Defined Benefit Program of the California State Teachers' Retirement System

June 30, 2018 Actuarial Valuation

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April 23, 2019

Teachers' Retirement Board
California State Teachers' Retirement System

Re: **Defined Benefit Program Actuarial Valuation as of June 30, 2018**

Dear Members of the Board:

At your request, we have performed an actuarial valuation of the Defined Benefit (DB) Program of the State Teachers' Retirement Plan as of June 30, 2018. The major findings of the actuarial valuation are contained in the following report, which reflects the benefit provisions and contribution rates in effect as of the valuation date. This report satisfies all basic disclosure requirements under the Model Disclosure Elements for Actuarial Valuation Reports recommended by the California Actuarial Advisory Panel.

Actuarial Certification

To the best of our knowledge and belief, this report is complete and accurate and contains sufficient information to fairly disclose the funded condition of the DB Program as of June 30, 2018.

CalSTRS funding is based on complex legislation. This valuation contains analysis based on our understanding of the relevant law based on our experience working with CalSTRS and other large public retirement systems and has been augmented by consultation with CalSTRS staff.

In preparing this report, we relied, without audit, on information (some oral and some in writing) supplied by CalSTRS staff. This information includes, but is not limited to, statutory provisions, employee data, and financial information. In our examination of these data, we have found them to be reasonably consistent and comparable with data used for other purposes. 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.

All costs, liabilities, rates of interest, and other factors for CalSTRS have been determined on the basis of actuarial assumptions and methods which are individually reasonable (taking into account the experience of CalSTRS and reasonable expectations) and which, in combination, offer a reasonable estimate of anticipated experience affecting CalSTRS. Further, in our opinion, each actuarial assumption used is reasonably related to the experience of CalSTRS and to reasonable expectations which, in combination, represent a reasonable estimate of anticipated experience.

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 Teachers' Retirement Board has sole authority to determine the actuarial assumptions and methods used for the valuation of the DB Program. The board adopted the actuarial methods and assumptions used in the 2018 valuation.

Actuarial computations presented in this report are for purposes of assessing the funding levels of CalSTRS and calculating contribution rates under CalSTRS valuation policy. The calculations in the enclosed report have been made on a basis consistent with our understanding of CalSTRS funding structure. Determinations for other purposes, such as for financial reporting in accordance with GASB standards, may be significantly different from the results contained in this report. Accordingly, additional determinations may be needed for other purposes.

This valuation report is only an estimate of the System's financial condition as of a single date. It can neither predict the System's future condition nor guarantee future financial soundness. Actuarial valuations do not affect the ultimate cost of System benefits, only the timing of System contributions. While the valuation is based on an array of individually reasonable assumptions, other assumption sets may also be reasonable and valuation results based on those assumptions would be different. No one set of assumptions is uniquely correct. Determining results using alternative assumptions is outside the scope of our engagement.

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The consultants who worked on this assignment are retirement actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

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, including the relevant Actuarial Standards of Practice. We are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

We would like to express our appreciation to the CalSTRS staff who gave substantial assistance in supplying the data on which this report is based.

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

Sincerely,

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Consulting Actuary

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Julie D. Smith, FSA, EA, MAAA
Consulting Actuary

April 23, 2019
Date

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1. Summary of the Findings

The primary purpose of the actuarial valuation is to calculate the contribution rates for members, employers, and the state and analyze the sufficiency of these future contributions to meet the current and future obligations of the DB Program. By using the actuarial methods and assumptions adopted by the Teachers' Retirement Board (TRB), this actuarial valuation provides a reasonable estimate of the long-term financing of the DB Program. The assumptions and methods were adopted at the February 2017 TRB meeting, and there have been no changes in them since the last valuation.

Under the board's valuation policy, an increase to the state supplemental contribution rate beginning July 2019 has been calculated. For the employer contribution rate, adjustments will be effective with the 2020 valuation for the fiscal year beginning July 2021. Note that the contribution rates calculated in this valuation are based on the relevant provisions of the Education Code and the board's valuation policy and are not necessarily our opinion of what the funding level should be; however, we note that CalSTRS is projected to make progress, albeit slow progress in the short term, toward paying off the Unfunded Actuarial Obligation (UAO).

The key findings of this actuarial valuation are:

- The **Funded Ratio** increased from 62.6% to 64.0% primarily due to an actual investment return for the prior fiscal year of approximately 9.0% which exceeded the 7.0% assumed return, as well as the reflection of a portion of prior investment gains in the asset smoothing calculation.
- An increase in the **state supplemental contribution rate** of 0.500% of payroll to 5.811% of payroll has been calculated for the fiscal year beginning July 1, 2019 pursuant to the valuation policy. This increase is the maximum increment allowed under the Education Code. Current projections show increases in the state supplemental contribution rate will be needed for three additional years, assuming all actuarial assumptions are met.
- The **employer supplemental contribution rate** for the fiscal year beginning July 1, 2019 increases to 9.88% of payroll (currently 8.03%) as required by the Education Code, which specifies a fixed schedule of contribution increases until 2021.
- Based on this 2018 valuation, no change in the CalSTRS 2% at 62 **member contribution rate** is required for the fiscal year beginning July 1, 2019. The member contribution rate for 2% at 60 members is fixed in the Education Code, so no change is required for this group, either.

Note the governor's proposed 2019-20 budget (January, 2019) includes additional contributions for CalSTRS and some short-term shifting of contributions between the state and the employers. For purposes of this valuation, we have only reflected the contribution rates currently specified in the Education Code.

Contribution Rates

The 2014 legislation added three subsections to the Education Code which address contribution rates. EC §22955.1 specifies graded increases in the supplemental state contribution rates. Effective with the 2016 valuation, the board has the authority to annually adjust the state contribution rate for years through June 30, 2046, so that the rate is sufficient to amortize the UAO attributable to the 1990 contribution and benefit structure. However, the maximum increase in a given year is limited to 0.5% of payroll.

EC §22950.5 specifies graded increases in the employer supplemental contribution rate. Effective July 1, 2021, the employer supplemental contribution rate will be adjusted annually based on the contribution rate necessary to amortize the UAO attributable to service prior to July 1, 2014 that is not funded by the state as part of the 1990 Benefit Structure.

The 2% at 60 member rate is fixed at 10.25% of pay. The 2% at 62 member rate, currently 10.205% of pay, can vary depending on the calculated Normal Cost Rate as discussed later in this section.

The following table shows a summary of the contribution rates currently being paid (2018-19 fiscal year) and those to be paid next year (2019-20 fiscal year) under the valuation policy.

Source of Revenue	2018 Valuation FY 19-20 Rate	2017 Valuation FY 18-19 Rate
Employers – Base Rate	8.000 %	8.000 %
Employers – Sick Leave	0.250	0.250
Employers – Supplemental Rate	9.880	8.030
Employers – Total Rate	**18.130**	**16.280**
State – Base Rate	2.017 %	2.017 %
State – Supplemental Rate[(1)]	5.811	5.311
State – Total DB Program	**7.828**	**7.328**
State – SBMA Rate[(2)]	2.500	2.500
State – Total Contribution to CalSTRS	**10.328**	**9.828**
Members – 2% at 60	10.250 %	10.250 %
Members – 2% at 62	10.205	10.205

1. Calculated based on valuation policy and subject to board adoption.

2. The state contribution to fund the Supplemental Benefit Maintenance Account (SBMA) is reduced by $72 million each fiscal year.

State Supplemental Contribution Rate

For the 2018 valuation, an increase in the state supplemental contribution rate under EC §22955.1 has been calculated. The following table shows a numerical breakdown of each of the factors that caused the increase in the unconstrained (i.e., prior to the application of the minimum supplemental rate and the maximum increase) state supplemental contribution rate. The actual calculation is limited to a 0.5% increase over the prior year and cannot be less than 4.311% until the 1990 UAO has been fully paid off.

Sources of Change	Theoretical Unconstrained State Supplemental Rate
June 30, 2017 Actuarial Valuation	**8.21%**
Expected Year-to-Year Change	0.16%
Recognized Asset (Gain) / Loss	
• From Prior Years	-0.26%
• From Current Year	-0.14%
Salary / Payroll Variation	
• Salary Increase < Assumed	-0.29%
• Payroll Increase < Assumed	0.05%
All Other Sources	0.08%
Total Change	**-0.40%**
June 30, 2018 Actuarial Valuation	**7.81%** (1)

1. Calculated rate is 5.811% due to application of maximum increase.

An **increase to the state supplemental contribution rate to 5.811%** effective July 1, 2019 has been calculated based on the board's valuation policy. For the current fiscal year, the state contribution rate is 5.311%, so the calculated rate for the next fiscal year represents the maximum increase allowed of 0.5% of payroll. We have shown details of the calculation of the state supplemental contribution rate in Section 6 of this report. These calculations are based on the smoothed actuarial value of assets. As shown later in this section (see "Looking Ahead"), when the deferred asset gain as of June 30, 2018 and other factors are reflected in the projected contribution rates, the total state DB Program contribution rate is projected to increase to about 9.2% (2.017% base contribution rate plus 7.2% supplemental contribution rate). In addition, the state contributes approximately 2.5% of payroll to the Supplemental Benefits Maintenance Account (SBMA).

Employer Supplemental Contribution Rate

Consistent with the Education Code, the 2018 valuation does not calculate changes in the employer supplemental contribution rate. Increases in this rate are fixed for the next two years. Effective with the 2020 valuation, we will calculate the change in the employer supplemental contribution rate starting July 1, 2021. For illustrative purposes, we have shown details of how this calculation will look in Section 7 of this report.

UAO for New Benefits, Post-2014 Service

The funding legislation included actuarial funding (within certain constraints) for most of the benefits provided by CalSTRS. The one exception is that there is no provision for the state, employers, or members to fund any UAO arising for New Benefits (i.e., those not included in the 1990 Benefit Structure) attributable to service after

June 30, 2014. We will refer to this as the "Unallocated UAO". Under the valuation policy, a portion of each year's total contributions, equal to the Normal Cost of the New Benefits, is allocated to fund these benefits. Since the contribution is equal to the Normal Cost, there are no remaining contributions to pay down the Unallocated UAO. Therefore, the Unallocated UAO will increase or decrease based on future experience.

The following table shows how the Unallocated UAO (based on assets at market value) has evolved over time. The primary cause of the decrease this year was the actual return being in excess of the assumed return for the fiscal year ending June 30, 2018. Because of the leveraged nature of the Unallocated UAO calculation and the fact the value is reported on a market value basis, the decrease was relatively large. In addition, positive experience also reduced the Unallocated UAO. As of June 30, 2018, the Unallocated UAO is small relative to the total UAO, as it only reflects service accrued for four years. However, as members continue to accrue benefits for service after June 30, 2014, there is the potential for the Unallocated UAO to increase (or decrease) significantly if actual experience differs materially from that assumed or if further changes in assumptions occur.

($ Millions)	Unallocated UAO[(1)]	Uallocated UAO as % of Payroll
2014 Valuation	$ 0	0.0%
2015 Valuation	213	0.7%
2016 Valuation	639	2.0%
2017 Valuation	369	1.1%
2018 Valuation	65	0.2%

1. The Unallocated UAO is calculated using the market value of assets. It is currently $298 million based on the actuarial value of assets.

As previously discussed, there is currently no dedicated funding to pay off the Unallocated UAO. If the Unallocated UAO were to be funded on an actuarial basis with a June 30, 2046 target date, an additional 0.04% of payroll would be required effective July 1, 2019.

Normal Cost Rate for CalSTRS 2% at 62 Members

As part of the annual valuation process, the Normal Cost Rate is calculated for CalSTRS 2% at 62 members, generally those first hired on or after January 1, 2013. The Normal Cost Rate is used as the basis for setting the base member contribution rate for this group for the following fiscal year, the fiscal year beginning July 1, 2019, for this valuation. Generally, the base member contribution rate is one-half of the Normal Cost Rate, within certain parameters.

EC §22901(b)(1) requires the board to adopt the Normal Cost Rate that is used to determine the 2% at 62 member contribution rate. As of June 30, 2018, the Normal Cost Rate for the CalSTRS 2% at 62 members is 17.863%. We recommend the board adopt this rate.

EC §22901(b)(2) specifies that the CalSTRS 2% at 62 base member contribution rate does not change if the increase or decrease in the Normal Cost Rate for members is less than 1% of creditable compensation since the last adjustment. This year, the cumulative change is a decrease in the Normal Cost Rate of 0.030%, from 17.893% (the time of the last adjustment) to 17.863% for this group. Therefore, the current base member contribution rate should remain at 9.00% for 2% at 62 members based on the relevant section of the Education Code.

Note that under EC §22901.7(b) 1.205% of pay is added to the base member rate. Therefore, **as of July 1, 2019, the total member contribution rate for 2% at 62 members continues to be 10.205%** (9.00% plus the 1.205% additional contribution rate).

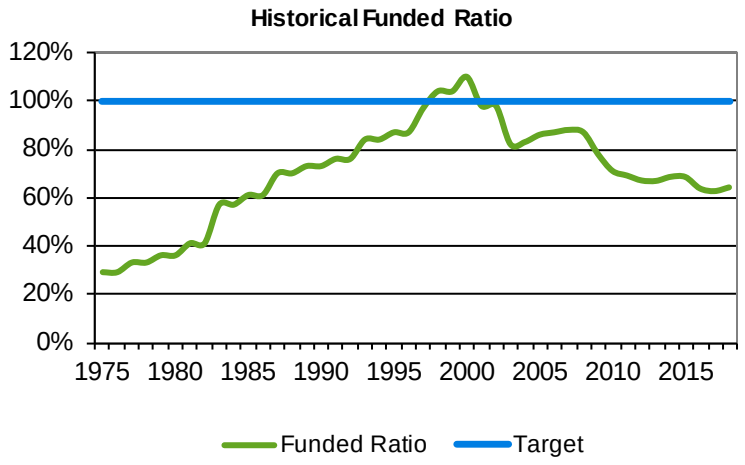
Funding Progress

The UAO of a retirement plan is equal to the difference between its Actuarial Value of Assets and its Actuarial Obligation. The Funded Ratio is equal to the Actuarial Value of Assets divided by the Actuarial Obligation.

($ Millions)	2018 Valuation	2017 Valuation
Actuarial Obligation	$ 297,603	$ 286,950
Actuarial Value of Assets	190,451	179,689
Unfunded Actuarial Obligation	$ 107,152	$ 107,261
Funded Ratio	64.0%	62.6%

The $107.2 billion UAO compares to a projected June 30, 2018 value of $111.1 billion based on the prior valuation. The primary reasons for the decrease in the UAO and the increase in the Funded Ratio are salary increases less than assumed and actuarial asset gains recognized from the current and prior years. Additional discussion of the contributing factors in this change can be found in Section 5 under Actuarial Gains and Losses.

The following graph shows a historical perspective of the Funded Ratio for CalSTRS.

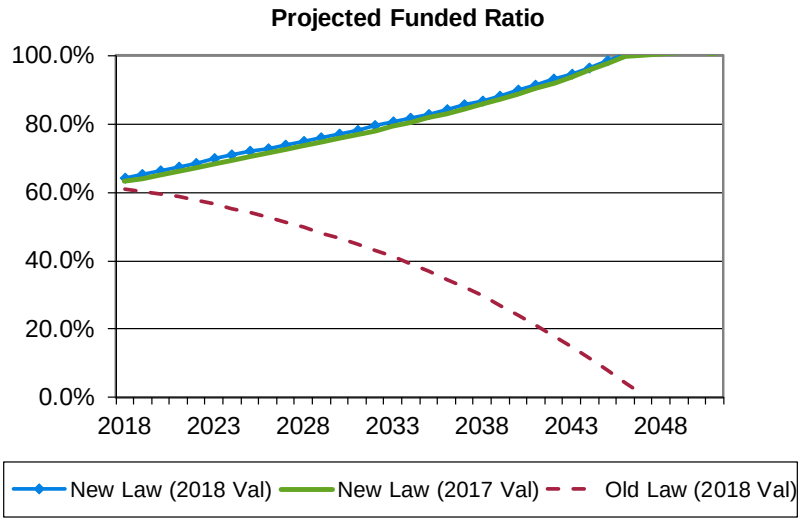


The table below shows the factors that affected the DB Program's Funded Ratio since the last valuation. As previously discussed, the primary reasons for the increase in the Funded Ratio are salary increases less than assumed and actuarial asset gains recognized from the current and prior years.

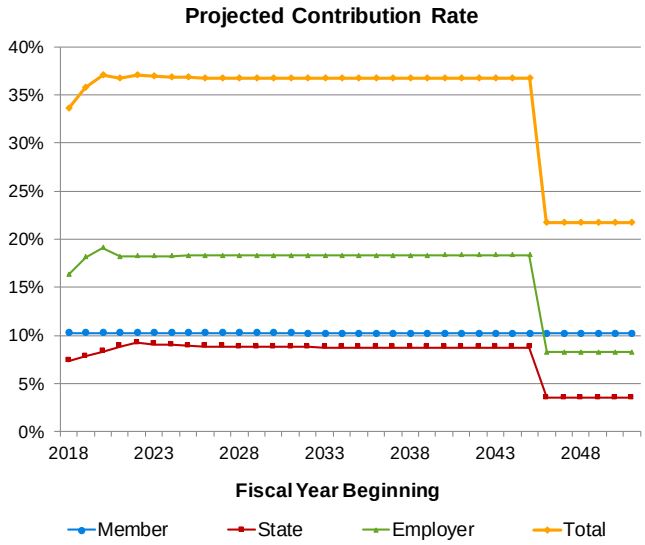
Sources of Change	Funded Ratio
June 30, 2017 Actuarial Valuation	**62.6%**
Expected Year-to-Year Change	0.2%
Recognized Asset Gain/(Loss)	
• From Prior Years	0.5%
• From Current Year	0.4%
Salary Variation	0.4%
All Other Sources	-0.1%
Total Change	**1.4%**
June 30, 2018 Actuarial Valuation	**64.0%**

Looking Ahead

The following projection shows the Funded Ratio if the DB Program earns 7.00% in each future year and all other assumptions are met. As shown in the graph, the DB Program is projected to reach approximately 100% funding by 2046 based on the 2018 valuation (blue line). The Funded Ratio is slightly higher than projected in the 2017 valuation (green line), primarily due to the actual return for the prior year which was greater than assumed. Note that we have also shown a hypothetical projection of the funded status based on the 2018 valuation but without the 2014 funding legislation (red line). See the end of this subsection for a summary of the assumptions on which these projections are based.



The following graph shows the projected contribution rates for each of the stakeholder groups and in total. Note that the actual contribution rates paid in the future will vary based on experience after the valuation date. The contribution rates shown include both the base and supplemental contribution rates, but do not reflect the state contribution to the Supplemental Benefit Maintenance Account (SBMA).



Asset gains and losses will generally have the largest year-to-year impact on the total contribution rates needed, although assumption changes can cause a significant change in years when they occur. Under the legislation, as reflected in the valuation policy, the impact of asset gains and losses will tend to have a much more significant impact on the state contribution rate than the employer contribution rate. Therefore, the state contribution rate will tend to be more volatile than the employer rate, as shown in the following section ("Projections Under Alternate Return Scenarios").

The above projection calculations are based on the following assumptions:

- All experience subsequent to the valuation date is consistent with the valuation assumptions, as described in Appendix B.
- Future changes in the state and employer supplemental contribution rates will be consistent with the board's valuation policy. In particular, the state rate is based on funding the UAO by 2046, a year which is not defined in statute.
- Current deferred asset gains and losses (currently a net deferred gain) are reflected as they are expected to be recognized in the asset smoothing method.
- The projection assumes new members will have the same Normal Cost Rate as the current 2% at 62 members. The emerging Normal Cost Rate for the total plan will gradually decrease over time due to the lower benefits provided for 2% at 62 members.

Projections Under Alternate Return Scenarios

Actuarial valuations are based on a certain set of assumptions. The reality is that these assumptions will not be exactly met and that this will affect future valuation results. Investment returns will likely have the biggest impact on the future funding of CalSTRS. In the following graphs, we show some simple examples of the future variation

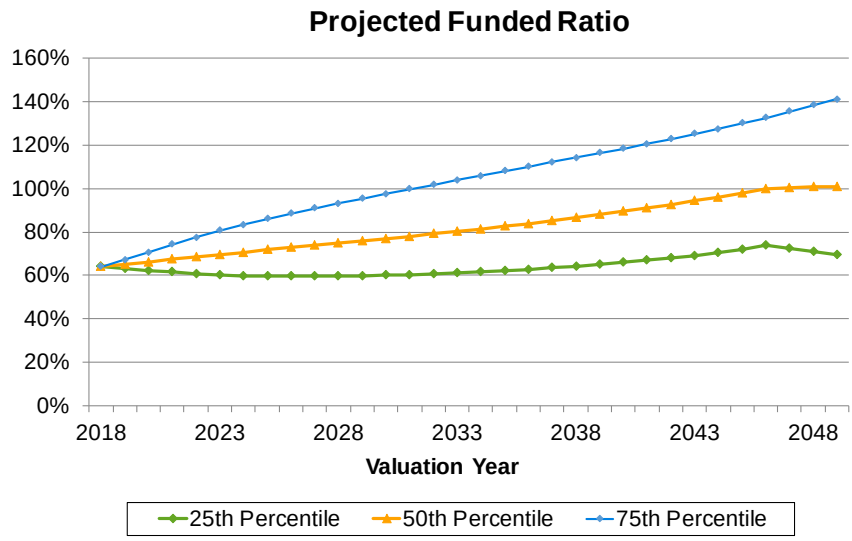
that may occur on key funding metrics. This is not intended to be a comprehensive analysis of the potential risks to CalSTRS funding, but it will give the board some idea of the sensitivity of funding levels and contribution rates caused by returns that are above or below the assumption.

Each fall, CalSTRS internal actuarial staff completes a rather comprehensive analysis of potential risks to future DB Program funding levels ("Review of Funding Level and Risks"). The update for the 2018 valuation is scheduled to be presented at the November 2019 board meeting.

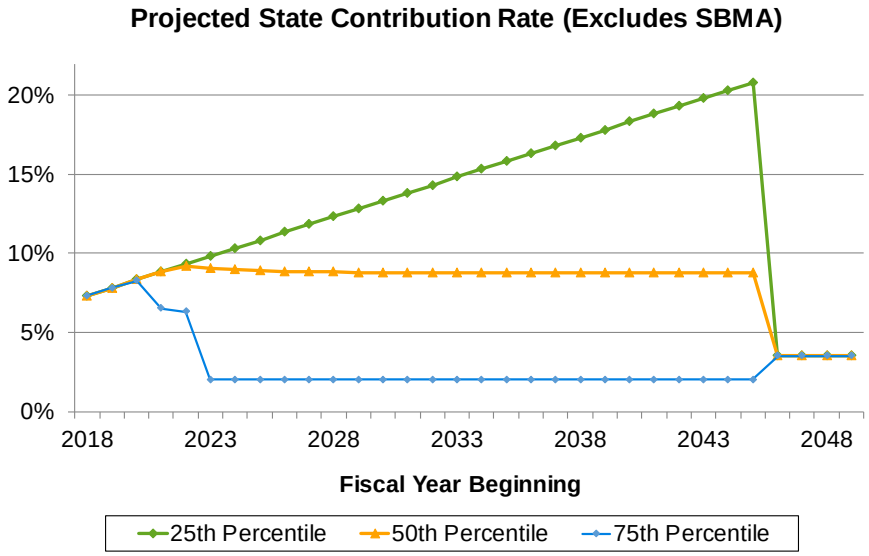
To show potential variability of future returns, we have assumed CalSTRS earns the 25th, 50th, and 75th percentile returns over the next 30 years. This assumes a median (50th percentile) geometric return of 7.0% and a standard deviation of 13.0%. The average 30-year returns shown for the 30-year period are approximately 5.5% for the 25th percentile and 8.5% for the 75th percentile.

Note that the 25th percentile indicates there is a 25% probability of earning a return lower than 5.5%. This may be different than the way investment professionals use percentiles, but we have used this approach for consistency with the way CalSTRS actuarial staff reports percentiles in their risk report.

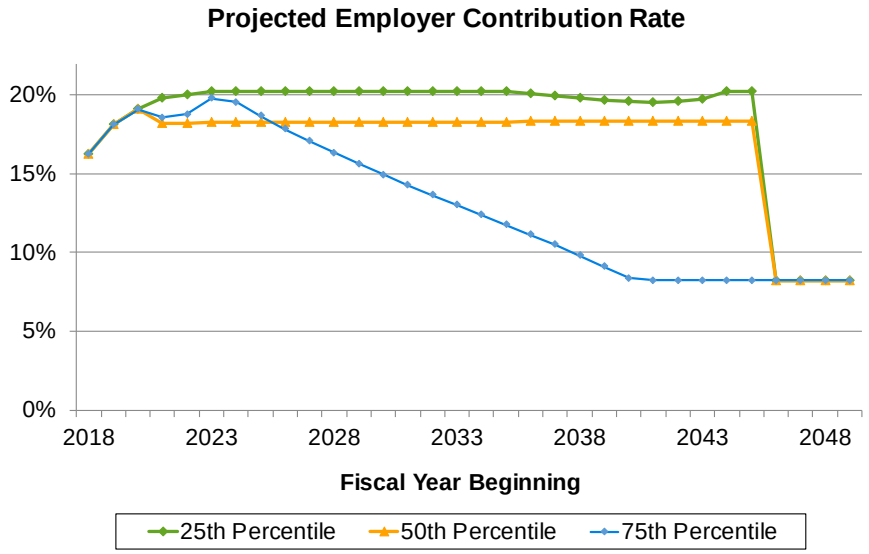
The following graph shows the potential impact of alternate returns on CalSTRS Funded Ratio. The green line (below average returns) illustrates how the caps on contribution rate increases restrict CalSTRS ability to make significant progress toward its funding goal when the Funded Ratio is low.



The following graph shows the potential impact of alternate returns on the state contribution rate (excluding contributions to the SBMA). The state's contribution rate is quite sensitive to future returns, although the 0.5% cap on increases prevents large year-over-year increases. It should be noted that minimizing the year-over-year increases defers these costs and ultimately results in a higher ultimate contribution level than if the full increase needed was implemented in the following fiscal year.



The following graph shows the potential impact of varying returns on the employer contribution rate. The employer contribution rate is not as sensitive to future returns as the state contribution rate, although returns can still have a significant impact. Note that the green line reflects the 12.00% cap on the employer supplemental contribution rate (20.25% total).



Member rates are not affected by future returns; however, the 2% at 62 member contributions may be affected by changes in the investment return assumption or other assumption changes.

Further Information

Details of our findings are included in later sections of this report. The appendices include supporting documentation on the benefit and eligibility provisions used to project future benefits, the actuarial methods and assumptions used to value the projected benefits, and the underlying census data provided by CalSTRS for this valuation.

Summary of Key Valuation Results

	2018 Valuation	2017 Valuation	Percent Change
1. Total Membership			
A. Active Members	449,595	445,935	0.8 %
B. Inactive Members	198,058	192,601	2.8 %
C. Retired Members and Beneficiaries	301,859	294,874	2.4 %
D. Total Membership	949,512	933,410	1.7 %
2. Payroll as of Valuation Date (All Members)			
A. Annual Total *($Millions)*	$ 31,884	$ 31,136	2.4 %
B. Annual Average Earned Salary per Active Member	$ 70,918	$ 69,822	1.6 %
3. Average Annual Allowance Payable			
A. Service Retirement	$ 49,032	$ 47,820	2.5 %
4. Actuarial Obligation *($Millions)*			
A. Active Members	$ 130,051	$ 126,326	2.9 %
B. Inactive Members	6,333	6,006	5.4 %
C. Retired Members and Beneficiaries	160,932	154,304	4.3 %
D. Existing MPPP Unfunded Obligation	287	314	(8.6) %
E. Total	$ 297,603	$ 286,950	3.7 %
5. Value of System Assets *($Millions)*			
A. Fair Market Value	$ 211,367	$ 197,718	6.9 %
B. Deferred Investment (Gains) or Losses	(5,160)	(3,793)	
C. Actuarial Value	$ 206,207	$ 193,925	6.3 %
D. Ratio of Actuarial Value to Fair Value	98%	98%	
E. Less SBMA Reserve	(15,756)	(14,236)	10.7 %
F. Net Actuarial Value	$ 190,451	$ 179,689	6.0 %
6. Funded Status -- Actuarial Value Basis			
A. Unfunded Actuarial Obligation *($Millions)*	$ 107,152	$ 107,261	(0.1) %
B. Funded Ratio *(5F ÷ 4E)*	64.0%	62.6%	
7. Normal Cost Rates *(percent of salaries)*			
A. CalSTRS 2% at 60 Members	20.557%	20.566%	(0.0) %
B. CalSTRS 2% at 62 Members	17.863%	17.893%	(0.2) %
C. All Members	20.181%	20.275%	(0.5) %
8. Next Fiscal Year Contribution Rates (percent of salaries)			
A. 2% at 60 Members	10.250%	10.250%	- %
B. 2% at 62 Members	10.205%	10.205%	- %
C. State Supplemental Rate	5.811%	5.311%	9.4 %
D. Employer Supplemental Rate	9.880%	8.030%	23.0 %
9. Funded Status -- Market Value Basis			
A. Unfunded Actuarial Obligation *($Millions) [4E - (5A + 5E)]*	$ 101,992	$ 103,468	(1.4) %
B. Alternate Funded Ratio (Based on Market Value of Assets)	65.7%	63.9%	

2. Scope of the Report

This report presents the actuarial valuation of the DB Program of the State Teachers' Retirement Plan as of June 30, 2018. A summary of the key results of this valuation is presented in the previous section. The remainder of this report is arranged as follows:

Section 3 describes the benefit obligations of CalSTRS, including the development of the Normal Cost and the Actuarial Obligation.

Section 4 outlines the Fair Market Value of Assets of the DB Program and the determination of the Actuarial Value of Assets as of June 30, 2018. All of the assets of the Program are available to finance future DB Program benefits and expenses, except those allocated for the Supplemental Benefit Maintenance Account (SBMA).

Section 5 shows the relationship between the Actuarial Value of Assets and the Actuarial Obligation, also called the Funded Ratio.

Section 6 discusses the calculations used to determine the state supplemental contribution rate in accordance with EC §22955.1(b). The key elements of this calculation pertain to an evaluation of the assets and obligations associated with the benefits in effect in 1990. An adjustment to the state supplemental rate is calculated based on this valuation and effective with the fiscal year beginning July 1, 2019.

Section 7 discusses the calculations used to determine the employer supplemental contribution rate in accordance with EC §22950.5. The key elements of this calculation are parallel to the funding valuation, except the assets and obligations are those associated with the benefits earned prior to July 1, 2014. Note that the employer supplemental rate is currently based on a fixed schedule of increases. No adjustments to the scheduled rates will be calculated until the 2020 valuation.

Section 8 shows the projected UAO payment schedule and a comparison of the projected contributions and benefit payments for the DB Program.

Section 9 provides a general discussion of the potential risks to CalSTRS funding.

This report includes several appendices:

Appendix A is a summary of the current benefit structure, as determined by the provisions of governing law on June 30, 2018.

Appendix B is a summary of the actuarial methods and assumptions used to estimate actuarial obligations and the funding sufficiency.

In our opinion, the assumptions used in the valuation are reasonably related to the past experience of the DB Program, are internally consistent, and represent a reasonable estimate of future conditions affecting the DB Program. Nevertheless, the emerging costs of the DB Program will vary from those presented in this report to the extent that actual experience differs from that projected by the actuarial assumptions.

Appendix C includes schedules of valuation data classified by various categories of plan members. We relied upon the membership and beneficiary data supplied by CalSTRS. We compared the data for this and the prior valuation and tested for reasonableness. Based on these tests, we believe the data to be sufficient for the purposes of our calculations.

Appendix D is a glossary of actuarial terms used in this report.

3. Actuarial Obligation

In this section, the discussion will focus on the commitments of CalSTRS for retirement benefits, which are referred to as its Actuarial Obligation. The Actuarial Obligation, or liabilities, are compared with the actuarial value of assets. If there is a deficiency, it has to be provided by future contributions, net actuarial gains due to experience more favorable than assumed or, to some extent, net growth in the number of active members. An actuarial valuation method sets out a schedule of future contributions and determines whether they will amortize any deficiency in an orderly fashion.

Normal Cost

The **Normal Cost** represents the cost assigned to an average member for a given year such that it would meet the continuing costs of a particular benefit if contributed each year starting with the date of membership. The Entry Age Actuarial Cost Method is designed to produce a Normal Cost that remains a level percentage of payroll (payroll is calculated as the sum of the expected creditable compensation for the active members) and is expressed as a rate of compensation. Normal Cost contributions are assumed to be contributed uniformly throughout the year.

The following table shows that the total DB Program Normal Cost Rate has decreased from 20.275% to 20.181% since the last valuation. This rate represents a blended average of the Normal Cost Rates for the 2% at 60 and 2% at 62 members. **Table 1** provides more details on the calculation of the Normal Cost and Normal Cost Rate.

($ Millions)	Projected Payroll	Normal Cost	Normal Cost Rate
FYB July 1, 2017	$32,670	$6,624	20.275%
FYB July 1, 2018	$33,387	$6,738	20.181%

In general, the Normal Cost Rate is expected to remain fairly stable as a percentage of payroll as long as the benefit provisions are not amended, the assumptions are not changed, membership experience emerges as assumed, and the demographic characteristics of the membership remain reasonably consistent. CalSTRS can expect modest decreases in the Normal Cost Rate as current members leave active employment and are replaced by new members with lower benefit levels. The Normal Cost Rate decreased slightly since last year mainly due to the increasing membership of CalSTRS 2% at 62 members who have a lower overall Normal Cost Rate than the 2% at 60 members. We expect this trend to continue in the future.

Primarily because of the different benefit formulas, the CalSTRS 2% at 60 members have different Normal Cost Rates compared to the 2% at 62 members, as illustrated in the following table for the fiscal year beginning July 1, 2018.

($ Millions)	2% at 60 Members	2% at 62 Members	Proportion 2% at 62
Projected Payroll	$29,089	$4,298	12.9%
Normal Cost $	5,970	768	11.4%
Normal Cost Rate	20.557%	17.863%	NA

Normal Cost Rate for CalSTRS 2% at 62 Members

As part of the annual valuation process, we determine the Normal Cost Rate for CalSTRS 2% at 62 members, generally those first hired on or after January 1, 2013. The Normal Cost Rate is used as the basis for setting the base member contribution rate for this group for the following fiscal year, the fiscal year beginning July 1, 2019, for this valuation. Generally, the base member contribution rate is one-half of the Normal Cost Rate within certain parameters.

EC §22901(b)(1) requires the board to adopt the Normal Cost Rate that is used to determine the 2% at 62 member contribution rate. As of June 30, 2018, the Normal Cost Rate for the CalSTRS 2% at 62 members is 17.863%. We recommend the board adopt this rate.

EC §22901(b)(2) specifies that the CalSTRS 2% at 62 base member contribution rate does not change if the increase or decrease in the Normal Cost Rate for members is less than 1% of creditable compensation since the last adjustment. This year, the cumulative change is a decrease in the Normal Cost Rate of 0.030%, from 17.893% (the time of the last adjustment) to 17.863% for this group. Therefore, the current base member contribution rate should remain at 9.00% for 2% at 62 members based on the relevant section of the Education Code.

Note that increases under EC §22901.7(b) are added to the base member rate. Therefore, effective July 1, 2019, the total member contribution rate for 2% at 62 members continues to be 10.205% (9.00% plus the 1.205% additional contribution rate rate).

Actuarial Obligation

The next step in the actuarial valuation process is to project all future DB Program benefit payments for current members and retirees. The level of benefits currently being paid is known, but assumptions are needed to estimate how long they will be paid, and the amount and timing of the payment of future benefits for active and inactive members who are not currently receiving payments. The summation of the discounted values of all of the projected benefit payments for all current members at the assumed rate of return is called the **Actuarial Present Value of Projected Benefits**.

Details are shown in **Table 2** and summarized below.

($ Millions)	2018 Valuation	2017 Valuation
Benefits Being Paid	$ 160,932	$ 154,304
Inactive Deferred Benefits	6,333	6,006
Active Member Benefits	206,841	201,730
Existing MPPP Unfunded Obligation	287	314
Present Value of Projected Benefits	$ 374,393	$ 362,354
Present Value of Future Normal Costs	76,790	75,404
Actuarial Obligation	$ 297,603	$ 286,950

The **Actuarial Present Value of Future Normal Costs** is the value of all remaining Normal Costs expected to be received over the future working lifetime of current active members. The **Actuarial Obligation** is the difference between the Actuarial Present Value of Projected Benefits and the Actuarial Present Value of Future Normal Costs. The Actuarial Obligation is equal to the assets that would exist if the current Normal Cost Rate had been paid for all members since entry into the Program, and if all experience had emerged as assumed.

Over time, 2% at 62 members will account for a larger portion of the Actuarial Obligation; however, as of this valuation, only 1.8% of the Actuarial Obligation for active members is for the 2% at 62 members.

($ Millions)	2% at 60 Members	2% at 62 Members	Proportion 2% at 62
Active PVB	$189,675	$17,166	8.3%
Active PVFNC	61,918	14,872	19.4%
Active AO	$127,757	$2,294	1.8%

Table 1
Normal Cost

($Millions)	2018	2017
Estimated Annual Earned Salaries [1]	$31,871	$31,502
Present Value of Future Normal Costs for Current Active Members	$76,790	$75,404
Present Value of Future Earned Salaries for Current Active Members	$387,081	$377,098
Normal Cost		
Service Retirement	$5,711	$5,685
Deferred Retirement & Refund	406	390
Death	47	49
Disability	268	263
Total Normal Cost	$6,432	$6,387
Normal Cost Rate Percent of Payroll		
Service Retirement	17.919 %	18.046 %
Deferred Retirement & Refund	1.274	1.238
Death	0.147	0.156
Disability	0.841	0.835
Total Normal Cost	**20.181** %	**20.275** %

1. Annual payroll for active members on the valuation date, excluding active members over age 75 on the valuation date who are assumed to retire immediately and therefore do not generate a Normal Cost.

Table 2
Actuarial Obligation

($ Millions)	2018	2017
Present Value of Projected Benefits to All Current Members		
Benefits Currently Being Paid		
Service Retirement	$ 149,184	$ 143,042
Disability	3,905	3,803
Survivors	7,843	7,459
Total	$ 160,932	$ 154,304
Benefits to Inactive Members	6,333	6,006
Benefits to Active Members		
Retirement	$ 195,185	$ 190,580
Disability	5,621	5,347
Death	1,148	1,119
Deferred Retirement & Refund	4,887	4,684
Total	$ 206,841	$ 201,730
Existing MPPP Unfunded Obligation	287	314
Total Present Value of Projected Benefits	$ 374,393	$ 362,354
Present Value of Future Normal Costs	76,790	75,404
Actuarial Obligation	**$ 297,603**	**$ 286,950**

4. Valuation Assets

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, 2018. On that date, the assets available for the payment of retirement benefits are appraised.

The next step in the valuation process is to calculate the **Actuarial Value of Assets** that will be used to determine the funding status of the Program. As shown in **Table 3**, the Fair Market Value of assets was reported as $211,367 million as of June 30, 2018, up from $197,718 million as of June 30, 2017. **Table 4** shows the asset changes for the period.

Valuation Assets

Because the underlying calculations in the actuarial valuation are long term in nature, it may be advantageous to use an asset smoothing method to lessen the impact of short-term fluctuations in the value of assets. This is particularly true given that the supplemental state and employer contribution rates are determined based on the applicable funded status.

The asset smoothing method utilized in the valuation uses a projection of the expected Actuarial Value of Assets from the Actuarial Value of Assets as of the previous year based on the assumed rate of investment return and the net cash flow during the year. The projection then recognizes one-third of the difference between the expected value and the Fair Market Value as of the valuation date to arrive at the Actuarial Value of Assets. The calculation of the Actuarial Value of Assets is shown in **Table 5** and the result is shown below.

($ Millions)	2018 Valuation	2017 Valuation
Fair Market Value	$ 211,367	$ 197,718
Actuarial Value of Assets	206,207	193,925
Deferred Investment Gains or (Losses)	$ 5,160	$ 3,793
Ratio of AVA to FMV	97.6%	98.1%

Due to the asset smoothing method, there are investment gains of $5,160 million that have not yet been recognized (the difference between the Actuarial and Fair Market Value of Assets). Absent investment returns in future years less than the assumed rate to offset the deferred investment gains, the current deferred gains will gradually be reflected in the Actuarial Value of Assets.

If the future returns on the Fair Market Value of Assets are 7.00% each year, then as the current deferred gains flow through the smoothing method and are recognized, future valuations will show an actuarial gain. The result will be a gradual increase in the DB Program's funded status, ultimately decreasing the UAO by the $5,160 million of currently deferred investment gains.

Table 6 shows a history of the Actuarial Value of Assets compared to the Fair Market Value of Assets.

Table 3
Statement of Program Assets

($ Millions)	June 30, 2018	June 30, 2017
Invested Assets		
Cash	$ 404	$ 688
Debt Securities	41,288	38,856
Equity Securities	108,286	106,402
Alternative Investments	62,046	52,830
Derivative Instruments	29	-
Total Investments	$ 212,053	$ 198,776
Receivables	6,235	5,928
Liabilities Net of Securities Lending Collateral	(6,979)	(7,057)
Net Deferred (Inflows) and Outflows	58	71
Fair Market Value of Net Assets	**$ 211,367**	**$ 197,718**

Table 4
Statement of Changes in Program Assets

($ Millions)	June 30, 2018	June 30, 2017
Contributions		
Members	$ 3,345	$ 3,300
Employers	4,705	4,021
State of California	2,797	2,478
Total Contributions	10,847	9,799
Benefits and Expenses		
Retirement, Death and Survivors	(13,855)	(13,226)
Refunds of Member Contributions	(75)	(88)
Purchasing Power Benefits	(162)	(161)
Administrative & Other Expenses	(205)	(180)
Total Benefits and Expenses	(14,297)	(13,655)
Net Cash Flow	**$ (3,450)**	**$ (3,856)**
Investment Income		
Realized Income	$ 5,350	$ 4,951
Net Appreciation	12,549	18,912
Net Securities Lending Income	49	98
Investment Expenses	(473)	(373)
Other (Expense) Income	104	72
Net Investment Return	17,579	23,660
Net Increase (Decrease)	**$ 14,129**	**$ 19,804**
Fair Market Value of Net Assets		
Beginning of Year	197,718	177,914
Acounting Adjustments (GASB 75)	(480)	-
Prior Year Fair Value Accrual Adjustment	-	-
End of Year	**$ 211,367**	**$ 197,718**
Estimated Net Rate of Return [1]	9.0%	13.4%

1. Estimated return on an Fair-Market-Value basis, net of all investment expenses, gross of administrative expenses, and assuming uniform cash flow throughout the year. This number may differ from the money-weighted return reported by CalSTRS.

Table 5
Actuarial Value of Assets

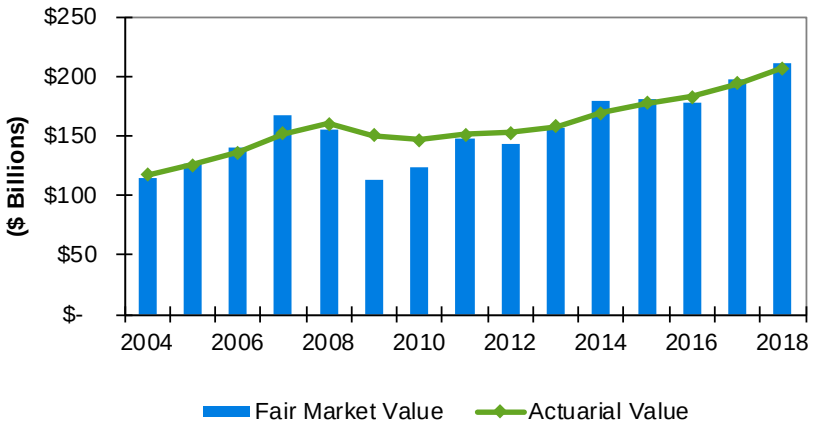
($ Millions)	June 30, 2018	June 30, 2017
Actuarial Value at Beginning of Year	$ 193,445	$ 182,772
Contributions	10,847	9,799
Benefits	(14,092)	(13,655)
Expected Return at 7.0% / 7.25%	13,427	13,112
Expected Actuarial Value End of of Year	$ 203,627	$ 192,028
Fair Market Value	211,367	197,718
Difference between Fair Market Value and Expected Actuarial Value	$ 7,740	$ 5,690
Recognition Factor	One-third	One-third
Recognized Gain or Loss	$ 2,580	$ 1,897
Actuarial Value at End of of Year	**$ 206,207**	**$ 193,925**
Deferred Investment Gains or (Losses)	$ 5,160	$ 3,793
Ratio of Actuarial Value of Assets to Fair Market Value of Assets	97.559%	98.082%
Estimated Net Rate of Return [1]	8.3%	6.1%

1. Estimated return on an Actuarial-Value basis, net of all investment expenses, gross of administrative expenses, and assuming uniform cash flow throughout the year.

Table 6
History of Actuarial Value of Assets

($ Millions) June 30	Fair Market Value	Estimated Return [1]	Actuarial Value	Ratio of Actuarial to Market
2001	$ 102,915	(9.1) %	$ 108,571	105%
2002	96,028	(6.1)	109,755	114
2003	99,031	3.8	111,604	113
2004	113,815	16.6	117,206	103
2005	126,447	12.3	125,665	99
2006	140,192	12.5	135,832	97
2007	166,903	20.9	151,827	91
2008	155,763	(5.5)	159,785	103
2009	113,192	(25.4)	150,445	133
2010	123,242	12.9	146,404	119
2011	147,140	23.6	151,030	103
2012	143,118	0.6	152,515	107
2013	157,176	13.9	157,883	100
2014	179,479	18.6	168,838	94
2015	180,633	3.9	177,059	98
2016	177,914	1.3	182,772	103
2017	197,718	13.4	193,925	98
2018	211,367	9.0	206,207	98

1. Estimated return on an Fair-Value basis, net of all investment expenses, gross of administrative expenses, and assuming uniform cash flow throughout the year, reported on a dollar-weighted basis.



5. Funded Status

The **Unfunded Actuarial Obligation** (UAO) is the excess of the Actuarial Obligation over the Actuarial Value of Assets, which represents a liability that must be funded over time. Contributions in excess of the Normal Cost are used to amortize the UAO. An **Actuarial Surplus** exists if the Actuarial Value of Assets exceeds the Actuarial Obligation.

The **Funded Ratio** is equal to the Actuarial Value of Assets divided by the Actuarial Obligation. A Funded Ratio of 100% means the Value of Assets equals the Actuarial Obligation, and the DB Program could be financed by contributions equal to the Normal Cost, if all future experience emerged as assumed. The Funded Ratio is shown below and in **Table 7**.

($ Millions)	2018 Valuation	2017 Valuation
Actuarial Obligation	$ 297,603	$ 286,950
Actuarial Value of Assets (AVA)		
From Table 5	$ 206,207	$ 193,925
Less SBMA Reserve	(15,756)	(14,236)
Net for Funding	190,451	179,689
Unfunded Actuarial Obligation	$ 107,152	$ 107,261
Funded Ratio (on AVA)	**64.0%**	**62.6%**
Alternate Funded Ratio (based on Fair Market Value)	*65.7%*	*63.9%*

The Funded Ratio increased by 1.4% during the past year and has decreased by approximately 23% over the past 10 years. The return on the Actuarial Value of Assets (8.3%) that exceeded the assumed return (7.0%) was the primary cause of the increase in the Funded Ratio from last year. The longer-term decrease has been primarily due to a combination of returns over the last 10 years that have, on a smoothed basis, been less than the actuarial assumption, contributions less than the actuarially calculated amount, and changes in the actuarial assumptions that have increased the Actuarial Obligation. The Alternate Funded Ratio using the Fair Market Value of assets has increased since the last valuation. This increase is due to the greater than expected return on assets during the 2017-2018 fiscal year.

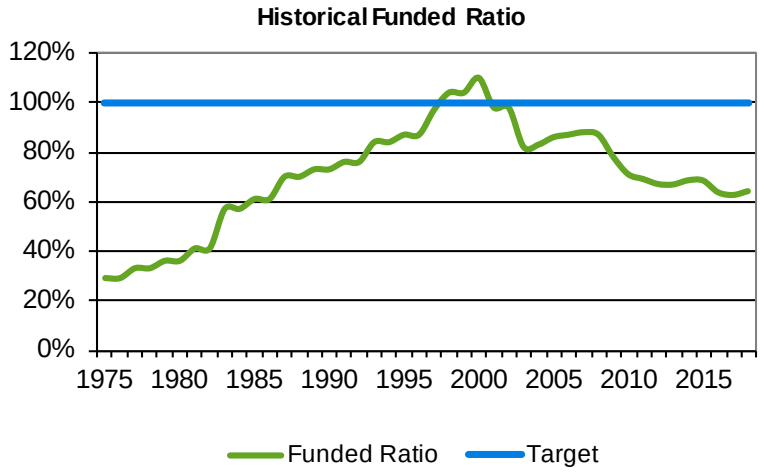
Future benefits provided through the Supplemental Benefits Maintenance Account (SBMA) are not part of the projected benefits included in this valuation. Therefore, the SBMA Reserve is subtracted from the DB Program assets to arrive at the value available to support the benefits included in this valuation.

In addition, the Teachers' Retirement Board has established a policy of allocating funds for future costs associated with the Teachers' Health Benefits Fund (THBF). This policy was revised in April of 2009 to make a one-time credit to the THBF and "true up" the future MPPP obligations (payable from the THBF) in the funding of the DB Program. As of June 30, 2018, only a relatively small amount to cover monthly payments resides in the THBF, while the remaining unfunded amount of $287 million is added to the DB Program obligation.

The following table shows a history of the Funded Status of the DB Program.

($ Millions) Year	Actuarial Obligation	Actuarial Value of Assets	Unfunded Actuarial Obligation	Funded Ratio
1975	**$ 12,834**	**$ 3,775**	**$ 9,059**	**29%**
1977	15,203	5,019	10,184	33%
1979	17,971	6,488	11,483	36%
1981	22,545	9,345	13,200	41%
1983	26,553	15,023	11,530	57%
1985	**28,401**	**17,457**	**10,944**	**61%**
1987	34,637	24,401	10,236	70%
1989	40,266	29,327	10,939	73%
1991	47,100	36,001	11,099	76%
1993	53,581	45,212	8,369	84%
1995	**63,391**	**55,207**	**8,184**	**87%**
1997	69,852	67,980	1,872	97%
1998	74,234	77,290	(3,056)	104%
1999	86,349	90,001	(3,652)	104%
2000	93,124	102,225	(9,101)	110%
2001	109,881	107,654	2,227	98%
2003	131,777	108,667	23,110	82%
2004	138,254	114,094	24,160	83%
2005	**142,193**	**121,882**	**20,311**	**86%**
2006	150,872	131,237	19,635	87%
2007	167,129	146,419	20,710	88%
2008	177,734	155,215	22,519	87%
2009	185,683	145,142	40,541	78%
2010	196,315	140,291	56,024	71%
2011	208,405	143,930	64,475	69%
2012	215,189	144,232	70,957	67%
2013	222,281	148,614	73,667	67%
2014	231,213	158,495	72,718	69%
2015	**241,753**	**165,553**	**76,200**	**69%**
2016	266,704	169,976	96,728	64%
2017	286,950	179,689	107,261	63%
2018	297,603	190,451	107,152	64%

The historical Funded Ratios are shown on the following graph. In years in which a valuation was not performed, the Funded Ratio from the previous year is used.



Actuarial Gains and Losses

Comparing the UAO as of two valuation dates does not provide enough information to determine whether there were actuarial gains or losses. The correct comparison is between the UAO on the valuation date and the expected UAO projected from the prior valuation date using the actuarial assumptions in effect since the previous valuation.

The actuarial gains and losses since the last report are summarized in the following tables and shown in **Table 8**.

($ Millions)	Expected Results	Actual Results	(Gain) or Loss
Actuarial Obligation	$ 299,465	$ 297,603	$ (1,862)
Act. Value of Assets	188,320	190,451	(2,131)
Unfunded Act. Oblig.	$ 111,145	$ 107,152	$ (3,993)
Actuarial (Gains) or Losses by Source			
Change in actuarial assumptions			$ 0
Salaries increased less than assumed			(2,099)
All other non-investment sources			237
(Gain) on the Actuarial Obligation			$ (1,862)
Investment Return on Actuarial Value of Assets			(2,100)
Contributions (in excess of) or less than assumed			(31)
(Gain) on the Actuarial Value of Assets			$ (2,131)
Total Actuarial (Gain)			$ (3,993)

($ Millions) Actuarial (Gains) or Losses on the Actuarial Obligation	(Gain) or Loss	Percent of Actuarial Obligation
Change in actuarial assumptions	$ 0	0.0%
Salaries increased less than assumed	(2,099)	(0.7)
All other non-investment sources	237	0.1
(Gain) or Loss on the Actuarial Obligation	$ (1,862)	(0.6)%
Actuarial (Gains) or Losses on the Actuarial Value of Assets	**(Gain) or Loss**	**Percent of AVA**
Return on Actuarial Value of Assets	$ (2,100)	(1.1)%
Contributions (greater)/less than assumed	(31)	(0.0)
(Gain) or Loss on the Actuarial Value of Assets	$ (2,131)	(1.1)%

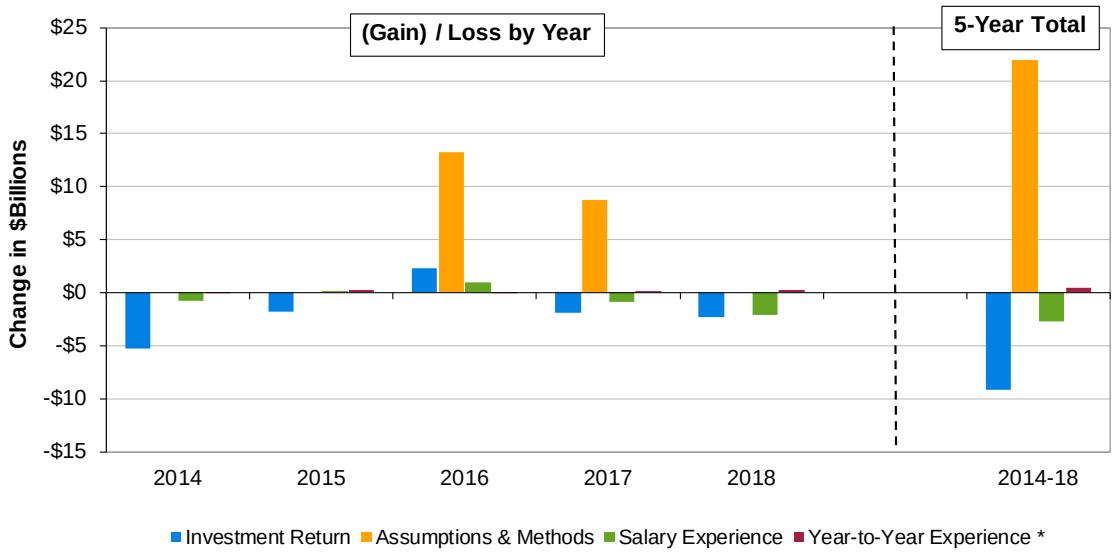
These net gains and losses are within a reasonable range for variances in a single year.

Based on the 2017 Actuarial Valuation, the UAO was expected to increase to $111,145 million. The actual UAO of $107,152 million represents a net actuarial gain of $3,993 million.

- Salaries increased less than projected by the current actuarial assumptions, causing the Actuarial Obligation to decrease by $2,099 million from the expected amount. We expect to continue to see salary increase fluctuations from year to year.
- All other non-investment experience represents only a relatively small portion of the expected Actuarial Obligation. These relatively minor net gains and losses indicate that the census is reasonably consistent from the prior period, and the actual experience tracked closely overall with the actuarial assumptions (exclusive of the asset return and salary increases)
- On the asset side, there was an asset gain based on both the actuarial value of assets and the Market Value of Assets, as the investment return on the Fair Market Value of Assets was greater than the prior valuation's 7.00% assumption. The return on market value was estimated at 9.0%, while the return on the Actuarial Value of Assets was less (estimated at 8.3%) due to recognizing only a portion of the current year actuarial investment gain.

Actuarial Gain and Loss History

To get an idea of the overall trend of gains and losses, we have analyzed actuarial gains and losses since 2014. The following graph shows how changes in assumptions have increased the UAO over the last five years. It also shows the actuarial investment gains that have somewhat offset this.



** Year-to-Year Experience includes changes due to Termination, Retirement, Mortality, and Other Experience.*

Over the last five years, assumptions changes have increased the UAO by over $20 billion. During that period, investment returns that have generally exceeded the assumed return and salary increases that have generally been less than assumed have caused decreases in the UAO, partially offsetting the increase due to assumptions. All other experience has had a relatively small impact.

Note that the UAO has increased by approximately $33 billion over the last 5 years. This compares to the net effect of actuarial gains and losses (including assumption changes) described above which account for approximately $11 billion of the increase in UAO. The remaining $22 billion increase is due to contributions received by CalSTRS that were less than the actuarially calculated rate. These contributions were insufficient to cover the interest on the UAO resulting in an increase in the UAO. Under the new funding law, the contributions are projected to eventually cover the interest on the UAO and reduce the principal, but this is not projected to occur for a few more years due to the graded increases in the state and employer contribution rates. Based on the baseline projections included in this report, the UAO is projected to start declining in 2027 and be lower than the current value by the year 2031.

Table 7
Funded Status

($ Millions)	2018	2017
Actuarial Obligation *(Table 2)*	$297,603	$286,950
Actuarial Value of Assets		
Calculated *(Table 5)*	$ 206,207	$ 193,925
Less SBMA Reserve	(15,756)	(14,236)
Program Assets	$ 190,451	$ 179,689
Unfunded Actuarial Obligation	**$ 107,152**	**$ 107,261**
Funded Ratio	**64.0%**	**62.6%**

Table 8
Actuarial Gains and Losses

($ Millions)	Expected	Actual	(Gain) / Loss
Actuarial Obligation			
Actuarial Obligation June 30, 2017	$286,950		
Normal Cost for 2017-2018	6,611		
Benefits Paid (Excludes Purchasing Power)	(13,930)		
Expected Interest at 7.00%	19,835		
Actuarial Obligation June 30, 2018	**$299,465**	**$297,603**	**$ (1,862)**
By Source:			
Change in actuarial assumptions			*0*
Retiree Mortality			*(115)*
Active Member Mortality			*84*
Service Retirements			*164*
Disability Retirement			*(3)*
Other Terminations of Employment			*211*
Salary increases more / (less) than assumed			*(2,099)*
All Other Non-investment Sources			*(104)*
Total (Gain) Loss on the Actuarial Obligation			*$ (1,862)*
Actuarial Value of Assets			
Actuarial Value of Assets June 30, 2017	$179,689		
Expected Contributions for 2017-2018	10,116		
Benefits Paid (Excludes Purchasing Power)	(13,930)		
Expected Interest at 7.00% on AVA	12,444		
Actuarial Value of Assets June 30, 2018	**$188,319**	**$190,451**	**$ (2,132)**
By Source: Investment Return on Actuarial Value of Assets (including the recognition of prior deferred investment gains and losses)			*$ (2,101)*
Contributions (in excess of) or less than assumed (including service purchases)			*(31)*
Total (Gain) Loss on the Actuarial Value of Assets			*$ (2,132)*
Unfunded Actuarial Obligation	**$111,145**	**$107,152**	**$(3,993)**

6. State Supplemental Contribution Rate

Under EC §22955.1(b), scheduled increases in the state contribution rate were required through June 30, 2017, with subsequent adjustments to the contribution rate based on actuarial funding. We will refer to this contribution as the state supplemental contribution. Note that for the state, the payroll is the second prior fiscal year payroll, so contributions made in fiscal year 2019-2020 will be based on the covered member compensation for fiscal year 2017-2018. The state supplemental rate is in addition to the base state contribution under EC §22955.1(a) of 2.017% of payroll and contributions to fund the SBMA under EC §22954.

Effective July 1, 2017, the board shall increase or decrease the state supplemental contribution rate (within certain parameters) to reflect the contribution required to eliminate the remaining UAO associated with the 1990 benefit and contribution rate structure. This will be referred to as the 1990 UAO. State supplemental contributions are included as part of the 1990 UAO. Although not specified in the law, the board's valuation policy calls for the state supplemental contribution rate to be calculated to amortize the UAO by June 30, 2046.

Changes in the state supplemental contribution are determined annually beginning with the 2016 valuation and subject to the following conditions:

- The state supplemental contribution rate cannot increase by more than 0.5% of payroll over the prior year supplemental rate. There is no limit on decreases, except for the 4.311% floor discussed below.
- In any year when there is no UAO for the 1990 Benefit Structure, the supplemental contribution shall be reduced to zero.
- The state supplemental contribution rate shall not be reduced below 4.311% if a UAO for the 1990 Benefit Structure exists.

The state is contributing at 5.311% of pay for the current fiscal year ending June 30, 2019. In accordance with the valuation policy, this rate is increased to 5.811% for the next fiscal year as discussed in this section.

1990 Unfunded Actuarial Obligation

The 1990 Actuarial Obligation for the DB Program is calculated using the benefit provisions in place during 1990. CalSTRS provides us with supplementary information on the census data for this determination. The process has limitations since we do not know, for example, whether members would have retired earlier or later if the post-1990 benefit enhancements had not been enacted. However, we believe it is a reasonable process to estimate what the Actuarial Obligation would be if only the 1990 benefits were currently in place.

There were no benefit improvements enacted between 1990 and 1998 that had a material cost. All benefit enhancements enacted with effective dates from July 1, 1990 to December 31, 1998 have been presumed to be cost-neutral. Due to the enhanced retirement benefits enacted since 1990, a separate set of retirement probabilities is used to evaluate the 1990 Benefit Structure.

The Actuarial Obligation related to the 1990 Benefit Structure is $243.9 billion. This compares to the Actuarial Obligation for the DB Program of $297.6 billion.

($ Millions)	2018 Valuation	2017 Valuation
Actuarial Obligation -- 1990 Benefit Structure		
Value of Projected Benefits	$ 311,968	$ 300,895
Value of Future Normal Costs	68,092	66,249
Actuarial Obligation	$ 243,876	$ 234,646

To estimate the portion of the Actuarial Value of Assets associated with the 1990 Actuarial Obligation, the current Actuarial Value of Assets for the DB Program are adjusted for 1) contributions started after September 30, 1998 (excluding the state supplemental contributions under 22955.1(b)) as detailed below, and 2) additional benefits that have been paid over time due to the post-1990 benefit increases. Limitations exist with this approach since precise data regarding the portion or the timing of benefit payments that would be attributable to only the 1990 benefit structure is unknown.

The most significant adjustments to the assets are:

- Eliminating contributions in excess of 16.00% (except for the state supplemental contributions),
- Adding back the member contributions that were directed to the DBS Program,
- Adding back the post-1990 benefit enhancements that have been paid, and
- Adjusting for actual investment return.

See **Table 9** for the details of the asset adjustment.

($ Millions)	2018 Valuation	2017 Valuation
Asset Adjustment -- 1990 Benefit Structure		
Actuarial Value for DB Program	$ 190,451	$ 179,689
Adjustments per Table 9	20,039	19,616
Actuarial Value of Assets	$ 210,490	$ 199,305

For purposes of testing the funding sufficiency of the 1990 Benefit Structure, note that we did not reserve the board's allocation of assets for future THBF costs because it was established subsequent to 1990.

The following table summarizes the Funded Status of the 1990 Benefit Structure as detailed in **Table 10**. The 1990 Benefit Structure has an actuarial deficit equal to the UAO of $33.4 billion.

($ Millions)	2018 Valuation	2017 Valuation
Funded Status -- 1990 Benefit Structure		
Actuarial Obligation	$ 243,876	$ 234,646
Actuarial Value of Assets	210,490	199,305
Unfunded Actuarial Obligation	$ 33,386	$ 35,341
Funded Ratio	86.3%	84.9%

State Supplemental Contributions

The statute calls for an adjustment to the state supplemental contribution to amortize the 1990 UAO effective with the 2016 and later actuarial valuations. An increase in the state supplemental contribution rate is needed effective July 1, 2019.

As shown in **Table 10**, a supplemental contribution rate of 7.815% of payroll is needed to amortize the 1990 UAO by June 30, 2046 based on the board's current valuation policy. This is based on an unconstrained increase of about 2.5% of payroll from the current supplemental rate of 5.311%. However, increases in the state contribution rate are limited to 0.5%. Therefore, the state supplemental contribution rate for the fiscal year beginning July 1, 2019 should be 5.811% under EC §22955.1(b). Note that the 7.815% is based on the Actuarial Value of Assets, so it does not reflect the future recognition of currently deferred asset gains and losses, and therefore differs from the projection shown in the "Looking Ahead" subsection of Section 1.

The funded status of the 1990 Benefit Structure in future years is difficult to forecast because the Actuarial Value of Assets for the 1990 Benefit Structure includes adjustments for contributions and benefits paid in excess of those that were in place in 1990. The benefits paid may also vary considerably depending on demographic experience.

Actuarial Gains and Losses

Similar to the total DB Program, we perform a comparison for the 1990 Benefit Structure between the UAO on the valuation date and the Expected UAO projected from the prior valuation date using the actuarial assumptions in effect since the previous valuation.

The actuarial gains and losses since the last report for the 1990 Benefit Structure are summarized in the following table. Note that projected payroll used in the 1990 Actuarial Obligation is fractionally different than in the calculation of the total Actuarial Obligation because the retirement assumption used in the calculations differ.

($ Millions)	Expected Results	Actual Results	(Gain) or Loss
Actuarial Obligation	$ 244,825	$ 243,876	$ (949)
Act. Value of Assets	208,169	210,490	(2,321)
Unfunded Act. Oblig.	$ 36,656	$ 33,386	$ (3,270)
Actuarial (Gains) or Losses by Source			
Change in actuarial assumptions			$ 0
Salaries increased less than assumed			(1,673)
All other non-investment sources			724
(Gain) on the Actuarial Obligation			$ (949)
Investment Return on Actuarial Value of Assets			(2,450)
Contributions (in excess of) or less than assumed			129
(Gain) on the Actuarial Value of Assets			$ (2,321)
Total Actuarial (Gain)			$ (3,270)

Table 9
Asset Adjustment for 1990 Benefit Structure

($ Millions)	2018	2017
Assets Adjustment due for 1990 Structure Changes		
Allocated Market Value at Beginning of Year	$20,000	$18,232
Contributions During the Year		
EC §22901.7 at 2.250% (or 1.205%) of Earned Salaries	(688)	(684)
EC §22950.5 at 6.180% / 4.330% of Earned Salaries	(2,015)	(1,384)
EC §22951 at 0.250% of Earned Salaries	(82)	(80)
EC §22955 at 2.017% of second preceding fiscal year Earned Salaries	(618)	(581)
THBF costs reallocated to DB Program	28	29
Total Adjustment to Contributions[1]	(3,375)	(2,700)
Benefits Paid During the Year		
Post-1990 Benefits Paid During the Year	2,205	2,077
Post-1990 Refunds of supplemental member contributions	3	3
Prior 2% DBS redirection contributions refunded	(10)	(10)
Total Adjustment to Benefits Paid [1]	2,198	2,070
Estimated Investment Earnings for the Year [2]	1,717	2,398
Total Allocated Market Value at End of Year	**$20,540**	**$20,000**
Ratio of Actuarial Value to Market Value [3]	97.559%	98.082%
Asset Adjustment (Actuarial Value of Assets)	**$20,039**	**$19,616**

1. May not add exactly, due to rounding.

2. Based on Fair Market Value and uniform cash flow for contributions, benefits, and expenses. The rates of return used in these calculations were 13.44% for 2016-2017 and 8.88% for 2017-2018.

3 Developed from Table 5.

Table 10
Funded Status and Supplemental Contribution Rate for 1990 Benefit Structure

($ Millions)	2018	2017
Actuarial Obligation		
Present Value of Projected Benefits		
Benefits Currently Being Paid	$ 134,102	$ 128,651
Benefits to Inactive Members	6,116	5,808
Benefits to Active Members	171,750	166,436
Total	$ 311,968	$ 300,895
Present Value of Future Normal Costs	(68,092)	(66,249)
Actuarial Obligation	$ 243,876	$ 234,646
Actuarial Value of Assets		
Actuarial Value of Assets *(Table 7)*	$ 190,451	$ 179,689
Plus, 1990 Asset Adjustment (Table 9)	20,038	19,616
Theoretical AVA for 1990 Benefits	$ 210,489	$ 199,305
Funded Status		
Actuarial Obligation	$ 243,876	$ 234,646
Actuarial Value of Assets	210,489	199,305
Unfunded Actuarial Obligation (Surplus)	$ 33,387	$ 35,341
Funded Ratio	86.3%	84.9%
Amortization Sufficiency Under Current Contribution Schedule		
Revenue for 1990 Benefits	16.000%	16.000%
Normal Cost Rate for 1990 Benefits	(17.613)	(17.615)
Equivalent Normal Cost Surplus / (Deficit) Express as Percent of Employer Payroll	(1.613%)	(1.615%)
Equivalent Normal Cost Surplus / (Deficit) Express as Percent of State Payroll	(1.726%)	(1.726%)
Level Equivalent Additional Revenue Under EC 22955.1(b)	5.311	4.811
Revenue Available for Amortization	3.585%	3.085%
Revenue Needed for Amortization	6.089	6.487
Revenue Surplus / (Deficit)	(2.504%)	(3.402%)
Amortization Status under current contribution rate	Contribution Intreases Needed	Contribution Intreases Needed
Contribution Rate for Amortization of 1990 UAO without Statutory Limits		
Current EC 22955.1(b) Contribution Rate	5.311%	4.811%
Increase / (Decrease) in State Contribution Rate for Next Fiscal Year	2.504	3.402
Unconstrained Contribution Rate for Next FY	7.815%	8.213%
Contribution Rate for Amortization of 1990 UAO with Statutory Limits		
Current EC 22955.1(b) Contribution Rate	5.311%	4.811%
Increase / (Decrease) in State Contribution Rate for Next Fiscal Year (Increase capped at 0.5%)	0.500	0.500
EC 22955.1(b) Contribution Rate for Next FY	**5.811%**	**5.311%**

7. Employer Supplemental Contribution Rate

Under EC §22950.5, increases in the employer contribution rate are required, reaching an ultimate increase of 10.85% of payroll as of July 1, 2020. We will refer to this contribution as the employer supplemental contribution. The employer supplemental rate is in addition to the base employer contribution under EC §22950 and §22951 of 8.25% of payroll.

Effective July 1, 2021, the board shall increase or decrease the employer supplemental contribution rate (within certain parameters) to reflect the contribution required to eliminate the remaining UAO associated with service earned prior to July 1, 2014. This will be referred to as the pre-2014 UAO.

There is an additional complexity in that the pre-2014 UAO that the employer is responsible for funding overlaps with the 1990 UAO that the state is responsible for funding. Under the board's valuation policy, the pre-2014 UAO is split into two separate pieces: 1) the pre-2014 UAO for the 1990 Benefit Structure; and 2) the pre-2014 UAO for "new" benefits (i.e., those adopted after 1990). The employers are responsible for funding the New Benefit UAO. However, the employer supplemental contribution rate must, at a minimum, be sufficient to pay down the total Pre-2014 UAO when combined with the base employer rate and the state and member contribution rates. This is referred to as the "minimum rate."

Changes in the employer supplemental contribution are determined annually beginning with the 2020 valuation and are subject to the following conditions:

- The employer supplemental contribution rate cannot increase or decrease by more than 1.0% of payroll over the prior year supplemental rate.
- The employer supplemental contribution rate cannot exceed 12.00%.

To determine the pre-2014 UAO for New Benefits, we must determine the total UAO for pre-2014 service and subtract the 1990 UAO for pre-2014 service.

Pre-2014 Unfunded Actuarial Obligation

The pre-2014 Actuarial Obligation for the DB Program is calculated using service through June 30, 2014 and projected salaries. Since there are no future service accruals for this portion of the Actuarial Obligation, the Projected Unit Credit actuarial cost method is used, per the board's valuation policy.

To determine the pre-2014 assets to be used in the 2018 valuation, a theoretical pre-2014 asset value is maintained based on the prior year value adjusted as follows:

- Add total contributions (excluding SBMA),
- Subtract total Normal Costs for prior year,
- Subtract benefit payments attributable to pre-2014 service, and
- Adjust for actual investment return.

See **Table 11** for the details of the asset adjustment.

Pre-2014 Unfunded Actuarial Obligation for 1990 Benefit Structure

A second calculation is done to isolate the portion of the pre-2014 UAO that is allocated to the 1990 Benefit Structure and therefore is subject to state funding. The Actuarial Obligation for this portion is calculated using the 1990 Benefit Structure, service through June 30, 2014 and projected salaries. Since there are no future service accruals, the Projected Unit Credit actuarial cost method is used.

To determine the pre-2014 assets allocated to the 1990 Structure that are to be used in the 2018 valuation, a theoretical pre-2014 asset value for the 1990 Structure is maintained based on the prior year value adjusted as follows:

- Add contributions equal to 16.00% of prior year payroll,
- Add state supplemental contributions under EC §22955.1(b),
- Subtract total Normal Costs for prior year attributable to 1990 Benefit Structure,
- Subtract benefit payments attributable to pre-2014 service and the 1990 Benefit Structure, and
- Adjust for actual investment return.

See **Table 12** for the details of the asset adjustment.

Pre-2014 Unfunded Actuarial Obligation for New Benefits

The following table shows the calculation of the UAO for Pre-2014 Service attributable to New Benefits.

($ Millions)	Pre-2014 Service		
	Total	1990 Benefits	New Benefits
Funded Status -- Pre-2014 Service			
Actuarial Obligation	$ 254,062	$ 209,981	$ 44,081
Actuarial Value of Assets	150,356	179,743	(29,387)
Unfunded Actuarial Obligation	$ 103,706	$ 30,238	**$ 73,468**

Employer Supplemental Contributions

The statute calls for an adjustment to the employer supplemental contribution rate to amortize the pre-2014 UAO effective with the 2020 actuarial valuation. Therefore, no adjustment to the scheduled employer supplemental contribution is required effective July 1, 2019.

For illustrative purposes, we have shown the adjustment to the employer supplemental contribution rate that would have been calculated if this were the 2020 valuation. As shown in **Table 13**, no increase in the employer supplemental contribution rate, above the ultimate rate of 10.85%, would be needed to amortize the pre-2014 UAO for New Benefits by June 30, 2046. However, under the minimum contribution rate requirement for the total Pre-2014 UAO, an increase would apply. Note that this is a hypothetical calculation as the employer contribution rate is still being determined under a fixed graded schedule through June 30, 2021. As shown in the projection in the "Looking Ahead" subsection of Section 1, a small decrease is projected after the ultimate supplemental contribution rate of 10.85% (19.10% total) is reached.

Table 11
Total Assets Allocated for Pre-2014 Service[1]

($ Millions)	2018	2017
Asset Value for Pre-2014 Service (excludes SBMA)		
Allocated Market Value at Beginning of Year	$151,553	$142,731
Pre-2014 Allocation of GASB 75 Adjustment	(396)	-
Contributions During the Year		
Total Contributions (excluding SBMA)	10,146	9,146
Less Normal Costs for Year with Expenses	(6,612)	(6,105)
Total Adjusted Contributions	$ 3,534	$ 3,041
Benefits Paid for Pre-2014 Service	(13,761)	(13,382)
Estimated Investment Earnings for the Year [2]	13,188	19,163
Total Allocated Market Value at End of Year	**$154,118**	**$151,553**
Ratio of Actuarial Value to Market Value [3]	97.559%	98.082%
Actuarial Value of Assets for Pre-2014 Service	**$150,356**	**$148,646**

1. May not add exactly, due to rounding.

2. Based on Fair Market Value excluding SBMA and uniform cash flow for contributions, benefits, and expenses. The rates of return used in these calculations were 13.93% for 2016-2017 and 9.03% for 2017-2018.

3. Developed from Table 5.

Table 12
1990 Assets Allocated for Pre-2014 Service[1]

($ Millions)	2018	2017
1990 Asset Value for Pre-2014 Service (excludes SBMA)		
Allocated Market Value at Beginning of Year	$179,603	$167,166
Pre-2014 Allocation of GASB 75 Adjustment	(396)	-
Contributions During the Year for 1990 Structure		
Total Contributions (excluding SBMA)	6,770	6,445
Less 1990 Normal Costs for Year with Expenses	(5,745)	(5,211)
Total Adjusted Contributions	$ 1,025	$ 1,234
Benefits Paid for Pre-2014 Service	(11,695)	(11,378)
Estimated Investment Earnings for the Year [2]	15,703	22,581
Total 1990 Allocated Market Value at End of Year	**$184,240**	**$179,603**
Ratio of Actuarial Value to Market Value [3]	97.559%	98.082%
1990 Actuarial Value of Assets for Pre-2014 Service	**$179,743**	**$176,158**

1. May not add exactly, due to rounding.

2. Based on Fair Market Value excluding SBMA and uniform cash flow for contributions, benefits, and expenses. The rates of return used in these calculations were 13.93% for 2016-2017 and 9.03% for 2017-2018.

3. Developed from Table 5.

Table 13
Funded Status and Employer Supplemental Contribution Rate for Pre-2014 Service

($ Millions)	2018	2017
Funded Status		
Total Unfunded Actuarial Obligation (Pre-2014 Service)		
Total Actuarial Obligation for Pre-2014 Service	$254,062	$252,226
Total AVA for Pre-2014 Service	150,356	148,646
Total UAO (pre-2014 Service)	$103,706	$103,580
1990 Unfunded Actuarial Obligation (Pre-2014 Service)		
1990 Actuarial Obligation for Pre-2014 Service	$209,981	$208,341
1990 AVA for Pre-2014 Service	179,742	176,158
1990 UAO (pre-2014 Service)	$30,239	$32,183
Post-1990 UAO (Pre-2014 Service)	$73,467	$71,397
Amortization Sufficiency for Post-1990, Pre-2014 UAO Under Current Contribution Schedule		
Revenue from Member Contributions[1]	10.227%	10.222%
Revenue from Employer Contributions (22950 & 22951)[1]	8.250	8.250
Revenue from State Contributions EC 22955(a)[1]	1.888	1.888
Equivalent Normal Cost Rate for Total Benefits	(19.445)	(19.544)
Post-1990 Normal Cost Rate (Surplus)/Deficit	2.582	2.474
Additional Revenue Under EC 22950.5[1]	10.647	10.411
Revenue Available for Amortization	14.149%	13.701%
Revenue Needed for Amortization	12.433	12.194
Revenue Surplus / (Deficit)	1.716%	1.507%
Minimum Contribution Required for Total Pre-2014 UAO		
Total Preliminary Pre-2014 UAO Contribution Rate	17.136%	16.424%
Total Pre-2014 UAO Contribution Rate Needed	17.566	17.705
Revenue Surplus / (Deficit)	(0.430%)	(1.280%)
Amortization Status under current contribution rate schedule and no changes in ultimate employer rate	Contribution Increase Needed	Contribution Increase Needed
Contribution Rate for Amortization of UAO for pre-2014 Service and New Benefits [Illustrative Purposes Only. Not Applicable for 2018 Valuation]		
Current EC 22950.5 Contribution Rate	10.850%	10.850%
Adjustment in Employer Contribution Rate for Next Fiscal Year[2]	0.430	1.000
EC 22955.1(b) Contribution Rate for FYB 2021[2]	**11.280%**	**11.850%**

1. Equivalent level contribution rate payable through June 30, 2046.

2. Hypothetical value based on the Actuarial Value of Assets. Current projections indicate a decrease in the ultimate employer contribution rate when reflecting the future recognition of currently deferred asset gains and losses. See the "Looking Ahead" subsection of Section 1.

8. Projected Amortization and Cash Flows

We have previously shown graphical projections of contribution rates, the Funded Ratio, and the UAO. In this section, we show the numerical details behind those projections.

Table 14 shows the amortization of the UAO for the total DB Program on a year-by-year basis, based on 7.00% future returns, additional contribution rate increases, and the future recognition of the currently deferred asset gains. Assuming all other future experience emerges as assumed and no changes in the scheduled contribution rates, the UAO will not be amortized by June 30, 2046. However, the CalSTRS board has rate-setting authority (within certain parameters) to adjust the state and employer contribution rates to pay down the UAO. Assuming the contribution rates are adjusted in the future, the UAO is projected to be fully paid off, except for a small portion of the UAO attributable to New Benefits and Post-2014 service (the Unallocated UAO) that is not actuarially funded. It is our understanding the board does not have authority to adjust contribution rates to fund this portion of the UAO. In total, the Funded Ratio is projected to be 99.9% under the assumptions described in the "Looking Ahead" subsection of Section 1.

In **Table 14**, we show the contributions projected to be paid into the DB Program to fund on-going benefits and amortize the UAO. **Table 15** shows a comparison of these inflows into DB Program with the outflows from the DB Program, which consist of benefit payments and expenses. The difference between these two values is the net cash flow. A negative value indicates CalSTRS is paying out more than it is receiving. Note that this projection does not account for cash received internally, such as interest and dividends on investments.

The net cash flow is currently negative and this is projected to remain at approximately the current level over the next 10 years. In future years, the cash flow is expected to become increasingly negative. This is a typical pattern for a mature retirement system where it is expected that contributions will be less than benefits and that the system will begin drawing on the fund that has been built up over prior years.

Table 14
Amortization of Unfunded Actuarial Obligation[1]

(Reflecting Projected Contribution Increases)[2]

($Millions)		Beginning	Amortization Payment						Interest	Ending	Ending
		Unfunded	Contributions				Normal	Available	Charge	Unfunded	Funded
Year	FYE	Act. Oblig.	Member	Employer	State	Total	Cost	Amtzn.	at 7.00%	Act. Oblig.	Ratio
1	2019	$107,152	$3,419	$5,435	$2,353	$11,207	$6,703	$4,504	$7,346	$108,153	65.1%
2	2020	108,153	3,539	6,265	2,569	12,373	6,921	5,452	7,383	108,772	66.3%
3	2021	108,772	3,662	6,831	2,781	13,274	7,148	6,126	7,403	109,113	67.5%
4	2022	109,113	3,790	6,715	3,050	13,555	7,381	6,174	7,425	109,696	68.6%
5	2023	109,696	3,922	6,950	3,299	14,171	7,621	6,550	7,453	110,123	69.7%
6	2024	110,123	4,059	7,200	3,365	14,624	7,867	6,757	7,476	110,503	70.8%
7	2025	110,503	4,200	7,457	3,447	15,104	8,121	6,983	7,495	110,773	71.8%
8	2026	110,773	4,347	7,722	3,540	15,609	8,383	7,226	7,505	110,879	72.8%
9	2027	110,879	4,498	7,996	3,644	16,138	8,652	7,486	7,504	110,774	73.9%
10	2028	110,774	4,655	8,278	3,757	16,690	8,928	7,762	7,487	110,412	74.9%
11	2029	110,412	4,818	8,570	3,877	17,265	9,212	8,053	7,452	109,748	76.0%
12	2030	109,748	4,985	8,872	4,005	17,862	9,503	8,359	7,395	108,739	77.1%
13	2031	108,739	5,159	9,184	4,139	18,482	9,802	8,680	7,313	107,340	78.1%
14	2032	107,340	5,339	9,507	4,279	19,125	10,108	9,017	7,204	105,503	79.2%
15	2033	105,503	5,525	9,841	4,426	19,792	10,422	9,370	7,063	103,180	80.4%
16	2034	103,180	5,717	10,187	4,579	20,483	10,747	9,736	6,888	100,320	81.5%
17	2035	100,320	5,917	10,545	4,736	21,198	11,083	10,115	6,674	96,871	82.7%
18	2036	96,871	6,123	10,916	4,900	21,939	11,431	10,508	6,419	92,776	84.0%
19	2037	92,776	6,336	11,300	5,071	22,707	11,790	10,917	6,119	87,973	85.3%
20	2038	87,973	6,557	11,697	5,248	23,502	12,162	11,340	5,768	82,398	86.6%
21	2039	82,398	6,786	12,108	5,431	24,325	12,547	11,778	5,363	75,981	88.0%
22	2040	75,981	7,022	12,534	5,621	25,177	12,947	12,230	4,898	68,648	89.5%
23	2041	68,648	7,267	12,975	5,817	26,059	13,364	12,695	4,369	60,320	91.0%
24	2042	60,320	7,521	13,432	6,020	26,973	13,797	13,176	3,769	50,913	92.6%
25	2043	50,913	7,783	13,906	6,230	27,919	14,249	13,670	3,094	40,336	94.3%
26	2044	40,336	8,055	14,396	6,448	28,899	14,719	14,180	2,336	28,492	96.1%
27	2045	28,492	8,336	14,905	6,673	29,914	15,210	14,704	1,489	15,276	98.0%
28	2046	15,276	8,627	15,436	6,906	30,969	15,723	15,246	545	575	99.9%

1. Based on the actuarial value of assets with projected recognition of known deferred asset gains and losses.

2. Contribution rates include projected increases and decreases allowed under Education Code.

Table 15
Projected Cash Flow

(Reflecting Projected Contribution Increases)[1]

($Millions)

Year	FYE	Contributions[1] Member	Employer	State	Total	Benefit Payments[2]	Net Program Cash Flow	Cash Flow as a Percentage of Payroll	Market Value of Assets	Ending Funded Ratio
1	2019	$3,419	$5,435	$2,353	$11,207	$15,245	($4,038)	(12.1%)	(2.0%)	65.1%
2	2020	3,539	6,265	2,569	12,373	15,764	(3,391)	(9.8%)	(1.6%)	66.3%
3	2021	3,662	6,831	2,781	13,274	16,454	(3,180)	(8.9%)	(1.4%)	67.5%
4	2022	3,790	6,715	3,050	13,555	17,170	(3,615)	(9.8%)	(1.5%)	68.6%
5	2023	3,922	6,950	3,299	14,171	17,919	(3,748)	(9.8%)	(1.5%)	69.7%
6	2024	4,059	7,200	3,365	14,624	18,699	(4,075)	(10.3%)	(1.6%)	70.8%
7	2025	4,200	7,457	3,447	15,104	19,513	(4,409)	(10.7%)	(1.6%)	71.8%
8	2026	4,347	7,722	3,540	15,609	20,360	(4,751)	(11.2%)	(1.6%)	72.8%
9	2027	4,498	7,996	3,644	16,138	21,252	(5,114)	(11.6%)	(1.7%)	73.9%
10	2028	4,655	8,278	3,757	16,690	22,246	(5,556)	(12.2%)	(1.7%)	74.9%
11	2029	4,818	8,570	3,877	17,265	23,309	(6,044)	(12.8%)	(1.8%)	76.0%
12	2030	4,985	8,872	4,005	17,862	24,450	(6,588)	(13.5%)	(1.8%)	77.1%
13	2031	5,159	9,184	4,139	18,482	25,681	(7,199)	(14.3%)	(1.9%)	78.1%
14	2032	5,339	9,507	4,279	19,125	26,985	(7,860)	(15.1%)	(2.0%)	79.2%
15	2033	5,525	9,841	4,426	19,792	28,342	(8,550)	(15.8%)	(2.1%)	80.4%
16	2034	5,717	10,187	4,579	20,483	29,724	(9,241)	(16.5%)	(2.1%)	81.5%
17	2035	5,917	10,545	4,736	21,198	31,129	(9,931)	(17.2%)	(2.2%)	82.7%
18	2036	6,123	10,916	4,900	21,939	32,557	(10,618)	(17.7%)	(2.2%)	84.0%
19	2037	6,336	11,300	5,071	22,707	34,001	(11,294)	(18.2%)	(2.3%)	85.3%
20	2038	6,557	11,697	5,248	23,502	35,515	(12,013)	(18.7%)	(2.3%)	86.6%
21	2039	6,786	12,108	5,431	24,325	37,019	(12,694)	(19.1%)	(2.3%)	88.0%
22	2040	7,022	12,534	5,621	25,177	38,502	(13,325)	(19.4%)	(2.3%)	89.5%
23	2041	7,267	12,975	5,817	26,059	39,943	(13,884)	(19.5%)	(2.3%)	91.0%
24	2042	7,521	13,432	6,020	26,973	41,341	(14,368)	(19.5%)	(2.3%)	92.6%
25	2043	7,783	13,906	6,230	27,919	42,737	(14,818)	(19.4%)	(2.3%)	94.3%
26	2044	8,055	14,396	6,448	28,899	44,079	(15,180)	(19.2%)	(2.2%)	96.1%
27	2045	8,336	14,905	6,673	29,914	45,344	(15,430)	(18.9%)	(2.1%)	98.0%
28	2046	8,627	15,436	6,906	30,969	46,516	(15,547)	(18.4%)	(2.1%)	99.9%

1. Contribution rates include projected increases and decreases allowed under Education Code.

2. Projected benefit payments include estimated administrative expenses.

9. Risk Disclosures

The results of any actuarial valuation are based on a set of assumptions. Although we believe the current DB Program assumptions provide a reasonable estimate of future expectations, it is almost certain that future experience will differ from the assumptions to some extent.

The following is a general discussion of the potential risks to CalSTRS funding. Additional analysis on the potential impact of future investment returns on the Funded Ratio and supplemental contribution rates is included in Section 1 (subsection "Projections Under Alternate Return Scenarios"). A more comprehensive analysis of potential risks ("Review of Funding Level and Risks") is completed each fall by CalSTRS internal actuarial staff.

Factors Affecting Future Results

There are a number of factors that affect future valuation results. To the extent actual experience for these factors varies from the assumptions, this will likely cause either increases or decreases in the plan's future funding level and calculated supplemental contribution rates. Examples of factors that can have a significant impact on valuation results are:

- Investment return
- Payroll variation
- Salary variation
- Mortality (how long retirees live)
- Service retirement
- Termination (members leaving active employment for reasons other than death, disability or service retirement)
- Contribution limitations. The board has limited rate-setting authority. If significant contribution increases are needed in the future, CalSTRS may receive insufficient funding due to the limitations on the board's ability to increase contribution rates under the current law. Projections based on the valuation assumptions indicate this is not currently an issue.

Of these factors, we believe the factor with the greatest potential risk is future investment returns. Payroll variation could also have a significant impact if there was a significant decline in the active teacher population, which, for example could occur if there was a large increase in the proportion of charter schools.

As an example of these risks, if actual investment returns fall short of the current assumption of 7% per year, this will cause an increase in the total supplemental contribution rate and a decrease in the Funded Ratio for the DB Program, all other things being equal. Conversely, if returns exceed 7%, this will decrease the total supplemental contribution rate and increase the Funded Ratio.

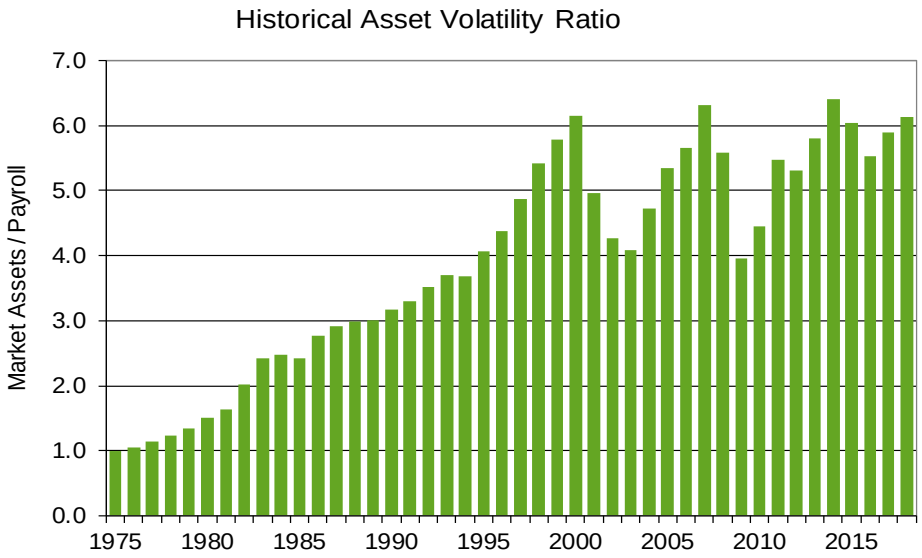
Maturity Risk

The magnitude of any contribution rate increase or decrease is affected by the Program's maturity level. As the DB Program becomes more mature (i.e., the number of retirees grows compared to the number of actives, and the accumulated assets grow compared to payroll), it tends to be subject to increased volatility in the contributions needed. Specifically, for CalSTRS there may be significant fluctuations in the state supplemental contribution rates (and to a lesser extent the employer contribution rates) from year to year due to the actual investment return. One way to measure maturity risk is volatility ratios.

One indicator of this potential volatility is the Asset Volatility Ratio (AVR), which is equal to the Fair Market Value of Assets divided by total payroll. Plans with a high Asset Volatility Ratio will be subject to a greater level of contribution rate volatility. The AVR is a current measure since it is based on the current level of assets and will vary from year to year.

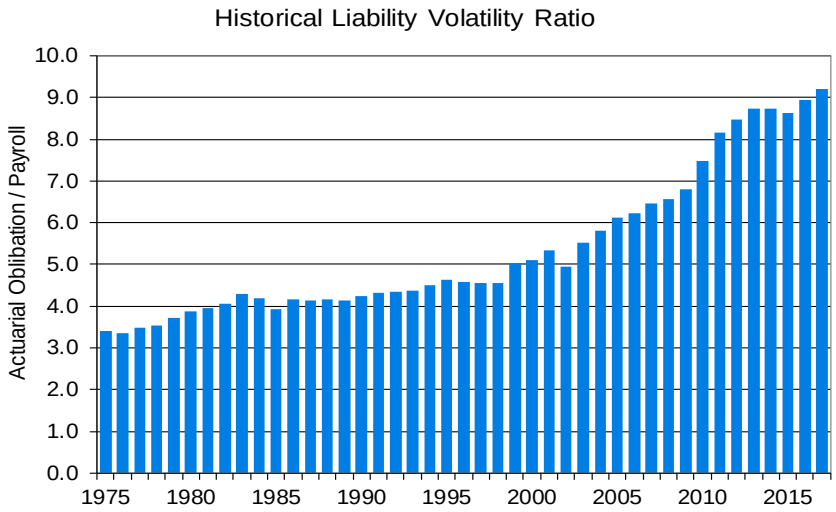
For CalSTRS, the current AVR is equal to 6.1, which is typical for a mature system. This means that for each 1% asset loss (in relation to the assumed investment return), there will need to be an increase in contributions equivalent to 6.1% of one-year's payroll. Since CalSTRS is currently targeting a funding period of 27 years (the years from the next valuation date to June 30, 2046), the increase (or decrease) in the state and employer contribution rates will be spread out over 27 years, resulting in approximately a 0.34% of payroll increase (or decrease) in the total contribution rate needed for each 1% asset loss (gain). An asset loss (or gain) will primarily cause a contribution rate increase (or decrease) for the state and have a much smaller impact on the employer contribution rate.

The following graph shows how the System matured during the last 25 years of the 20th Century, as represented by the increasing AVR. Over the last decade and a half, increases in the AVR have somewhat leveled off although there continues to be year-to-year variance.



Another measure of a system's maturity is the Liability Volatility Ratio (LVR), which is equal to the Actuarial Obligation divided by the total payroll. This ratio provides an indication of the longer-term potential for contribution rate volatility if CalSTRS becomes fully funded. In addition, this ratio provides an indication of the potential contribution rate volatility due to liability experience (gains and losses) and liability re-measurements (assumption changes). For CalSTRS, the current LVR is 9.3. Ultimately, the LVR and AVR should be equal if CalSTRS achieves 100% funding in the future.

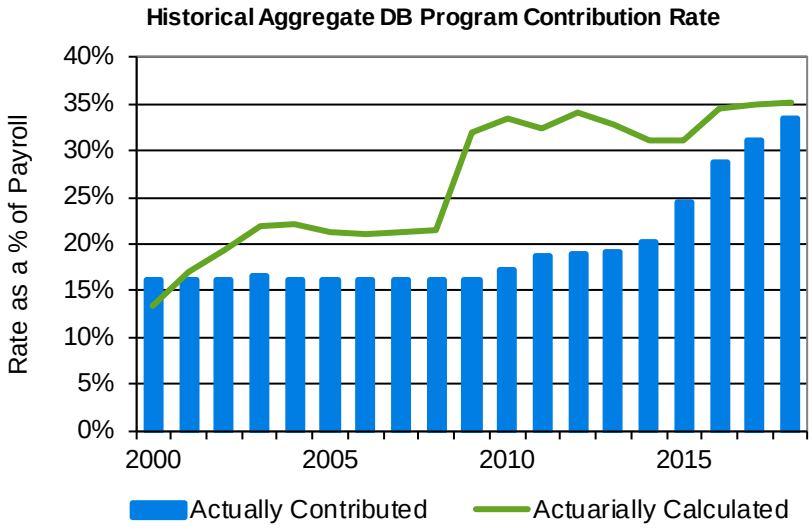
The following graph shows the historical LVR. It is a similar pattern to the Asset Volatility Ratio except the increase is more gradual and the year-to-year variance is significantly less, although there have been larger changes in years where assumptions changes have occurred.



Historical Measures

One way to assess future risks is to look at historical measurements. The following graph shows how the DB Program Funded Ratio has varied over the last 30 years. In particular, it reflects the significant impact that investment returns can have. The strong returns of the 1990's caused a large increase in the Funded Ratio. Since 2000, actual returns have lagged the assumption and expectations of future returns have decreased. This combination has been the primary cause of the decline in the Funded Ratio since then.

The graph below shows the history of the actual contributions made (blue bar) as a percentage of payroll. The green line shows the actuarially calculated contribution rate based on amortizing the UAO by June 30, 2046 (for years before 2014, a 30-year amortization was used). There has been variance in both rates. As previously noted, as the DB Program continues to mature, year-to-year variance is projected to increase. Year-to-year changes in the actual contribution rate will likely be less than for the actuarially calculated rate due to the restrictions on changes in the state and employer supplemental contribution rates.



Appendix A Provisions of Governing Law

The actuarial calculations contained in this report are based upon our understanding of the CalSTRS DB Program as contained in Part 13 of the California Education Code and augmented by consultation with CalSTRS staff. The provisions used in this valuation are summarized below for reference purposes.

Member Contributions

Base Contribution Rate:

2% at 60 Members: 8.0% of creditable compensation. 25% of this contribution was redirected to the member's Defined Benefit Supplement account from January 1, 2001 through December 31, 2010.

The redirection of member contributions does not apply to the 1990 Benefit Structure.

2% at 62 Members: Equal to one-half of the Normal Cost Rate determined in the valuation rounded to the nearest quarter percent. Member rates only change when the Normal Cost Rate changes by 1.0% of payroll as compared to the initial Normal Cost Rate (or at the time of the last adjustment). Currently, the base member contribution rate is equal to 9.0% of creditable compensation.

Supplemental Contribution Rates:

In addition to the base contribution rates, members make additional contributions for fiscal years beginning July 1, 2016 and later:

2% at 60 Members: 2.250% of creditable compensation

2% at 62 Members: 1.205% of creditable compensation

Interest Rate:

Interest is credited at the end of each fiscal year based on rates adopted by the Teachers' Retirement Board. Currently, rates are approximately equal to two-year Treasury notes.

Normal Retirement

Eligibility Requirement:

2% at 60 Members: Age 60 with five years of credited service.

2% at 62 Members: Age 62 with five years of credited service.

Allowance:

Two percent of final compensation for each year of credited service.

Final Compensation:

2% at 60 Members: Average salary earnable for the highest three consecutive years of credited service for one position. For members with 25 years of service, the calculation is based on the highest average compensation earnable in a consecutive 12-month period.

Twelve-month highest average compensation does not apply to the 1990 Benefit Structure.

2% at 62 Members: Final compensation is based on the highest three consecutive years of salary earnable. Compensation is limited to 120% of the Social Security Wage Base. The limit effective July 1, 2018 is $146,230 (after applying the 120% factor) and is adjusted annually based on changes to the Consumer Price Index for All Urban Consumers. The 2% at 62 members are not eligible for the one-year final compensation benefit enhancement.

Credited Service:

For each year of membership, credited service is granted based on the ratio of salary earned to full-time salary earnable for one position.

Sick Leave Service Credit:

Credited service is granted for unused sick leave at the time of retirement. Sick Leave Service Credit up to 0.2 years of Credited Service may be used for eligibility for One-Year Final Compensation or to attain the Career Factor or the Longevity Bonus.

Unused sick leave service credit does not apply to the 1990 Benefit Structure for members hired after June 30, 1980.

Career Factor:

If a member has 30 years of credited service, the age factor is increased by 0.2%. However, the maximum age factor is 2.4%.

Career factor does not apply to 2% at 62 members or the 1990 Benefit Structure.

Longevity Bonus:

For members attaining 30 years of service by January 1, 2011, a longevity bonus of $200 per month is added to the unmodified allowance. The bonus is increased to $300 per month with 31 years of service, and $400 per month with 32 or more years of service.

Longevity Bonus does not apply to 2% at 62 members or the 1990 Benefit Structure.

IRC Section 415:

Benefits are subject to limits imposed under Internal Revenue Code (IRC) Section 415. However, no limits are imposed in the valuation of the DB Program until they actually occur, in order to address the potential pay-as-you-go funding needs of the Teachers' Replacement Benefits Program Fund.

IRC Section 401(a)(17):

Compensation is limited under IRC Section 401(a)(17) and assumed to increase at the rate of inflation for valuation purposes. Current 401(a)(17) limits do not apply to members hired before July 1, 1996.

Early Retirement

Eligibility Requirement:

2% at 60 Members: Age 55 with five years of credited service, or age 50 with 30 years of credited service.

2% at 62 Members: Age 55 with five years of credited service.

Benefit Reduction:

2% at 60 Members: A half-percent reduction in the normal retirement allowance for each full month or partial month the member is younger than age 60, plus a reduction of a quarter percent for each full month or partial month the member is younger than age 55.

2% at 62 Members: A half-percent reduction in the normal retirement allowance for each full month or partial month the member is younger than age 62

Late Retirement

Allowance:

2% at 60 Members: Members continue to earn additional service credit after age 60. The 2% age factor increases by 0.033% for each quarter year of age that the member is over age 60, up to a maximum of 2.4%.

2% at 62 Members: Members continue to earn additional service credit after age 62. The 2% age factor increases by 0.033% for each quarter year of age that the member is over age 62, up to a maximum of 2.4%.

The late retirement adjustment does not apply to the 1990 Benefit Structure.

Deferred Retirement

Allowance:

Any time after satisfying the minimum service requirement, a member may cease active service, leave the accumulated contributions on deposit, and later retire upon attaining the minimum age requirement.

Post-Retirement Benefit Adjustment

Benefit Improvement:

2% simple increase on September 1 following the first anniversary of the effective date of the allowance, applied to all continuing allowances.

Disability Allowance - Coverage A

Eligibility Requirement Allowance:*

Member has five years of credited California service and has not attained age 60.

50% of final compensation
or
5% of final compensation for each year of service credit if over age 45 with less than 10 years of service credit.

Children's Benefit:

10% for each eligible dependent child, up to a maximum of 40% of final compensation. The increment for each eligible child continues until the child marries or attains age 22.

**Note that, for valuation purposes, the greater of the service retirement allowance and the disability allowance is valued if the member is eligible for service retirement.*

Offsets:

Allowance, including children's increment, is reduced by disability benefits payable under Social Security, Workers' Compensation and employer-paid income protection plan.

Disability Allowance - Coverage B (including 2% at 62 members)

Eligibility Requirement:

Member has five years of credited California service.

Allowance:*

50% of final compensation, regardless of age and service credit.

Children's Benefit:

10% for each eligible child up to four children, for a maximum of 40% of final compensation. The increment for each child continues until the child attains age 21, regardless of student, marital, or employment status.

Offsets:

The member's allowance is reduced by disability benefits payable under Workers' Compensation.

**Note that, for valuation purposes, the greater of the service retirement allowance and the disability allowance is valued if the member is eligible for service retirement.*

Death Before Retirement - Coverage A

Eligibility Requirement:

One or more years of service credit for active members or members receiving a disability allowance. Ineligible members may receive a lump sum payment of their contributions with interest.

Lump Sum Payment:

$6,372 lump sum to the designated beneficiary. If there is no surviving spouse, domestic partner, or eligible children, the contributions and interest are paid to the designated beneficiary.

Allowance:

The surviving spouse or domestic partner with eligible children will receive a family benefit of 40% of final compensation for as long as there is at least one eligible child. An additional 10% of final compensation is payable for each eligible child up to a maximum benefit of 90%.

If there is no surviving spouse or domestic partner, an allowance of 10% of final compensation is payable to eligible children up to a maximum benefit of 50%.

When there are no eligible children, the spouse or domestic partner may elect to receive one-half of a 50% joint and survivor allowance projected to age 60, or take a lump sum payment of the remaining contributions and interest.

Death Before Retirement - Coverage B (including 2% at 62 members)

Eligibility:

One or more years of service credit for active members. Ineligible members may receive a lump sum payment of their contributions with interest.

Lump Sum Payment:

$25,488 lump sum to the designated beneficiary. If there is no surviving spouse or domestic partner, the contributions and interest are paid to the designated beneficiary.

Allowance:

A lump sum payment of the contributions and interest.

or

One-half of a 50% joint and survivor allowance, beginning on the member's 60th birthday, or immediately with a reduction based on the member's and spouse's (or domestic partner's) ages at the time the benefit begins.

If the surviving spouse or domestic partner elects a monthly allowance, each eligible child would receive 10% of the member's final compensation, with a maximum benefit of 50%.

Death After Retirement

Lump Sum Payment:

$6,372 lump sum to the designated beneficiary.

Annuity Form:

If the retiree had elected one of the joint and survivor options, the retirement allowance would be modified in accordance with the option selected.

If no annuity option had been elected, payment of the unpaid contributions and interest, if any, remaining in the retiree's account will be made.

Termination from the Program

Refund:

Refund of contributions with interest as credited to the member's account to date of withdrawal. A refund terminates membership and all rights to future benefits from the System

Re-entry After Refund:

Former members who re-enter the System may redeposit all amounts previously refunded plus regular interest. The member must earn one year of credited service after re-entry before becoming eligible for System benefits.

Appendix B Actuarial Methods and Assumptions

This section of the report discloses the actuarial methods and assumptions used in this Actuarial Valuation. These methods and assumptions have been chosen on the basis of recent experience of the DB Program and on current expectations as to future economic conditions. The assumptions were reviewed and changed for the June 30, 2016 actuarial valuation as a result of the 2015 Experience Analysis. Please refer to that Experience Analysis report dated December 30, 2016 for the data and rationale used in the recommendation of each assumption.

The assumptions are intended to estimate the future experience of the members of the DB Program and of the DB Program itself in areas that affect the projected benefit flow and anticipated investment earnings. Any variations in future experience from that expected from these assumptions will result in corresponding changes in estimated costs of the DB Program's benefits.

Actuarial Cost Method

Entry Age Normal Cost Method:

The accruing costs of all benefits with future accruals are measured by the Entry Age Normal Actuarial Cost Method. For measurements where no future service is earned (i.e., those with service fixed as of June 30, 2014), the Actuarial Obligation uses the Projected Unit Credit Actuarial Cost Method.

The projected revenue in excess of the Normal Cost is tested for sufficiency to amortize the Unfunded Actuarial Obligation created by this method. Amortization is calculated on a level percentage of payroll including general wage inflation but no increase or decrease in the number of active members.

The actuarial present value of projected benefits for each individual member included in the valuation is allocated on a level basis over the earnings of the individual between entry age and assumed exit ages. The portion of this actuarial present value allocated to a valuation year is called the Normal Cost. For 2% at 60 members, the Normal Cost is based on Coverage B benefit structure. For 2% at 62 members, the Normal Cost is based on their benefit structure. The portion of this actuarial present value not provided for at a valuation date by the actuarial present value of future Normal Costs is called the Actuarial Obligation. The excess of the Actuarial Obligation over the Actuarial Value of Assets is called the Unfunded Actuarial Obligation. If the Actuarial Value of Assets exceeds the Actuarial Obligation, the difference is called the Actuarial Surplus.

Entry Age:

The ages at entry of future active members are assumed to average the same as the entry ages of the present active members they replace. If the number of active members should increase (or decrease), it is further assumed that the average entry age of the larger (or smaller) group will be the same, from an actuarial standpoint, as that of the present active group. Under these assumptions, the Normal Cost Rate will not vary significantly due to the termination of the present active membership, or with an expansion or contraction of the active membership.

Projected Unit Cost Method:

The actuarial present value of projected benefits for each individual member included in the valuation is determined based on the current service and salary projected to the age the member leaves active employment. The Normal Cost is $0 since no benefits are being earned.

Asset Valuation Method

The assets are valued using a method that delays recognition of investment gains or losses. The expected actuarial value is the prior year's actuarial value increased with net cash flow of funds, and all increased with interest during the past year at the expected investment return assumption. One-third of the difference between the expected actuarial value of assets and the Fair Market Value of assets is added to the expected actuarial value of assets to arrive at the Actuarial Value of Assets. The smoothing is applied on the total DB Program assets and then the SBMA is deducted to determine the net actuarial value for funding purposes.

The asset smoothing method was adopted for the 1999 Actuarial Valuation and is effective for the investment experience beginning in July of 1993.

Actuarial Assumptions

The Actuarial Standards Board has adopted Actuarial Standard of Practice No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. This Standard provides guidance on selecting economic assumptions under defined benefit retirement programs such as the System. In our opinion, the economic assumptions have been developed in accordance with the Standard.

The Actuarial Standards Board has adopted Actuarial Standard of Practice No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This Standard provides guidance on selecting demographic assumptions under defined benefit retirement programs such as the System. In our opinion, the demographic assumptions have been developed in accordance with the Standard.

The assumptions are intended to estimate the future experience of the members of the DB Program and of the System itself in areas that affect the projected benefit flow and anticipated investment earnings. Any variations in future experience from that expected from these assumptions will result in corresponding changes in estimated costs of the Program's benefits.

The demographic assumptions are listed in Table B.1 and illustrated at selected ages and duration combinations in Tables B.2 – B.7.

Payroll Growth Assumption

The wage growth assumption is equal to 3.50%, and the active population is assumed to be stable. Thus, the DB Program payroll is assumed to increase at a rate of 3.50% each year.

Table B.1
List of Major Valuation Assumptions

Economic Assumptions

A.	Investment Return (net of investment and administrative expenses)	7.00%
B.	Interest on Member Accounts	3.00%
C.	Wage Growth	3.50%
D.	Inflation	2.75%

Demographic Assumptions

A. Mortality[1]

Active	- Male	RP-2014 White Collar Employee Male set back 2 years	Table B.2
	- Female	RP-2014 White Collar Employee Female set back 2 years	Table B.2
Retired & Beneficiary	- Male	2016 CalSTRS Retired Male	Table B.2
	- Female	2016 CalSTRS Retired Female	Table B.2
Disabled	- Male	RP-2014 Disabled Retiree Male set back 2 years	Table B.2
	- Female	RP-2014 Disabled Retiree Female set back 2 years (select rates in first three years for both Males and Females)	Table B.2

1. The mortality assumption uses a generational mortality approach with a base year of 2016. Projected improvement is based on 110% of the MP-2016 Ultimate Projection Scale. The combined base tables and projection scale specified contain a margin for expected future mortality improvement. See Table B.9 of this report for a key to the custom mortality tables used for CalSTRS.

B.	Service Retirement	Experience Tables	Table B.3
C.	Disability Retirement	Experience Tables	Table B.4
D.	Withdrawal	Experience Tables	Table B.5
E.	Probability of Refund	Experience Tables	Table B.6
F.	Merit Salary Increases	Experience Tables	Table B.7
G.	Supplemental Assumptions		Table B.8

Table B.2
Mortality as of June 30, 2018

Active Members[1]		
Age	**Male**	**Female**
25	0.034%	0.013%
30	0.030	0.016
35	0.033	0.021
40	0.038	0.027
45	0.053	0.043
50	0.091	0.073
55	0.154	0.115
60	0.254	0.169
65	0.441	0.251

	Retired Members and Beneficiaries[1]		Disabled Members (After Year 3) [1]	
Age	**Male**	**Female**	**Male**	**Female**
50	0.238%	0.132%	1.827%	1.032%
55	0.350	0.208	2.125	1.291
60	0.469	0.277	2.410	1.524
65	0.667	0.418	2.805	1.820
70	1.068	0.689	3.478	2.363
75	1.915	1.266	4.586	3.363
80	3.514	2.428	6.349	4.981
85	6.756	4.842	9.223	7.401
90	13.026	9.847	13.983	10.932
95	22.246	18.442	20.892	16.170
	Select rates for disability:			
	First year of disability		4.0%	3.0%
	Second year of disability		3.5	2.5
	Third year of disability		3.0	2.0

1. The mortality assumption uses a generational mortality approach with a base year of 2016. Projected improvement is based on 110% of the MP-2016 Ultimate Projection Scale. The rates shown reflect mortality improvement through June 30, 2018. The projection scale does not apply to the select minimum rates.

Table B.3
Service Retirement

			DB Program – 2% at 60 Members				DB Program – 2% at 62 Members	
	Only for the 1990 Benefit Structure		Under 30 Years[1]		30 or More Years		All Years	
Age	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
50	0.0%	0.0%	0.0%	0.0%	5.0%	5.0%	0.0%	0.0%
51	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0
52	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0
53	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0
54	1.5	1.5	0.0	0.0	3.0	3.0	0.0	0.0
55	5.8	7.0	2.7	3.5	6.0	8.0	3.0	4.0
56	3.9	4.5	1.8	2.5	6.0	8.0	2.0	3.0
57	4.9	4.5	1.8	2.5	8.0	10.0	3.0	3.5
58	6.8	7.0	2.7	3.5	12.0	15.0	4.0	4.0
59	17.5	14.0	4.5	5.0	16.0	18.0	6.0	6.0
60	25.0	22.0	6.3	7.0	25.0	29.0	9.0	9.0
61	16.5	15.0	7.0	9.0	50.0	50.0	15.0	15.0
62	16.5	15.0	11.0	12.5	45.0	45.0	15.0	17.0
63	15.0	15.0	12.0	16.0	35.0	40.0	15.0	18.0
64	17.5	18.0	13.0	14.0	30.0	35.0	15.0	18.0
65	20.0	18.0	14.0	17.0	32.5	37.5	30.0	30.0
66	16.0	18.0	13.0	15.0	30.0	32.0	25.0	25.0
67	16.0	18.0	13.0	15.0	27.0	32.0	25.0	25.0
68	16.0	16.0	12.0	14.0	27.0	30.0	20.0	20.0
69	16.0	16.0	12.0	14.0	25.0	30.0	20.0	20.0
70	100.0	100.0	12.0	14.0	25.0	30.0	20.0	20.0
71			11.0	13.5	25.0	30.0	20.0	20.0
72			11.0	13.5	25.0	30.0	20.0	20.0
73			11.0	13.5	25.0	30.0	20.0	20.0
74			11.0	13.5	25.0	30.0	20.0	20.0
75			100.0	100.0	100.0	100.0	100.0	100.0

1. If credited service is equal to or greater than 25 but less than 28 years, the assumed retirement rates shown above for members with less than 30 years of credited service are multiplied by 225%. For example, a 63-year old female member with 26 years of credited service would have a 36.0% probability of retirement (2.25 times the rate for service less than 30 years of 16.0%). For members with 28 but less than 30 years of credited service, the rates are equal to 125% of the assumed retirement rates shown above for members with less than 30 years of credited service.

The assumptions shown above are for retirement from active status. It is assumed that all vested terminated members retire at age 60 (2% at 60 members) or age 62 (2% at 62 members).

Table B.4
Disability Retirement

Coverage A

Age	Male	Female
25	0.018%	0.018%
30	0.027	0.027
35	0.045	0.054
40	0.072	0.081
45	0.099	0.099
50	0.144	0.198
55	0.189	0.252

Coverage B

Age	Male	Female
25	0.010%	0.020%
30	0.020	0.020
35	0.030	0.040
40	0.060	0.070
45	0.100	0.110
50	0.140	0.185
55	0.245	0.300
60	0.365	0.380
65	0.400	0.400
70	0.400	0.400

Table B.5
Withdrawal

Year[1]	Male	Female
0	16.0%	15.0%
1	11.0	9.0
2	8.5	7.0
3	6.3	5.5
4	4.0	4.0
5	3.5	3.0
10	1.8	1.8
15	1.2	1.2
20	0.9	0.9
25	0.7	0.7
30	0.6	0.6

1. Based on elapsed service since membership date.

Table B.6
Probability of Refund

	Entry Ages – Male				
Year[1]	**Under 25**	**25 - 29**	**30 - 34**	**35 - 39**	**40 and Up**
Under 5	100%	100%	100%	100%	100%
5	60	60	60	56	45
10	46	46	38	36	36
15	38	38	31	21	
20	31	31	15		
25	15	15			
30	10				
	Entry Ages – Female				
Year	**Under 25**	**25 - 29**	**30 – 34**	**35 - 39**	**40 and Up**
Under 5	100%	100%	100%	100%	100%
5	60	60	60	52	35
10	34	34	32	32	29
15	27	24	24	24	
20	19	14	14		
25	10	10			
30	10				

1. Assumption applied at time of assumed termination. Based on elapsed service since membership date. Members who terminate with less than five years of credited service are assumed to have a 100% probability of refund.

Table B.7
Merit Salary Increases(1)

	Entry Age - Annual Increase in Salaries Due to Merit					
Year[2]	**Under 25**	**25 - 29**	**30 - 34**	**35 - 39**	**40 - 44**	**45 & up**
0	6.4%	5.8%	5.3%	4.8%	4.5%	3.7%
1	6.4	5.8	5.3	4.8	4.5	3.7
2	6.0	5.5	5.0	4.5	4.3	3.5
3	5.6	5.3	4.8	4.3	4.1	3.3
4	5.4	5.0	4.5	4.1	3.9	3.0
5	5.2	4.8	4.3	3.9	3.8	2.8
10	3.7	3.4	3.0	2.7	2.5	1.8
15	1.8	1.7	1.5	1.2	1.2	0.9
20	1.3	1.2	1.2	0.8	0.8	0.6
25	1.1	1.0	0.9	0.6	0.6	
30	0.9	0.8	0.7	0.5		
35	0.8	0.7	0.6			
40	0.8	0.7				
45	0.8					

1. The total expected increase in salary includes both merit (shown above) and the general wage increase assumption of 3.50% per annum. The total result is compounded rather than additive. For example, the total assumed increase for service less than one year (Year 0 above) is 10.124% (1.064 x 1.035) for members in the entry age under 25 group.

2. Based on elapsed service since membership date.

Table B.8
Supplemental Assumptions

PEPRA Coverage

All members hired on or after the valuation date are assumed to be subject to the provisions of PEPRA.

Unused Sick Leave

Credited Service is increased by 1.8%.

Optional Forms

Active and Inactive: Based on single life annuity assumed.
Retirees and Beneficiaries: Based on optional form in data.

Probability of Marriage

Male: 85%
Female: 65%

Male spouses are assumed to be three years older than female spouses.

Children

Married members under age 60 are assumed to have the number of children shown in the following table. Children are assumed to receive benefits until the member would have turned age 60.

Member's Gender	Assumed Number of Children
Male	0.65
Female	0.50

Assumed Offsets

No offsets to disability and survivor benefits are assumed.

Table B.8
Supplemental Assumptions
(continued)

Valuation of Inactive Members

Salary and benefit information is not available on the valuation data provided for inactive members. Therefore, we estimate the projected retirement benefits for inactive members as follows:

1) The inactive member's earnable salary information is retrieved from when they were active by matching with a database of active valuation data back to 2001 and taking the highest earnable salary for the member during the period.
2) For those members who cannot be located on the active database (because they terminated prior to 2001 or another reason), their earnable salary is estimated based on 120% of the average earnable salary for all active members in the year the member terminated.
3) The earnable salary amount from the prior steps is treated as the member's final compensation with two additional adjustments.
    a. An additional load of 5% for all inactive members is applied to their salary amount to account for potential post-termination increases in salary due to factors such as reciprocity.
    b. Final compensation is increased by an additional 4.3% if the member has 25 or more years of credited service.
4) Based on the salary data described above and the birth date and credited service from the current year's valuation data, the projected benefit amount is calculated and valued as a deferred service retirement.
5) Non-vested members who have been inactive for less than two years are assumed to take an immediate refund of their member contributions.

Table B.9
Custom Mortality Table Key

Inactives, Healthy (Service) Retirees and Beneficiaries -- Males	
Current:	RP-2014 Healthy Male White Collar -1 to age 70 smoothed to +1 at age 95
Inactives, Healthy (Service) Retirees and Beneficiaries -- Females	
Current:	RP-2014 Healthy Female White Collar -4 to age 70 smoothed to +1 at age 95
Disabled Retirees -- Males	
Current:	All Ages: RP-2014 Disabled Male -2 (select rates in first three years, regardless of age)
Disabled Retirees -- Females	
Current:	All Ages: RP-2014 Disabled Female -2 (select rates in first three years, regardless of age)
Active Members -- Males	
Current:	RP-2014 Healthy Male White Collar Employee set back 2 years
Active Members -- Females	
Current:	RP-2014 Healthy Female White Collar Employee set back 2 years

Notes:

1. All mortality tables use 110% of the MP-2016 Ultimate Projection Scale applied generationally. Projection scale does not apply to select minimum rates.
2. All mortality tables to be used in the June 30, 2018 actuarial valuations include four years of mortality improvement from the 2014 tables shown above.

Appendix C Valuation Data

The membership data for this actuarial valuation was supplied by CalSTRS. Although we did not audit this data, we compared the data for this and the prior valuation and tested for reasonableness, as well as for consistency with prior periodic reports from the CalSTRS staff. Based on these tests, we believe the data to be sufficiently accurate for the purposes of this valuation. Since the valuation results are dependent on the integrity of the data supplied, the results can be expected to differ if the underlying data is incomplete or missing. It should be noted that if any data or other information is inaccurate or incomplete, our calculations may need to be revised.

Note that CalSTRS provides two files with benefit recipients. The benefit valuation file includes all service retirees, disabled retirees, and most surviving beneficiaries. The family benefit valuation file includes other survivors, including child beneficiaries and survivors deferring their benefit. Information from the family benefit valuation file is included with the survivor information shown in this section, except for average ages and benefit amounts.

Tables C.1-C.6 summarize the census data used in this valuation.

Table C.1
Summary of Statistical Information

	June 30, 2018	June 30, 2017
Number of Members		
Active Members [1]	449,595	445,935
Inactive Members [1]	198,058	192,601
Retirees and Beneficiaries		
Service Retirees	264,780	258,550
Disabled Retirees	10,089	10,023
Survivors	26,990	26,301
Total Benefit Recipients	301,859	294,874
Total Membership in Valuation	949,512	933,410
Active Member Statistics		
Earned Salaries [2]	$ 31,884 million	$ 31,136 million
Average Earned Salary	$ 70,918	$ 69,822
Average Age	45.2 years	45.3 years
Average Service	12.1 years	12.1 years

1. Some active members were reported with no Earnable Salaries, in which case their liabilities, if any, were included with inactive members.

2. Total of prior year Earned Salaries for all active members. This may differ from the payroll amounts shown elsewhere which may include other adjustments.

Retired Member Statistics[3]	June 30, 2018	June 30, 2017
Average Age		
Service Retiree	73.7	73.5
Disabled Retiree	66.2	66.0
Survivors	77.6	77.5
All Benefit Recipients	73.7	73.5
Average Monthly Benefit		
Service Retirees	$ 4,086	$ 3,985
Disabled Retirees	2,833	2,762
Survivors	2,624	2,538
All Benefit Recipients	$ 3,930	$ 3,831

3. Average retiree ages shown here are current ages; average retiree ages shown elsewhere in this Appendix are age at retirement. Survivors from family benefit valuation file are excluded from averages.

Inactive Member Statistics	June 30, 2018	June 30, 2017
Average Age	49.7	49.4
Average Account Balance	$ 12,257	$ 12,072

Table C.1
Summary of Statistical Information
(Continued)

Active Member Statistics by Benefit Formula [1]	2% at 60 Members	2% at 62 Members
Number	349,181	100,414
Earned Salaries [2]	$ 27,637 million	$ 4,248 million
Average Earned Salary	$ 79,147	$ 42,301
Average Age	48.3 years	34.4 years
Average Service	15.0 years	2.0 years

Retired Member Statistics by Benefit Structure[3]	1990 Benefit	Total Benefit
Average Monthly Benefit		
Service Retirees	$ 3,383	$ 4,086
Disabled Retirees	2,803	2,833
Survivors	2,458	2,624
All Benefit Recipients	$ 3,292	$ 3,930

	Pre-2014	Total
Pre-2014 Statistics		
Active Member Average Service	8.9 years	12.1 years
Inactive Member Average Account Balance	$ 10,998	$ 12,257
Average Monthly Benefit for All Benefit Recipients	$ 3,892	$ 3,930

1. Some active members were reported with no Earnable Salaries, in which case their liabilities, if any, were included with inactive members.

2. Total of prior year Earned Salaries for all active members. This differs from the payroll amounts shown elsewhere in this report which reflect annualized amounts for members who were hired part way through the prior year.

Table C.2
Age and Service Distribution – Active Male Members

	Male					
	Years of Service					
Age	1 & Under	Greater than 1 & Under 5	5-9	10-14	15-19	20-24
Less than 25	1199	350				
25 to 30	3,398	5,430	498			
30 to 35	2,089	5,696	3,950	660		
35 to 40	1,566	3,982	4,147	5,529	871	1
40 to 45	1,166	2,747	2,595	4,887	6,337	928
45 to 50	1,047	2,150	1,873	3,261	6,130	5,906
50 to 55	741	1,643	1,393	2,095	3,500	4,663
55 to 60	639	1,323	1,089	1,522	2,457	2,736
60 to 65	389	1,012	865	1,183	1,597	1,576
65 to 70	258	587	487	549	716	625
70 and over	161	425	314	298	268	194
Age Unknown	-	-	-	-	-	-
Total	12,653	25,345	17,211	19,984	21,876	16,629

	Years of Service					
Age	25-29	30-34	35-39	40-44	45 & Over	Total
Less than 25						1549
25 to 30						9,326
30 to 35						12,395
35 to 40						16,096
40 to 45	3					18,663
45 to 50	368	2				20,737
50 to 55	2,926	213				17,174
55 to 60	2,879	1,968	136	1		14,750
60 to 65	1,385	913	466	23		9,409
65 to 70	399	242	115	70	3	4,051
70 and over	127	80	56	42	50	2,015
Age Unknown	-	-	-	-	-	-
Total	8,087	3,418	773	136	53	126,165

Table C.3
Age and Service Distribution – Active Female Members

Female

	Years of Service					
Age	1 & Under	Greater than 1 & Under 5	5-9	10-14	15-19	20-24
Less than 25	4,126	1,600	2			
25 to 30	8,264	18,639	2,381			
30 to 35	4,406	15,199	13,527	2,563	2	
35 to 40	3,499	9,687	11,392	18,249	2,806	2
40 to 45	2,735	7,117	7,362	13,244	17,510	2,258
45 to 50	2,151	5,759	5,955	8,582	13,418	12,949
50 to 55	1,455	4,012	4,187	5,883	8,100	8,788
55 to 60	1,064	2,937	3,121	4,776	6,483	6,453
60 to 65	584	1,794	1,963	2,952	4,236	4,151
65 to 70	278	821	845	1,052	1,528	1,418
70 and over	149	417	398	360	439	362
Age Unknown	-	-	-	-	-	-
Total	28,711	67,982	51,133	57,661	54,522	36,381

	Years of Service					
Age	25-29	30-34	35-39	40-44	45 & Over	Total
Less than 25						5,728
25 to 30						29,284
30 to 35						35,697
35 to 40						45,635
40 to 45	2					50,228
45 to 50	885	1				49,700
50 to 55	6,506	756	3			39,690
55 to 60	5,784	4,671	376	3		35,668
60 to 65	2,929	1,841	974	48		21,472
65 to 70	837	390	211	139	18	7,537
70 and over	265	186	87	57	71	2,791
Age Unknown	-	-	-	-	-	-
Total	17,208	7,845	1,651	247	89	323,430

Table C.4
Age and Service Distribution – All Active Members

Total

	Years of Service					
Age	1 & Under	Greater than 1 & Under 5	5-9	10-14	15-19	20-24
Less than 25	5,325	1,950	2			
25 to 30	11,662	24,069	2,879			
30 to 35	6,495	20,895	17,477	3,223	2	
35 to 40	5,065	13,669	15,539	23,778	3,677	3
40 to 45	3,901	9,864	9,957	18,131	23,847	3,186
45 to 50	3,198	7,909	7,828	11,843	19,548	18,855
50 to 55	2,196	5,655	5,580	7,978	11,600	13,451
55 to 60	1,703	4,260	4,210	6,298	8,940	9,189
60 to 65	973	2,806	2,828	4,135	5,833	5,727
65 to 70	536	1,408	1,332	1,601	2,244	2,043
70 and over	310	842	712	658	707	556
Age Unknown	-	-	-	-	-	-
Total	41,364	93,327	68,344	77,645	76,398	53,010

	Years of Service					
Age	25-29	30-34	35-39	40-44	45 & Over	Total
Less than 25						7,277
25 to 30						38,610
30 to 35						48,092
35 to 40						61,731
40 to 45	5					68,891
45 to 50	1,253	3				70,437
50 to 55	9,432	969	3			56,864
55 to 60	8,663	6,639	512	4		50,418
60 to 65	4,314	2,754	1,440	71		30,881
65 to 70	1,236	632	326	209	21	11,588
70 and over	392	266	143	99	121	4,806
Age Unknown	-	-	-	-	-	-
Total	25,295	11,263	2,424	383	142	449,595

Table C.5
Inactive Members

Fiscal Year Ending June 30	Number Vested	Total Number	Male % of Total	Female % of Total
2004	22,511	116,128	28.7%	71.3%
2005	24,113	124,394	28.8	71.2
2006	26,733	133,601	28.8	71.2
2007	28,922	141,450	28.9	71.1
2008	30,370	147,997	29.0	71.0
2009	31,661	156,207	29.0	71.0
2010	33,036	166,976	29.2	70.8
2011	33,976	173,719	29.1	70.9
2012	34,848	178,655	29.1	70.9
2013	35,883	182,576	29.1	70.9
2014	36,344	182,815	29.2	70.8
2015	36,953	184,396	29.3	70.7
2016	38,014	187,722	29.4	70.6
2017	38,955	192,601	29.5	70.5
2018	39,942	198,058	29.6	70.4

Fiscal Year Ending June 30	Average Account on Deposit	Average Age	Average Service Credit	Average Years Inactive
2004	$12,418	45.8	2.9	7.3
2005	12,177	45.9	2.9	7.4
2006	12,282	45.9	2.9	7.5
2007	12,440	46.0	3.0	7.7
2008	12,698	46.3	2.9	8.0
2009	12,717	46.5	2.9	8.2
2010	12,334	46.7	2.8	8.3
2011	12,035	46.8	2.8	8.6
2012	11,818	47.2	2.8	8.9
2013	11,771	47.6	2.8	9.4
2014	11,815	48.1	2.8	9.9
2015	11,825	48.7	2.9	10.4
2016	11,953	49.1	2.9	10.8
2017	12,072	49.4	2.9	11.1
2018	12,257	49.7	2.9	11.4

Table C.6
Members Retired for Service

Fiscal Year Ending June 30	Total	Male % of Total	Female % of Total
2004	169,022	37.2%	62.8%
2005	176,008	36.9	63.1
2006	181,833	36.5	63.5
2007	188,659	36.1	63.9
2008	195,960	35.7	64.3
2009	203,649	35.3	64.7
2010	213,952	34.9	65.1
2011	222,222	34.4	65.6
2012	230,278	34.0	66.0
2013	236,487	33.6	66.4
2014	241,920	33.1	66.9
2015	247,353	32.7	67.3
2016	252,672	32.3	67.7
2017	258,550	31.9	68.1
2018	264,780	31.5	68.5

Fiscal Year Ending June 30	Average Age at Retirement	Average Years of Service Credit	Final Average Compensation	Average Current Allowance Payable
2004	60.7	26.0	$3,931	$2,488
2005	60.8	26.1	4,103	2,617
2006	60.8	26.2	4,264	2,741
2007	60.8	26.3	4,437	2,878
2008	60.8	26.3	4,620	3,021
2009	60.8	26.4	4,798	3,164
2010	60.9	26.3	4,983	3,302
2011	61.0	26.3	5,138	3,417
2012	61.1	26.2	5,271	3,517
2013	61.1	26.1	5,385	3,609
2014	61.2	26.0	5,487	3,694
2015	61.3	25.9	5,597	3,786
2016	61.3	25.8	5,716	3,884
2017	61.4	25.7	5,846	3,985
2018	61.5	25.6	5,981	4,086

Appendix D Glossary

The following definitions are largely excerpts from a list adopted by the major actuarial organizations in the United States. In some cases, the definitions have been modified for specific applicability to the CalSTRS DB Program. Defined terms are capitalized throughout this Appendix.

Actuarial Assumptions

Assumptions as to the occurrence of future events affecting pension costs, such as mortality, withdrawal, disablement and retirement, changes in compensation, rates of investment earnings and asset appreciation or depreciation, and procedures used to determine other relevant items.

Actuarial Cost Method

A procedure for determining the Actuarial Present Value of pension plan benefits and expenses and for developing an actuarially equivalent allocation of such value to time periods, usually in the form of a Normal Cost and an Actuarial Obligation.

Actuarial Equivalent

Of equal Actuarial Present Value, determined as of a given date with each value based on the same set of Actuarial Assumptions.

Actuarial Gain or Loss

A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions during the period between two actuarial valuation dates, as determined in accordance with a particular Actuarial Cost Method.

Actuarial Obligation

That portion, as determined by a particular Actuarial Cost Method, of the Actuarial Present Value of pension plan benefits and expenses which is not provided for by future Normal Costs.

Actuarial Present Value

The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions.

Actuarial Surplus

The excess, if any, of the Actuarial Value of Assets over the Actuarial Obligation.

Actuarial Valuation

The determination, as of a Valuation Date, of the Normal Cost, Actuarial Obligation, Actuarial Value of Assets and related Actuarial Present Values for a pension plan.

Actuarial Value of Assets

The value of cash, investments and other property belonging to a pension plan, as used by the actuary for the purpose of an actuarial valuation.

Entry Age Cost Method

An Actuarial Cost Method under which the Actuarial Present Value of Projected Benefits of each individual included in the actuarial valuation is allocated on a level basis over the earnings of the individual between entry age and assumed exit ages. The portion of this Actuarial Present Value allocated to a valuation year is called the Normal Cost. The portion of this Actuarial Present Value not provided for at a Valuation Date by the Actuarial Present Value of future Normal Costs is called the Actuarial Obligation.

Normal Cost

The portion of the Actuarial Present Value of Projected Benefits which is allocated to a valuation year by the Actuarial Cost Method.

Projected Unit Credit Cost Method

An Actuarial Cost Method under which the Actuarial Obligation is equal to the portion of the Actuarial Present Value of Projected Benefits of each individual included in the actuarial valuation is attributable to service credit that has been earned to date (past service). Since this cost method is only used in this valuation for cases where the service is fixed as of June 30, 2014, the Actuarial Obligation is equal to the portion of the Actuarial Present Value of Projected Benefits for the DB Program, and there is no Normal Cost.

Unfunded Actuarial Obligation

The excess, if any, of the Actuarial Obligation over the Actuarial Value of Assets.

Valuation Date

June 30, 2018.