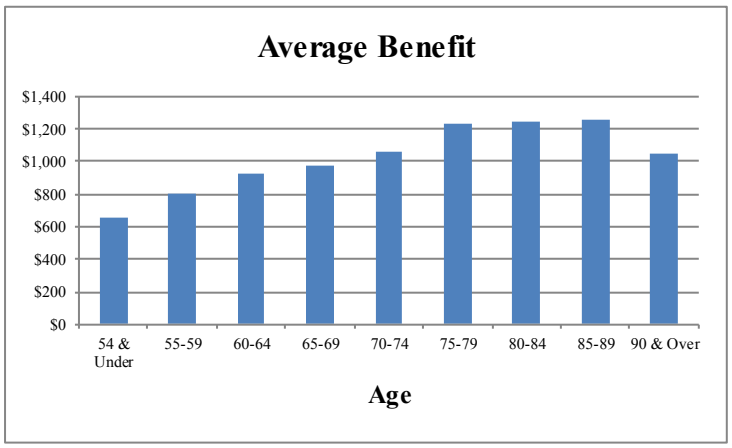




BENEFICIARIES RECEIVING BENEFITS
AS OF JUNE 30, 2020

	Count of Members			Monthly Benefits		
Age	Male	Female	Total	Male	Female	Total
54 & Under	225	318	543	$ 127,684	$ 225,676	$ 353,360
55-59	99	228	327	63,971	197,700	261,671
60-64	146	388	534	101,306	393,977	495,283
65-69	202	524	726	151,407	553,897	705,304
70-74	245	698	943	189,198	817,066	1,006,264
75-79	177	646	823	145,878	865,561	1,011,439
80-84	191	565	756	155,436	785,816	941,252
85-89	135	488	623	104,412	680,219	784,631
90 & Over	94	311	405	55,723	367,389	423,112
Total	1,514	4,166	5,680	$ 1,095,015	$ 4,887,301	$ 5,982,316





RETIRED LIVES BENEFITS PAYABLE AS OF JUNE 30, 2020 TABULATED BY OPTION AND TYPE OF BENEFIT

MSEP Benefits

Type of Benefit	No.	Total Monthly Benefits
Service Retirement		
Life Annuity	5,870	$ 7,854,131
50% Joint and Survivor	5,195	8,975,603
100% Joint and Survivor	3,147	6,045,933
5-Year Certain and Life	145	166,749
10-Year Certain and Life	177	184,164
Survivor Beneficiary	2,669	3,294,647
Total	17,203	26,521,227
Disability Retirement	1	193
Death-in-Service	1,422	1,492,982
Total	**18,626**	**$ 28,014,402**

MSEP 2000 Benefits

Type of Benefit	No.	Total Monthly Benefits
Service Retirement		
Life Annuity	18,983	$ 22,547,828
50% Joint and Survivor	4,491	7,481,919
100% Joint and Survivor	5,379	6,985,595
5-Year Certain and Life	20	26,052
10-Year Certain and Life	866	710,155
15-Year Certain and Life	725	523,773
Survivor Beneficiary	1,283	1,066,045
Total	31,747	39,341,367
Death-in-Service	301	126,316
Total	**32,048**	**$ 39,467,683**

RETIRED LIVES BENEFITS PAYABLE AS OF JUNE 30, 2020
TABULATED BY OPTION AND TYPE OF BENEFIT

MSEP 2011 Benefits

Type of Benefit	No.	Total Monthly Benefits
Service Retirement		
Life Annuity	101	$ 33,062
50% Joint and Survivor	15	6,409
100% Joint and Survivor	47	14,700
5-Year Certain and Life	0	0
10-Year Certain and Life	5	1,823
15-Year Certain and Life	10	4,431
Survivor Beneficiary	0	0
Total	178	60,425
Death-in-Service	5	2,324
Total	**183**	**$ 62,749**

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SALARY INCREASES
DURING PLAN YEAR 2019-2020

Age	Count	Salary Increases	
		Actual*	Expected
Under 20	35	10.5%	7.8%
20 - 24	1,184	6.1%	5.5%
25 - 29	3,087	6.9%	4.5%
30 - 34	3,857	6.3%	4.0%
35 - 39	4,373	6.0%	3.7%
40 - 44	4,744	5.5%	3.5%
45 - 49	5,693	5.5%	3.3%
50 - 54	5,841	4.7%	3.3%
55 - 59	5,763	4.6%	3.3%
60 - 64	3,804	3.9%	3.3%
65 & Over	1,459	3.3%	3.2%
Total	**39,840**		
Average		**5.2%**	**3.5%**

** Excludes new entrants and terminations.*

	Payroll Growth				
	2020	2019	2018	2017	2016
Actual	2.60%	0.8%	-1.4%	1.1%	0.2%
Assumed	2.35%	2.5%	3.0%	3.0%	0.0%

ACTIVE MEMBERS WHO RETIRED WITH SERVICE RETIREMENT BENEFITS DURING PLAN YEAR 2019-2020

Age	Male		Female		Total	
	Actual	Expected	Actual	Expected	Actual	Expected
Under 50	0	0.2	8	0.6	8	0.8
50	3	1.6	12	5.0	15	6.6
51	11	3.2	22	7.8	33	11.0
52	9	6.7	26	19.3	35	26.0
53	17	12.2	29	24.0	46	36.2
54	19	15.3	33	26.1	52	41.4
55	27	21.4	46	30.2	73	51.6
56	26	27.9	40	35.2	66	63.1
57	30	30.0	52	43.8	82	73.8
58	33	35.0	61	50.9	94	85.9
59	31	32.8	54	47.0	85	79.7
60	50	41.7	53	56.2	103	97.9
61	30	37.1	63	58.1	93	95.2
62	51	63.1	77	92.4	128	155.5
63	35	48.3	61	72.0	96	120.3
64	46	37.0	70	51.1	116	88.1
65	55	56.2	88	77.0	143	133.2
66	39	41.7	81	60.8	120	102.5
67	23	22.8	37	26.9	60	49.7
68	15	17.3	34	24.9	49	42.2
69	16	12.0	16	16.7	32	28.7
70 & Over	42	59.7	54	53.7	96	113.4
Total	**608**	**623.3**	**1,017**	**879.6**	**1,625**	**1,502.8**

	Male	Female	Total
Average age at retirement	61.7 years	61.2 years	61.4 years
Average service at retirement	21.7 years	22.7 years	22.3 years

ACTIVE MEMBERS WHO BECAME DISABLED DURING PLAN YEAR 2019-2020

Age	Male		Female		Total	
	Actual	Expected	Actual	Expected	Actual	Expected
Under 25	0	0.9	1	1.1	1	2.0
25 - 29	1	1.7	3	2.5	4	4.2
30 - 34	2	2.0	3	2.8	5	4.8
35 - 39	1	4.8	4	8.0	5	12.7
40 - 44	1	7.3	8	12.3	9	19.6
45 - 49	3	10.2	7	18.6	10	28.8
50 - 54	15	13.4	21	23.6	36	37.0
55 - 59	5	15.0	21	26.0	26	41.0
60 & Over	3	8.3	8	13.3	11	21.7
Total	**31**	**63.7**	**76**	**108.1**	**107**	**171.8**

	Male	Female	Total
Average age at disability	50.5 years	50.2 years	50.3 years
Average service at disability	11.2 years	9.6 years	10.1 years

ACTIVE MEMBERS WHO DIED DURING PLAN YEAR 2019-2020

Age	Male		Female		Total	
	Actual	Expected	Actual	Expected	Actual	Expected
Under 30	1	0.8	0	0.5	1	1.3
30 - 34	0	0.7	0	0.6	0	1.2
35 - 39	4	0.8	1	0.9	5	1.7
40 - 44	5	1.1	2	1.3	7	2.3
45 - 49	3	2.0	6	2.5	9	4.5
50 - 54	4	3.7	7	4.3	11	8.0
55 - 59	7	7.0	4	6.6	11	13.6
60 - 64	10	8.8	12	6.3	22	15.2
65 & Over	4	9.1	3	4.4	7	13.5
Total	**38**	**33.9**	**35**	**27.3**	**73**	**61.2**

	Male	Female	Total
Average age at death	53.4 years	55.7 years	54.5 years
Average service at death	15.2 years	16.0 years	15.6 years

Of the 73 active members who died in service during plan year 2019-2020, 52 members had a benefit payable to a survivor.

ACTIVE MEMBERS WHO TERMINATED EMPLOYMENT WITH A DEFERRED BENEFIT DURING PLAN YEAR 2019-2020

Age	Male		Female		Total	
	Actual	Expected	Actual	Expected	Actual	Expected
Under 30	34	24.7	33	31.3	67	56.0
30 - 34	100	72.0	112	105.1	212	177.1
35 - 39	86	83.6	98	130.3	184	213.9
40 - 44	85	71.9	143	121.2	228	193.1
45 - 49	61	64.3	145	115.5	206	179.9
50 - 54	66	46.8	111	81.6	177	128.4
55 - 59	42	20.8	80	35.6	122	56.3
60 & Over	19	2.6	31	3.6	50	6.2
Total	**493**	**386.8**	**753**	**624.2**	**1,246**	**1,010.9**

	Male	Female	Total
Average age at termination	42.1 years	44.0 years	43.2 years
Average service at termination	9.9 years	10.5 years	10.3 years

ACTIVE MEMBERS WHO TERMINATED EMPLOYMENT WITHOUT A DEFERRED BENEFIT PAYABLE DURING PLAN YEAR 2019-2020

Age	Male		Female		Total	
	Actual	Expected	Actual	Expected	Actual	Expected
Under 20	10	0.0	24	0.0	34	0.0
20 - 24	319	167.9	420	243.0	739	410.8
25 - 29	399	251.6	561	396.8	960	648.4
30 - 34	225	182.3	385	303.9	610	486.2
35 - 39	149	116.6	257	229.7	406	346.3
40 - 44	94	92.3	193	182.4	287	274.8
45 - 49	81	71.2	152	171.6	233	242.8
50 - 54	57	67.1	123	145.0	180	212.1
55 - 59	47	66.0	102	129.5	149	195.4
60 - 64	32	44.9	46	75.8	78	120.8
65 - 69	19	14.7	22	16.2	41	30.9
70 & Over	8	6.7	8	6.2	16	12.9
Total	**1,440**	**1,081.4**	**2,293**	**1,900.0**	**3,733**	**2,981.4**

Service	Male		Female		Total	
	Actual	Expected	Actual	Expected	Actual	Expected
0 - 1	678	438.5	1,050	787.7	1,728	1,226.2
1 - 2	307	251.9	542	465.9	849	717.8
2 - 3	199	176.9	331	294.2	530	471.0
3 - 4	150	126.8	222	216.3	372	343.1
4 - 5	106	87.3	148	135.9	254	223.2
Total	**1,440**	**1,081.4**	**2,293**	**1,900.0**	**3,733**	**2,981.4**

	Male	Female	Total
Average age at termination	33.3 years	34.4 years	34.0 years
Average service at termination	1.6 years	1.6 years	1.6 years

COMPARISON OF ACTUAL TO EXPECTED DEATHS AMONG RETIRED LIVES (SERVICE RETIREMENT ONLY) DURING PLAN YEAR 2019-2020

Age	Male			Female			Total		
	Actual	Expected	Exposures	Actual	Expected	Exposures	Actual	Expected	Exposures
Under 50	0	0.0	0	0	0.0	1	0	0.0	1
50 - 54	0	0.6	124	1	0.7	211	1	1.4	335
55 - 59	8	6.5	922	7	8.7	1,770	15	15.2	2,692
60 - 64	38	26.4	2,693	38	34.4	4,947	76	60.8	7,640
65 - 69	90	62.0	4,428	82	73.9	7,112	172	135.9	11,540
70 - 74	110	87.9	4,110	109	97.6	5,987	219	185.5	10,097
75 - 79	98	82.4	2,367	102	93.9	3,444	200	176.3	5,811
80 - 84	97	75.1	1,267	98	95.5	2,012	195	170.7	3,279
85 - 89	75	65.3	628	144	95.7	1,136	219	161.0	1,764
90 - 94	46	40.4	231	83	79.2	552	129	119.7	783
95 - 99	15	11.3	45	34	32.1	144	49	43.4	189
100 & Over	1	1.5	4	12	7.6	23	13	9.1	27
Total	**578**	**459.5**	**16,819**	**710**	**619.4**	**27,339**	**1,288**	**1,079.0**	**44,158**
Average Ages	**77.0**	**77.6**	**70.5**	**79.9**	**79.5**	**70.3**	**78.6**	**78.7**	**70.4**

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MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
DEFINITIONS **Participants** All MOSERS members, vested former members, retirees and survivors who first became members prior to July 1, 2000 and who do **not** elect to transfer to the MSEP 2000 plan. Election is made at the time benefits commence.	(1) All new employees who first become members on or after July 1, 2000, except full-time teaching and senior administrative personnel of the regional colleges and universities hired on or after July 1, 2002 who will be participants in the Colleges and Universities Retirement Plan (CURP). (2) MSEP active members and vested former members who elect to transfer to the MSEP 2000 plan prior to retirement. (3) MSEP retirees who elect to transfer to the MSEP 2000 plan during the election window from July 1, 2000 through June 30, 2001, and their survivors. (4) MSEP non-vested terminations rehired on or after July 1, 2000. (5) Members hired prior to January 1, 2011 participating in the CURP for six years may elect to change to MOSERS. Transferred service is for vesting purposes only.	(1) All new employees who first become employees on or after January 1, 2011, except full-time teaching and senior administrative personnel of the regional colleges and universities hired on or after July 1, 2002 who will be participants in the Colleges and Universities Retirement Plan (CURP). (2) Members hired on or after January 1, 2011 participating in the CURP for six years may elect to change to MOSERS. Transferred service is for vesting purposes only.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
Final average earnings		
The average annual compensation of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining Average Compensation). Non-recurring lump sum payments are excluded. Unused sick leave may be converted to additional credited service (usable only for benefit computation, not eligibility).	The average annual compensation of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining Average Compensation). Non-recurring lump sum payments are excluded. Unused sick leave may be converted to additional credited service (usable only for benefit computation, not eligibility).	The average annual compensation of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining Average Compensation). Non-recurring lump sum payments are excluded. Unused sick leave may be converted to additional credited service (usable only for benefit computation, not eligibility).
Member contributions		
None.	Same as MSEP.	4.0% of salary, with interest credited to member contributions based on the 52-week Treasury bill rate (4% prior to June 30, 2014).

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
ELIGIBILITY FOR BENEFITS		
Normal retirement		
Members of the General Assembly: Age 55 with completion of at least 3 full biennial assemblies.	*Members of the General Assembly:* The earliest of attaining: (1) Age 55 with completion of at least 3 full biennial assemblies. (2) Age 50 with completion of at least 3 full biennial assemblies and with age plus credited service equal to 80 or more.	*Members of the General Assembly:* The earliest of attaining: (1) Age 62 with completion of at least 3 full biennial assemblies. (2) Age 55 with completion of at least 3 full biennial assemblies and with age plus credited service equal to 90 or more.
Statewide Elected Officials: The earliest of attaining: (1) Age 65 with at least 4 years of credited service. (2) Age 60 with at least 15 years of credited service. (3) Age 50 with age plus credited service equal to 80 or more.	*Statewide Elected Officials:* The earliest of attaining: (1) Age 55 with at least 4 years of credited service. (2) Age 50 with age plus credited service equal to 80 or more.	*Statewide Elected Officials:* The earliest of attaining: (1) Age 62 with at least 4 years of credited service as a statewide elected official. (2) Age 55 with age plus credited service equal to 90 or more.
General Employees: The earliest of attaining: (1) Age 65 and active with at least 4 years of credited service. (2) Age 65 with at least 5 years of credited service. (3) Age 60 with at least 15 years of credited service. (4) Age 48 with age plus credited service equal to 80 or more.	*General Employees:* The earliest of attaining: (1) Age 62 with at least 5 years of credited service. (2) Age 48 with age plus credited service equal to 80 or more.	*General Employees:* The earliest of attaining: (1) Age 67 with at least 5 years of credited service. (2) Age 55 with age plus credited service equal to 90 or more.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
Uniformed Water Patrol Employees: The earliest of attaining: (1) Age 55 and active with at least 4 years of credited service. (2) Age 55 with at least 5 years of credited service. (3) Age 48 with age plus credited service equal to 80 or more. *Administrative Law Judges:* The earliest of attaining: (1) Age 62 and active with at least 12 years of credited service. (2) Age 60 with at least 15 years of credited service. (3) Age 55 with at least 20 years of credited service.		
Early retirement for general employees		
Age 55 with at least 10 years of credited service.	Age 57 with at least 5 years of credited service.	Age 62 with at least 5 years of credited service.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
MONTHLY BENEFITS PAYABLE		
Normal Retirement		
Members of the General Assembly: $150 per month per biennial assembly served.	*Members of the General Assembly:* 1/24 of pay times first 24 years of credited service as a member of the General Assembly.	*Members of the General Assembly:* 1/24 of pay times first 24 years of credited service as a member of the General Assembly.
Statewide Elected Officials: 1) Less than 12 years of credited service: 1.6% of Average Compensation times years of credited service. 2) 12 or more years of credited service: 50% of pay of the highest elected position held prior to retirement.	*Statewide Elected Officials:* 1/24 of pay (of the highest elected position held prior to retirement) times the first 12 years of credited service as a statewide elected official.	*Statewide Elected Officials:* 1/24 of pay (of the highest elected position held prior to retirement) times the first 12 years of credited service as a statewide elected official.
General Employees: 1.6% of Average Compensation times years of credited service. 2.1% of Average Compensation times years of credited service for any period of non-social security covered employment transferred from the Public School Retirement System.	*General Employees:* 1.7% of Average Compensation times years of credited service.	*General Employees:* 1.7% of Average Compensation times years of credited service.
Uniformed Water Patrol: 2.13% of Average Compensation times years of credited service.	Temporary Benefit: If member retires between ages 48 and 62 with age plus credited service equal to 80 or more, a temporary benefit is payable until the attainment of the minimum age at which reduced social security benefits are payable, in the amount of 0.8% of Average Compensation times years of credited service.	Temporary Benefit: If member retires between ages 55 and 62 with age plus credited service equal to 90 or more, a temporary benefit is payable until the attainment of the minimum age at which reduced social security benefits are payable, in the amount of 0.8% of Average Compensation times years of credited service.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
Administrative Law Judges: 50% of Compensation	Non-Social Security Covered Service: 2.5% of Average Compensation times years of credited service for any period of non-social security covered employment transferred from the Public School Retirement System.	Non-Social Security Covered Service: 2.5% of Average Compensation times years of credited service for any period of non-social security covered employment transferred from the Public School Retirement System.
Early retirement for general employees		
Normal retirement amount reduced by ½% for each month that retirement precedes eligibility for normal retirement. 1) Less than 15 years of service: Normal retirement amount actuarially reduced for years younger than age 65. 2) 15 years but less than 20 years of service, and less than the number of years of service necessary for age and service to total 80: Normal retirement amount actuarially reduced for years younger than age 60. 3) 20 or more years of service, but less than the number of years of service necessary for age and service to total 80: Normal retirement amount reduced for years younger than the 80 and out eligibility date.	Normal retirement amount reduced by ½% for each month that retirement precedes eligibility for normal retirement, age 62.	Normal retirement amount reduced by ½% for each month that retirement precedes eligibility for normal retirement, age 67.

<table>
<tr><th>MSEP
(Missouri State Employees' Plan)</th><th>MSEP 2000
(Missouri State Employees' Plan 2000)</th><th>MSEP 2011
(Missouri State Employees' Plan 2011)</th></tr>
<tr><td>

Vested deferred benefits

Benefits for employees who terminate prior to eligibility for an immediate benefit are considered to be vested in accordance with the following schedule (benefits commence at the age the individual would have been eligible for early or normal retirement, considering years of credited service). Unused sick leave is not converted.

<table>
<tr><th>Years of Service</th><th>General Assembly</th><th>Elected Officials</th><th>General Employees</th></tr>
<tr><td>4</td><td></td><td>100%</td><td></td></tr>
<tr><td>5</td><td></td><td></td><td>100%</td></tr>
<tr><td>6*</td><td>100%</td><td></td><td></td></tr>
</table>

*3 Assemblies

Death prior to retirement

The surviving spouse benefit is computed as if the member had been normal retirement age on the date of death and elected the joint and 100% survivor optional form of payment, provided the member had at least 5 years of credited service and was married on the date of death. If no eligible spouse survives, 80% of the member's life income annuity is paid to eligible children until age 21. If the death is duty related, the service requirement is waived and the minimum

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Benefits for employees who terminate prior to eligibility for an immediate benefit are considered to be vested in accordance with the following schedule (benefits commence at age 57 for early retirement or 62 for normal retirement). Unused sick leave is not converted. CURP to MOSERS transfers with 6 years of service are immediately vested.

<table>
<tr><th>Years of Service</th><th>General Assembly</th><th>Elected Officials</th><th>General Employees</th></tr>
<tr><td>4</td><td></td><td>100%</td><td></td></tr>
<tr><td>5</td><td></td><td></td><td>100%</td></tr>
<tr><td>6*</td><td>100%</td><td></td><td></td></tr>
</table>

*3 Assemblies, HB1455 prospectively

The surviving spouse benefit is computed as if the member had been normal retirement age on the date of death and elected the joint and 100% survivor optional form of payment, provided the member had at least 5 years of credited service (3 full assemblies for a member of the General Assembly, 4 years of credited service for a statewide elected official). If no eligible spouse survives, 80% of the member's life income annuity is paid to eligible children until age 21. If the death is duty related, the service requirement is waived

</td><td>

Benefits for employees who terminate prior to eligibility for an immediate benefit are considered to be vested in accordance with the following schedule (benefits commence at age 67 normal retirement). Unused sick leave is not converted.

<table>
<tr><th>Years of Service</th><th>General Assembly</th><th>Elected Officials</th><th>General Employees</th></tr>
<tr><td>4</td><td></td><td>100%</td><td></td></tr>
<tr><td>6*</td><td>100%</td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td><td>100%</td></tr>
</table>

*3 Assemblies, HB1455 prospectively

The surviving spouse benefit is computed as if the member had been normal retirement age on the date of death and elected the joint and 100% survivor optional form of payment, provided the member had at least 5 years of credited service (2 full assemblies for a member of the General Assembly, 4 years of credited service for a statewide elected official). If no eligible spouse survives, 80% of the member's life income annuity is paid to eligible children until age 21. If the death is duty related, the service requirement is waived

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</table>

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
spouse benefit is 50% of Average Compensation (rate of compensation for members of the General Assembly).	and the minimum spouse benefit is 50% of Average Compensation (rate of compensation for members of the General Assembly).	and the minimum spouse benefit is 50% of Average Compensation (rate of compensation for members of the General Assembly).
Death after retirement		
50% of the benefit the retired member was receiving on the date of death (the normal form of payment), or the benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement and provided the member was married on their date of retirement. Effective July 1, 2000, a member who is not married at retirement but marries thereafter may designate a spouse as beneficiary within one year of marriage. Additionally, a member may designate a new spouse as beneficiary within one year of marriage in the event of the death of the spouse the member was married to at the date of retirement (this provision does not apply to period certain annuities).	The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement. A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary within one year of marriage. Additionally, a member may designate a new spouse as beneficiary within one year of marriage in the event of the death of the spouse the member was married to at the date of retirement (this provision does not apply to period certain annuities).	The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement. A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary upon completion of one year of marriage. Additionally, a member may designate a new spouse as beneficiary upon completion of one year of marriage in the event of the death of the spouse the member was married to at the date of retirement (this provision does not apply to period certain annuities).

<table>
<tr><th>MSEP
(Missouri State Employees' Plan)</th><th>MSEP 2000
(Missouri State Employees' Plan 2000)</th><th>MSEP 2011
(Missouri State Employees' Plan 2011)</th></tr>
<tr><td>Disability

Normal retirement benefits become payable at the time the member is eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability (if the member retires on or after August 28, 1999, the member's rate of pay is based on the rate of pay at the time of disability indexed to the time of benefit commencement). An exception is Uniformed Water Patrol employees who are eligible for an immediate occupational disability benefit equal to 50% of pay at time of disability.

Post-retirement benefit adjustments

Benefits are increased to retired members (including survivors) annually in accordance with the following formulas:

<table>
<tr><th>Increase in CPI</th><th>Formula 1 Benefit Increase</th><th>Formula 2 Benefit Increase</th></tr>
<tr><td>5.00% or less</td><td>4%</td><td>80% of CPI increase</td></tr>
<tr><td>5.01% - 6.24%</td><td>80% of CPI increase</td><td>80% of CPI increase</td></tr>
<tr><td>6.25% or more</td><td>5%</td><td>5%</td></tr>
</table>
</td><td>Normal retirement benefits become payable at the time the member is eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability indexed to the time of benefit commencement. The annual percentage increase in the pay used to compute benefits is the lesser of: i) 80% of the CPI increase and ii) 5%.

Benefits are increased to retired members (including survivors) annually in accordance with the following:

Members of the General Assembly:
Benefit is adjusted annually based on the increase in the pay for an active member of the General Assembly.</td><td>Normal retirement benefits become payable at the time the member is eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability indexed to the time of benefit commencement. The annual percentage increase in the pay used to compute benefits is the lesser of: i) 80% of the CPI increase and ii) 5%.

Benefits are increased to retired members (including survivors) annually in accordance with the following:

Members of the General Assembly:
Benefit is adjusted annually based on the increase in the pay for an active member of the General Assembly.</td></tr>
</table>

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
Members first hired prior to August 28, 1997 receive COLAs based on Formula 1 until an aggregate increase of 65% is reached. At that point subsequent COLAs based on Formula 2 are granted. Members first hired on or after August 28, 1997 receive COLAs based solely on Formula 2. Statewide Elected Officials with 12 or more years of service have their benefit adjusted annually based on the increase in the pay for an active statewide elected official in the member's highest elected position. Members who are fully vested and work beyond age 65 will have their monthly benefit increased upon retirement. The percentage increase in benefit is equal to all COLAs for the years between age 65 and date of retirement, not to exceed 65% and counts toward the Formula 1 65% maximum.	*Statewide Elected Officials:* Benefit is adjusted annually based on the increase in the pay for an active statewide elected official in the retired member's highest elected position. *General Employees:* Annual benefit percentage increase equal to the lesser of: i) 80% of the CPI increase, and 5%. CPI: For the basis of determining CPI, the average monthly reported CPI for the prior calendar year is divided by the average monthly reported CPI for the second prior calendar year to determine the current year increases, if any. If this amount is less than one, benefits are not reduced, nor is there any cumulative effect on future years' determination of CPI. Timing of Increase: Benefits are adjusted on the anniversary of the effective date of retirement for most members. Members retiring under the BackDROP provisions have an anniversary based on the retroactive starting date for the BackDROP.	*Statewide Elected Officials:* Benefit is adjusted annually based on the increase in the pay for an active statewide elected official in the retired member's highest elected position. *General Employees:* Annual benefit percentage increase equal to the lesser of: i) 80% of the CPI increase, and 5%. CPI: For the basis of determining CPI, the average monthly reported CPI for the prior calendar year is divided by the average monthly reported CPI for the second prior calendar year to determine the current year increases, if any. If this amount is less than one, benefits are not reduced, nor is there any cumulative effect on future years' determination of CPI. Timing of Increase: Benefits are adjusted on the anniversary of the effective date of retirement. For inactive vested General Employees who enter retirement, the first COLA will not be granted until the second anniversary of the effective date of retirement.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
Pop-up provision		
Benefits to members who choose a survivor form of payment and whose spouse precedes the member in death, will "pop-up" or revert to the amount the member would have received had he/she not elected a survivor option.	Same.	Same.
Portability		
Purchase/Transfer Provisions (in addition to military). Effective August 28, 1999, a member may purchase up to four years of non-federal full-time Missouri public service, provided the member is not vested in another retirement system for that same service.	Purchase/Transfer Provisions (in addition to military). A member may purchase up to four years of non-federal full-time Missouri public service, provided the member is not vested in another retirement system for that same service. Local vested service credit granted after 10 years of state service if the other retirement plan agrees to transfer assets equal to the accrued liability to MOSERS.	May purchase qualifying public sector service at full actuarial cost.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
BackDROP To be eligible to participate in the BackDROP, a member must have been eligible to retire under normal retirement age and/or service conditions for at least two years. A retroactive starting date is established for BackDROP purposes which is the later of: 1) the member's normal retirement date or 2) five years prior to the annuity starting date under the retirement plan selected by the member. A member may elect the BackDROP period for the accumulation of the BackDROP account in 12 month increments prior to their actual retirement date or back to the earliest possible date. This results in a BackDROP period of one to five years depending upon the individual situation. A theoretical BackDROP account is accumulated that includes 90% of the value of the benefit payments that would have been paid during the BackDROP period had the member retired at the retroactive starting date with their respective option election. These payments include applicable post-retirement benefit increases.	Same as MSEP.	Not eligible for the BackDROP.

MSEP (Missouri State Employees' Plan)	MSEP 2000 (Missouri State Employees' Plan 2000)	MSEP 2011 (Missouri State Employees' Plan 2011)
The member is paid the resulting lump sum value of the BackDROP account as of the annuity starting date or as three equal annual installments beginning at the annuity starting date. The annuity benefit payable from the actual retirement date is computed with years of service and average pay as of the retroactive starting date for the BackDROP. Post-retirement benefit increases that occurred during the BackDROP period are applied in the calculation of the monthly annuity.		

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ACTUARIAL METHODS

1. **Calculation of Normal Cost and Actuarial Accrued Liability:** The funding method used to determine the normal cost and actuarial accrued liability was the Entry Age Actuarial Cost Method described below.

   Entry Age Actuarial Cost Method

   Under the entry age normal cost method, the actuarial present value of each member's projected benefit is allocated on a level basis over the member's compensation between the entry age of the member and their assumed exit age. The portion of the actuarial present value allocated to the valuation year is called the normal cost. The actuarial present value of benefits allocated to prior years of service is called the actuarial accrued liability. The unfunded actuarial accrued liability represents the difference between the actuarial accrued liability and the actuarial value of assets as of the valuation date. The unfunded actuarial accrued liability is calculated each year and reflects experience gains/losses.

2. **Calculation of the Actuarial Value of Assets:** Calculation of the Actuarial Value of Assets (AVA): The Board adopted the current asset smoothing method effective with the June 30, 2018 valuation. Under this method, the difference between the actual and assumed investment return on the market value of assets is recognized evenly over a five-year period. No corridor is used with the new method. In addition, the total unrecognized investment experience as of June 30, 2017 will be recognized evenly over a seven-year period beginning June 30, 2018.

3. **Amortization of the Unfunded Actuarial Accrued Liability (UAAL):** Beginning with the June 30, 2018 valuation, the UAAL is amortized using a "layered" approach. Under this method, the "Legacy UAAL", as determined in the June 30, 2018 valuation, is amortized over a closed 30-year period. Subsequent changes in the UAAL due to actuarial gains/losses or assumption changes are separately financed by establishing amortization bases and payments, as a level percentage of payroll, over closed 30-year periods. Any change in the System's benefit structure shall be amortized over a closed period of 20 years, as set out in state statutes. The total UAAL amortization payment is the sum of the payments for each of the amortization bases.

Changes in Methods and Assumptions since the Prior Year

An experience study which analyzed the System's economic assumptions was performed in 2018 and the results were presented to the Board. Below is a summary of the changes to methods and assumptions since the prior year:

- The investment return assumption was lowered from 7.10% to 6.95%.
- The inflation assumption was lowered from 2.35% to 2.25%
- The general wage growth assumption was lowered from 2.60% to 2.50%.
- The payroll growth assumption was lowered from 2.35% to 2.25%.
- The COLA assumption was lowered from 1.88% to 1.80%.

ACTUARIAL ASSUMPTIONS

An experience study which analyzed the System's economic assumptions was performed in 2018 and the results were presented to the Board. The economic assumptions listed below are a result of that experience study. The demographic assumptions are based on an experience study performed in 2015, by the prior actuary. The next experience study is scheduled for 2021.

Economic Assumptions

1. Investment Return — 6.95%, compounded annually, net of investment expenses.

2. Inflation — 2.25% per year

3. Salary Increases — Rates vary by service. Sample rates are as follows:

	Rates by Service			
Years	Inflation	Productivity	Merit	Total
1	2.25%	0.25%	5.75%	8.25%
2	2.25	0.25	2.50	5.00
3	2.25	0.25	1.50	4.00
4	2.25	0.25	1.25	3.75
5	2.25	0.25	1.00	3.50
9	2.25	0.25	0.75	3.25
10	2.25	0.25	0.50	3.00
21+	2.25	0.25	0.25	2.75

General Assembly members have a flat 2.50% assumption

4. Payroll Growth — 2.25% per year

5. Cost-of-Living Adjustment (COLA) — 4.00% on a compounded basis when a minimum COLA of 4.00% is in effect.

   1.80% on a compounded basis when no minimum COLA is in effect.

6. Interest on Member Contributions — 1.50% per year

7. Administrative Expenses — Actual prior year expenses, included in normal cost rate.

Demographic Assumptions

1. Mortality — The mortality assumption includes an appropriate level of conservatism that reflects expected future mortality improvement.

   a. Post-retirement — RP-2014 Healthy Annuitant mortality table, projected from 2006 to 2026 with Scale MP-2015 and scaled by 120%

   b. Pre-retirement — RP-2014 Employee mortality table, projected from 2006 to 2026 with Scale MP-2015 and scaled by 95% for males and 90% for females

   c. Long-term disability — RP-2014 Disabled mortality table, projected from 2006 to 2026 with Scale MP-2015 and scaled by 95% for males and 90% for females

2. Retirement Assumption

Normal Retirement					Early Retirement		
	MSEP and MSEP 2000*			MSEP 2011**		MSEP and MSEP 2000	MSEP 2011
Retirement Age	Percent Retiring			Percent Retiring	Retirement Age	Percent Retiring	Percent Retiring
	1st Year	2nd Year	3rd Year				
48	20 %						
49	20	10 %					
50	20	10	21 %				
51	20	10	21				
52	20	10	21				
53	20	10	21				
54	20	10	21				
55	20	10	21	45 %			
56	20	10	21	45			
57	20	10	21	35	57	2.4 %	
58	20	10	21	35	58	3.1	
59	20	10	21	30	59	3.0	
60	20	10	21	35	60	5.1	
61	19	10	21	25	61	6.0	
62	18	22	29	40	62	6.0	10 %
63	16	18	24	30	63	6.0	10
64	15	17	17	20	64	6.0	10
65	19	19	27	30	65		50
66	24	25	28	25	66		50
67	10	25	23	20	67		
68	20	25	23	20	68		
69	20	25	23	20	69		
70	20	25	23	20	70		
71	20	25	23	20	71		
72	20	25	23	20	72		
73	20	25	23	20	73		
74	20	25	23	20	74		
75	50	50	23	50	75		
76	50	50	23	50	76		
77	75	75	23	75	77		
78	100	100	100	100	78		

** For members hired prior to January 1, 2011.*
*** For members hired on or after January 1, 2011.*

3. Termination From Active Employment

Sample Age	Years of Service	Percent of Active Members Separating within the Next Year: Termination** Males	Termination** Females	Death* Males	Death* Females	Disability Males	Disability Females
	0-1	24.0 %	27.5 %				
	1-2	19.0	21.5				
	2-3	15.5	16.3				
	3-4	13.3	13.5				
	4-5	11.2	11.3				
25	5+	13.5 %	14.0 %	0.03 %	0.01%	0.10 %	0.10 %
30		10.6	11.0	0.03	0.02	0.10	0.10
35		8.2	8.5	0.04	0.03	0.10	0.10
40		5.8	6.0	0.05	0.03	0.36	0.36
45		4.3	4.5	0.07	0.05	0.41	0.41
50		2.9	3.0	0.13	0.08	0.57	0.57
55		2.9	3.0	0.22	0.14	0.77	0.77
60		2.9	3.0	0.40	0.20	1.02	1.02
65		2.9	3.0	0.70	0.30	1.23	1.23
70		2.9	3.0	1.17	0.50	1.23	1.23

** The pre-retirement mortality table used was the RP-2014 Employee mortality table, projected from 2006 to 2026 with Scale MP-2015 and scaled by 95% for males and 90% for females. 2% of the deaths in active service are assumed to be duty related.*

*** Does not apply to Elected Officials and Legislators.*

Elected Officials and Legislators

Years of Service	Percent of Active Members Separating within the Next Year: Termination Male/Female
0-1	8.0 %
1-2	8.0
2-3	8.0
3-4	8.0
4-5	12.0
5-6	12.0
6-7	12.0
7+	35.0

Other Assumptions

1. Form of Payment

   MSEP – 50% joint and survivor
   MSEP 2000 and MSEP 2011 – Straight life annuity

2. Marital Status

   a. Percent married

      70% married at retirement, 60% of those dying in active service are married

   b. Spouse's age

      Females assumed to be three years younger than males.

3. Pay Increase Timing

   Beginning of the fiscal year.

4. Decrement Timing

   Decrements of all types are assumed to occur mid-year.

5. Eligibility Testing

   Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.

6. Benefit Service

   Exact fractional service is used to determine the amount of the benefit payable.

7. Decrement Relativity

   Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects.

8. Decrement Operation

   Disability and withdrawal do not operate during normal retirement eligibility.

9. Other Liability Adjustments

   Pre-Retirement Survivor Benefits for Spouse of Terminated Vested Member

Age	Male/Female
<30	1.57/1.31
30-39	1.24/1.13
40-49	1.09/1.05
>50	1.02/1.01

   These factors are used to estimate the cost of immediate unreduced survivor annuities upon the death of a vested member.

10. Incidence of Contributions

    Contributions are assumed to be received continuously throughout the year based upon the computed percent of payroll shown in this report, and the actual payroll payable at the time contributions are made. New entrant normal cost

	contributions are applied to the funding of new entrant benefits.
11. MSEP 2000 Election	All regular state employees hired on or before June 30, 2000 are assumed to elect MSEP 2000 prior to age 62 and MSEP on or after age 62. Elected Officials, General Assembly, and Uniformed Water Patrol Members hired before July 1, 2000 are assumed to elect MSEP at retirement.
12. Service Adjustment	It is assumed that each member will be granted 8 months of service credit, 4 months for unused leave upon retirement and 4 months for military service purchases. For members hired on or after January 1, 2011 it is assumed that each member will be granted 5 months for unused leave.
13. Forfeitures	MSEP - For those hired on or after January 1, 2011, 50% of state employees terminating at first vesting eligibility are assumed to take a refund and forfeit their deferred pension. This percentage decreases to 0% at first retirement eligibility.
14. Salary and Benefit Limits	For purposes of the valuation, no limits were applied to member compensation or benefits.
15. Commencement age for deferred vested benefit	Normal Retirement Date

Data Adjustments

Active and retired member data was reported as of May 31, 2020. It was brought forward to June 30, 2020 by adding one month of service for all active members, one month of contributions and interest for MSEP 2011 members, and the June COLA for certain retired members. Financial information continues to be reported as of June 30. This procedure was instituted to provide sufficient time for the Board of Trustees to certify the appropriate contribution rate prior to the October 1 statutory deadline.

Active members reported with less than a $100 annualized salary were assumed to receive the average active member pay.

When the option of choosing plans is available, terminated vested members are reported with two records, one with benefits under the MSEP plan and one with benefits under the MSEP 2000 plan. Because it is unknown what the member will elect at retirement, both records are valued and the plan that produces the higher present value of future benefits is used for valuation purposes.

For any retired member who has elected a joint and survivor benefit yet has no beneficiary date of birth provided, it was assumed that the beneficiary is 3 years younger for male retirees and 3 years older for female retirees.

For members reported with no gender, the member is assumed to be male.

Due to limitations in our valuation program, members who are not eligible for normal retirement prior to age 85 had their date of birth adjusted.

TECHNICAL VALUATION PROCEDURES

Other Valuation Procedures

Salary increases are assumed to apply to annual amounts.

Decrements are assumed to occur mid-year, except that immediate retirement is assumed for those who are at or above the age at which retirement rates are 100%. Standard adjustments are made for multiple decrements.

No actuarial liability is included for participants who terminated without being vested prior to the valuation date, except those due a refund of contributions.

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Actuarial Accrued Liability	The difference between the actuarial present value of system benefits and the actuarial value of future normal costs. Also referred to as "accrued liability" or "actuarial liability".
Actuarial Assumptions	Estimates of future experience with respect to rates of mortality, disability, turnover, retirement, rate or rates of investment income and salary increases. Decrement assumptions (rates of mortality, disability, turnover and retirement) are generally based on past experience, often modified for projected changes in conditions. Economic assumptions (salary increases and investment income) consist of an underlying rate in an inflation-free environment plus a provision for a long-term average rate of inflation.
Accrued Service	Service credited under the system which was rendered before the date of the actuarial valuation.
Actuarial Equivalent	A single amount or series of amounts of equal actuarial value to another single amount or series of amounts, computed on the basis of appropriate assumptions.
Actuarial Cost Method	A mathematical budgeting procedure for allocating the dollar amount of the actuarial present value of retirement system benefit between future normal cost and actuarial accrued liability. Sometimes referred to as the "actuarial funding method".
Experience Gain (Loss)	The difference between actual experience and actuarial assumptions anticipated experience during the period between two actuarial valuation dates.
Actuarial Present Value	The amount of funds currently required to provide a payment or series of payments in the future. It is determined by discounting future payments at predetermined rates of interest and by probabilities of payment.
Amortization	Paying off an interest-discounted amount with periodic payments of interest and principal, as opposed to paying off with lump sum payment.
Normal Cost	The actuarial present value of retirement system benefits allocated to the current year by the actuarial cost method.
Unfunded Actuarial Accrued Liability	The difference between actuarial accrued liability and the valuation assets. Sometimes referred to as "unfunded actuarial liability" or "unfunded accrued liability". Most retirement systems have unfunded actuarial accrued liability. They arise each time new benefits are added and each time an actuarial loss is realized.

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