

Teachers' Pension and Annuity Fund of New Jersey

**Actuarial Experience Study for
July 1, 2015 through June 30, 2018**

Produced by Cheiron

January 2020

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January 24, 2020

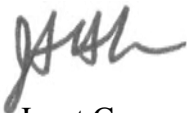
Board of Trustees
Teachers' Pension and Annuity Fund of New Jersey
State of New Jersey
Department of the Treasury
Division of Pension and Benefits, CN 295
Trenton, NJ 08625-0295

Dear Board Members:

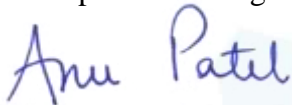
The purpose of this report is to present the Actuarial Experience Study of the Teachers' Pension and Annuity Fund of New Jersey (TPAF, the Fund) in accordance with Title 18A, Chapter 66-58 of the NJ State Statute. This Statute requires the actuary to conduct an actuarial investigation into the mortality, service and salary experience of the members and beneficiaries of the Fund at least once in every three year period. This experience study covers the actuarial experience from July 1, 2015 through June 30, 2018. The report includes analyses and results of our study as well as recommended assumptions for consideration by the Board for changes to several of the actuarial assumptions to be used beginning with the July 1, 2019 actuarial valuation. It also includes the estimated financial impact of these assumption changes.

If you have any questions about the report or would like additional information, please let us know.

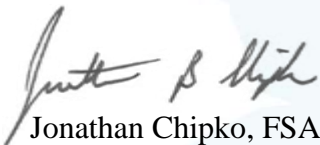
Sincerely,
Cheiron



Janet Cranna, FSA, FCA, MAAA, EA
Principal Consulting Actuary



Anu Patel, FSA, MAAA, EA
Principal Consulting Actuary



Jonathan Chipko, FSA, MAAA, EA
Consulting Actuary

cc: Kenneth Kent, FSA, FCA, MAAA, EA

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

SECTION I – EXECUTIVE SUMMARY

Actuarial assumptions (economic and demographic) are intended to be long-term in nature, and should be both individually reasonable and consistent in the aggregate. The purpose of this experience study is to evaluate whether or not the current assumptions adequately reflect the long-term expectations for TPAF, and if not, to recommend adjustments. It is important to note that frequent and significant changes in the actuarial assumptions are not typically recommended, unless there are known fundamental changes in expectations of the economy, or with respect to TPAF's membership, membership's future behavior or assets that would warrant such frequent or significant changes.

SUMMARY OF ASSUMPTION ANALYSIS

This experience study specifically analyzes and makes the following recommendations for the demographic assumptions.

- **Retirement rates** – Modify rates based on recent experience.
- **Termination rates** – Update to use a termination rate table that is only service based.
- **Disability rates** – Modify ordinary disability rates based on recent experience.
- **Mortality rates** – Update to use newly published Pub-2010 mortality tables with generational mortality improvements using SOA's Scale MP-2018.
- **Price and wage inflation rates** – Modify the inflation assumptions.
- **Salary increase rates** – Update the service based salary scale assumption for both the select and ultimate period. The rates during the select period are based on recent experience.

The recommended changes to the assumptions in aggregate would increase the actuarial liability and Statutory Contributions.

Further information about the impact of these changes to overall contribution rates can be found on the following page. We illustrate the cost impact based on the July 1, 2018 valuation results. However, assumption changes adopted by the Board will first impact the July 1, 2019 actuarial valuation.

The body of this report provides additional detail and support for our conclusions and recommendations.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

SECTION I – EXECUTIVE SUMMARY

Table I-1 Cost Impact of Assumption Changes on July 1, 2018 Valuation Results				
	Current Assumptions	Recommended Assumptions	Change in \$	% Change
<u>Assets and Liabilities</u>				
Actuarial Liability	\$ 60,971,919,315	\$ 62,838,863,683	\$ 1,866,944,368	3.1%
Actuarial Value of Assets (AVA) ¹	<u>26,308,754,955</u>	<u>26,308,754,955</u>	<u>0</u>	0.0%
Unfunded Actuarial Liability/(Surplus)	\$ 34,663,164,360	\$ 36,530,108,728	\$ 1,866,944,368	5.4%
Funded Ratio	43.1%	41.9%	-1.3%	
<u>Contribution Amounts</u>				
Gross Normal Cost at End of Year	\$ 1,148,439,462	\$ 1,211,348,259	\$ 62,908,797	5.5%
Expected Member Contributions	<u>(839,398,514)</u>	<u>(839,726,733)</u>	<u>(328,219)</u>	0.0%
State Normal Cost at End of Year	\$ 309,040,948	\$ 371,621,526	\$ 62,580,578	20.2%
Amortization Payment of UAL	<u>2,934,972,961</u>	<u>3,093,049,449</u>	<u>158,076,488</u>	5.4%
Total Statutory Contribution for FYE	\$ 3,244,013,909	\$ 3,464,670,975	\$ 220,657,066	6.8%

¹ Includes discounted State appropriations receivable and Lottery proceeds

The State normal cost increased 20.2% due to the proposed changes in assumptions resulting in an increase of 6.8% in the total Statutory contribution. The increase in normal cost was primarily driven by the change in the salary increase assumption. The gross normal cost increased 5.5% due to assumption changes. Because the member contribution rate is fixed, the entire increase in normal cost flows into the State's share of the normal cost resulting in the 20.2% increase in State normal cost.

TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018

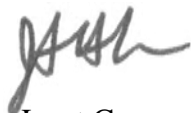
SECTION II – CERTIFICATION

The purpose of this report is to provide the results of an Actuarial Experience Study of the Teachers' Pension and Annuity Fund of New Jersey (TPAF) covering actuarial experience over a three year period from July 1, 2015 through June 30, 2018. This report is for the use of the Division of Pensions and Benefits and the TPAF Board of Trustees in selecting assumptions to be used in actuarial valuations beginning July 1, 2019. This experience study was completed in accordance with the provisions of Title 18A, Chapter 66-58 of the NJ State Statute which requires periodic review of the experience of the Fund.

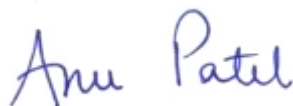
In preparing our report, we relied on information (some oral and some written) supplied by the Division of Pensions and Benefits. This information includes, but is not limited to, the plan provisions, employee data, and financial information. We performed an informal examination of the obvious characteristics of the data for reasonableness and consistency in accordance with Actuarial Standard of Practice No. 23.

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

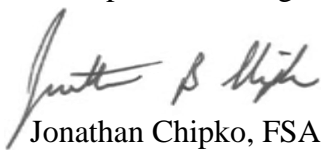
This report was prepared for the Teachers' Pension and Annuity Fund of New Jersey for the purposes described herein. This report is not intended to benefit any other party, and Cheiron assumes no duty or liability to any such party.



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Principal Consulting Actuary



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Consulting Actuary

SECTION III – DEMOGRAPHIC ASSUMPTIONS

Demographic assumptions are used to predict membership behavior, including rates of retirement, termination, disability, and mortality. These assumptions are based primarily on the historical experience of TPAF, with some adjustments where future experience is expected to differ from historical experience and with deference to standard tables where TPAF experience is not fully credible and a standard table is available.

ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS

For all of the demographic assumptions, we determined the ratio of the actual (A) number of decrements for each membership group compared to the expected (E) number of decrements (A/E ratio or actual-to-expected ratio). Generally, the goal is to get as close as possible to an A/E ratio of 100%. Appropriate assumptions are often dependent on the amount of data available, and if there is insufficient data, then the best assumption may be a reflection of standard tables. For example, there are typically relatively low incidences of pre-retirement deaths so using standard mortality tables may be more appropriate. This could result in the A/E ratio moving further away from 100%. Also, we aggregate members for demographic assumptions review when the data at individual ages is no longer credible. For example, we may reduce the number of service bands for an assumption with low incidences, if retaining those service bands do not materially improve the quality of the results.

We also calculate an *r-squared statistic* for each assumption. R-squared measures how well the assumption fits the actual data and can be thought of as the percentage of the variation in actual data explained by the assumption. Ideally, r-squared would equal 100%, although this is never the case in reality. Any recommended assumption change should increase the r-squared compared to the current assumption making it closer to 100% unless the pattern of future decrements is expected to be different from the pattern experienced during the period of study.

In addition, we calculated the 90% confidence interval, which represents the range within which the true decrement rate during the experience study period fell with a range anticipated to cover 90% of likely results. (If there is insufficient data to calculate a confidence interval, the confidence interval is shown as the entire range of the graph.) We generally propose assumption changes when the current assumption is outside the 90% confidence interval of the observed experience. However, adjustments are made to account for differences between future expectations and historical experience, to account for the past experience represented by the current assumption, and to maintain a neutral to slight conservative bias in the selection of the assumption. For mortality rates, we compare TPAF's experience to that of a standard table.

NON-CONTRIBUTING MEMBERS

The valuation census data provided by the Division of Pensions and Benefits includes non-contributing members. These members previously contributed to the Fund and, therefore, accrued benefits. However, they no longer contribute or accrue benefits. Typically, these members have terminated employment or applied for a retirement, disability, or death benefit and their paperwork was not processed in time to be reflected in the fiscal year end census data.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

SECTION III – DEMOGRAPHIC ASSUMPTIONS

We reviewed the experience among members who became non-contributing members during the three-year period to determine the status reported for these non-contributing members in subsequent years. This experience was used to estimate the proportion of this population that returned to work, elected a refund of their contributions, retired, became disabled, and died. While the available experience data is limited because the experience period is relatively short and some non-contributing members maintain that status for several years before electing a refund or returning to work, it is generally consistent with the last experience study. Therefore, we maintained the same assumptions used in the prior experience study, which was based on experience since 2006.

Specifically, for those who became non-contributing members during the study, 30% were assumed to return to active contributing status. Of the 70% of members not assumed to return to work, 1.2% were assumed to have become disabled, 0.5% were assumed to have died, and 98.3% were assumed to have terminated employment. Among members assumed to terminate employment, those eligible for a retirement benefit were assumed to have retired. Among members assumed to terminate employment prior to eligibility for a retirement benefit, 80% of members eligible for a deferred annuity were assumed to elect the deferred annuity and all other members were assumed to elect a refund of their contributions.

**SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES**

RETIREMENT RATES

The current retirement rates vary by tier, age, service, and gender and are applied to all members who are eligible to retire. As a result, a member who is age 60 with 20 years of service, for example, is assumed to be less likely to retire than a member of the same sex and tier who is age 60 with 25 years of service. In reviewing the data for TPAF, we find that at many ages, members are more likely to retire once they have attained 25 years of service, and those with less than 25 years of service are less likely to retire.

TPAF is not large enough to justify assumptions for each age, service and tier combination and the experience did not vary significantly by gender, so we recommend unisex assumptions by service groups separately for Tiers 1-4 and for Tier 5. The actual results shown on the following pages reflect eligible members and retirements in all five tiers.

We did not show results separately by tier because very few members in Tiers 2 through 5 are eligible for retirement. As of June 30, 2018, members in Tiers 2 through 5 can only retire under a service retirement allowance since they do not have sufficient service to meet early retirement eligibility. In addition, Tiers 2 through 4 are closed to new members so there will never be significant experience for these tiers. Due to these limited exposures for Tiers 2 through 5, the current rates shown on the following pages are based only on the current Tier 1 retirement rates.

We recommend separate retirement rates for Tier 5 because Tier 5 members need 30 years of service to retire early whereas Tiers 1 through 4 only require 25 years of service to retire early. The recommended retirement rates for Tier 5 members are based on professional judgement due to limited experience.

We recommend separate assumptions for the following service groups and tiers:

Tiers 1-4 Members

- Members with less than 25 years of service,
- Members with 25 years of service, and
- Members with 26 or more years of service.

Tier 5 Members

- Members with less than 25 years of service,
- Members with 25 years of service,
- Members with 26 to 29 years of service,
- Members with 30 years of service, and
- Members with 31 or more years of service.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES**

In Table III-R1 we show the calculation of actual-to-expected ratios and the r-squared statistic for Tier 1-5 members with less than 25 years of service, and Chart III-R1 shows the information graphically along with the 90% confidence interval. For retirements with less than 25 years of service, we recommend unisex retirement rates that are slightly higher than current Tier 1 rates for most ages.

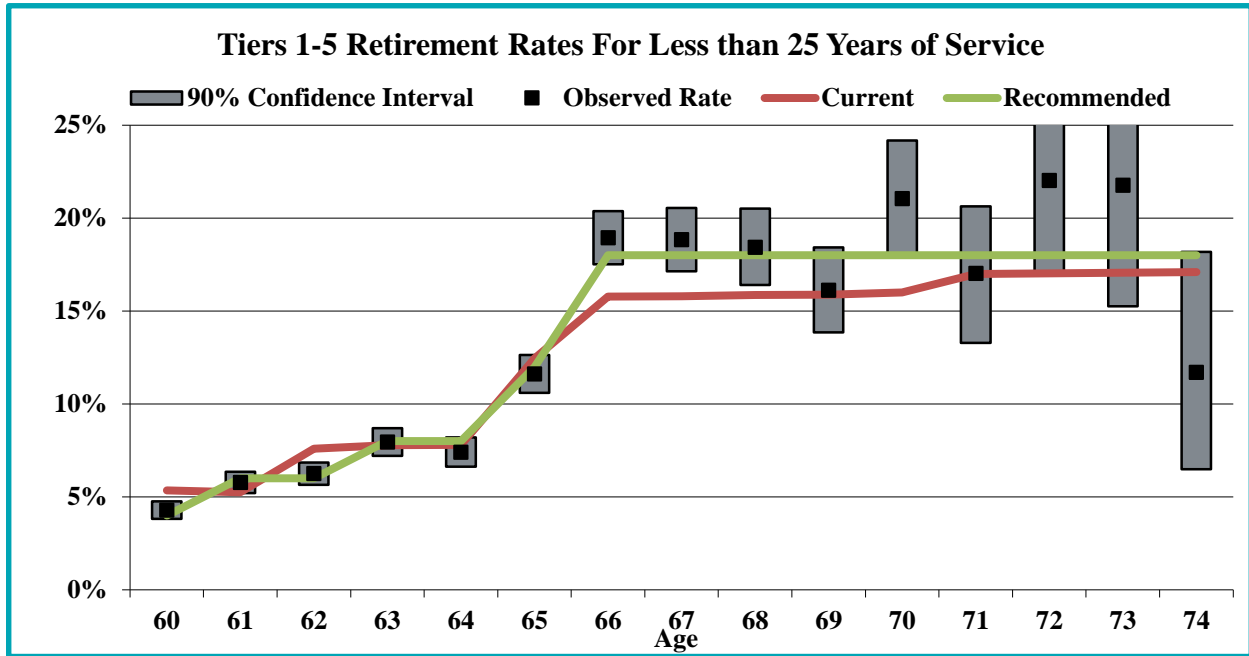
Table III-R1

Tiers 1-5 Retirement Rates For Less than 25 Years of Service									
Age	Exposures	Retirements			Retirement Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
60	5,006	214	267.3	200.2	4.3%	5.3%	4.0%	80%	107%
61	4,666	269	244.8	280.0	5.8%	5.2%	6.0%	110%	96%
62	4,289	268	325.5	257.3	6.3%	7.6%	6.0%	82%	104%
63	3,636	289	283.0	290.9	7.9%	7.8%	8.0%	102%	99%
64	3,050	226	238.0	244.0	7.4%	7.8%	8.0%	95%	92%
65	2,644	307	329.4	317.3	11.6%	12.5%	12.0%	93%	97%
66	2,066	391	325.9	371.9	18.9%	15.8%	18.0%	120%	105%
67	1,406	265	222.1	253.1	18.8%	15.8%	18.0%	119%	105%
68	975	180	154.7	175.5	18.4%	15.9%	18.0%	116%	102%
69	700	113	111.2	126.0	16.1%	15.9%	18.0%	101%	89%
70	455	96	72.8	81.9	21.1%	16.0%	18.0%	132%	117%
71	286	49	48.6	51.5	17.0%	17.0%	18.0%	100%	95%
72	188	41	32.0	33.8	22.0%	17.0%	18.0%	129%	122%
73	118	26	20.1	21.2	21.8%	17.1%	18.0%	128%	121%
74	77	9	13.2	13.9	11.7%	17.1%	18.0%	68%	65%
Total	29,562	2,742	2,688.6	2,718.5	9.3%	9.1%	9.2%	102%	101%
R-squared			0.929	0.991					

TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Chart III-R1



**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES**

Table III-R2 shows the calculation of actual-to-expected ratios and the r-squared statistic for members with 25 years of service, and Chart III-R2 shows the information graphically along with the 90% confidence interval. The data shows that the actual retirement rates are generally lower than expected for members younger than 66, so we recommend lower unisex retirement rates for most ages prior to 66 and maintaining the current assumption thereafter.

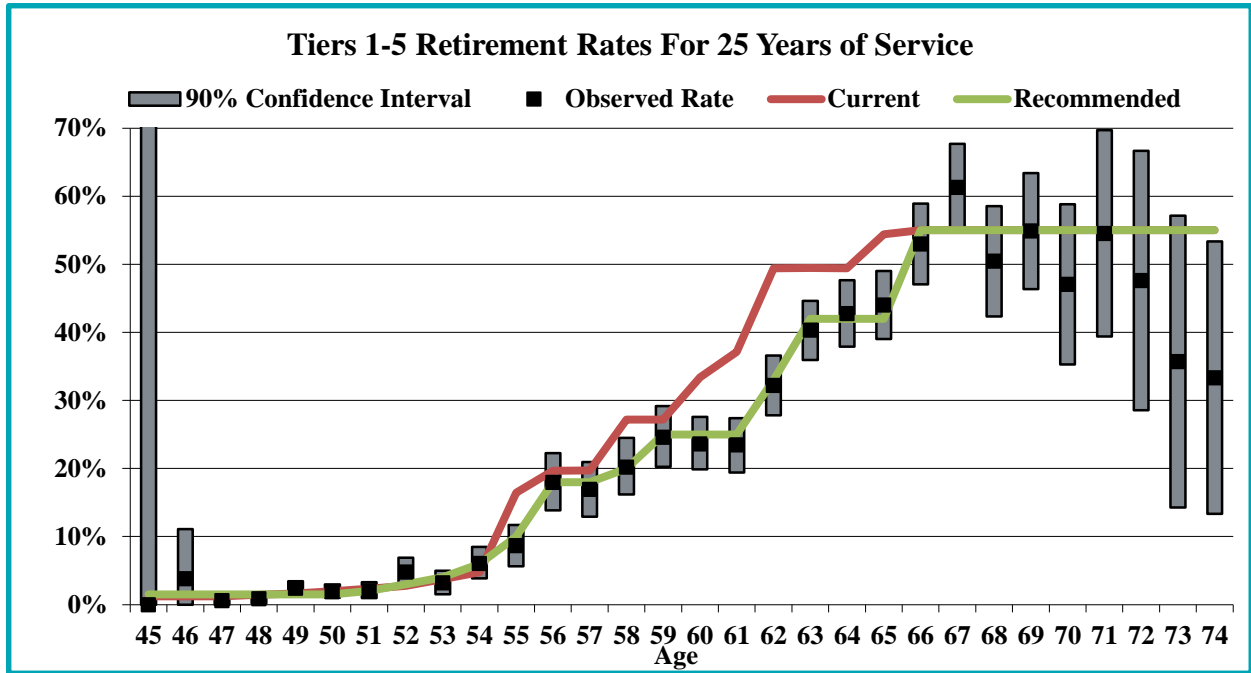
Table III-R2

Tiers 1-5 Retirement Rates For 25 Years of Service									
Age	Exposures	Retirements			Retirement Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
45	12	0	0.1	0.2	0.0%	1.2%	1.5%	0%	0%
46	18	1	0.2	0.3	3.8%	1.2%	1.5%	319%	255%
47	240	1	2.9	3.6	0.6%	1.2%	1.5%	48%	38%
48	544	5	7.9	8.2	0.9%	1.5%	1.5%	59%	57%
49	644	15	10.6	9.7	2.4%	1.7%	1.5%	145%	159%
50	508	10	9.9	7.6	1.9%	2.0%	1.5%	98%	127%
51	426	9	10.0	8.5	2.0%	2.4%	2.0%	87%	102%
52	334	16	9.2	10.0	4.8%	2.8%	3.0%	174%	160%
53	261	8	9.8	10.4	3.2%	3.8%	4.0%	86%	80%
54	260	16	12.4	15.6	6.0%	4.8%	6.0%	127%	101%
55	231	20	38.0	23.1	8.7%	16.4%	10.0%	53%	87%
56	238	43	46.8	42.8	17.9%	19.7%	18.0%	91%	100%
57	248	42	48.9	44.6	16.9%	19.7%	18.0%	86%	94%
58	241	49	65.6	48.2	20.2%	27.2%	20.0%	74%	101%
59	247	61	67.1	61.8	24.6%	27.2%	25.0%	90%	98%
60	312	74	104.2	78.0	23.6%	33.4%	25.0%	71%	94%
61	314	74	116.6	78.5	23.5%	37.1%	25.0%	63%	94%
62	295	95	145.7	97.4	32.2%	49.4%	33.0%	65%	98%
63	334	135	165.2	140.3	40.3%	49.5%	42.0%	82%	96%
64	277	118	136.9	116.3	42.7%	49.4%	42.0%	87%	102%
65	259	114	141.0	108.8	44.0%	54.4%	42.0%	81%	105%
66	202	107	111.1	111.1	53.0%	55.0%	55.0%	96%	96%
67	161	99	88.6	88.6	61.3%	55.0%	55.0%	111%	111%
68	111	56	61.1	61.1	50.5%	55.0%	55.0%	92%	92%
69	82	45	45.1	45.1	54.9%	55.0%	55.0%	100%	100%
70	51	24	28.1	28.1	47.1%	55.0%	55.0%	86%	86%
71	33	18	18.2	18.2	54.5%	55.0%	55.0%	99%	99%
72	21	10	11.6	11.6	47.6%	55.0%	55.0%	87%	87%
73	14	5	7.7	7.7	35.7%	55.0%	55.0%	65%	65%
74	15	5	8.3	8.3	33.3%	55.0%	55.0%	61%	61%
Total	6,933	1,273	1,528.4	1,293.4	18.4%	22.0%	18.7%	83%	98%
R-squared			0.949	0.992					

TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Chart III-R2



**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES**

Table III-R3 shows the calculation of actual-to-expected ratios and the r-squared statistic for members with 26 or more years of service, and Chart III-R3 shows the information graphically along with the 90% confidence interval. For retirements with 26 or more years of service, we recommend unisex rates that more closely align with actual experience.

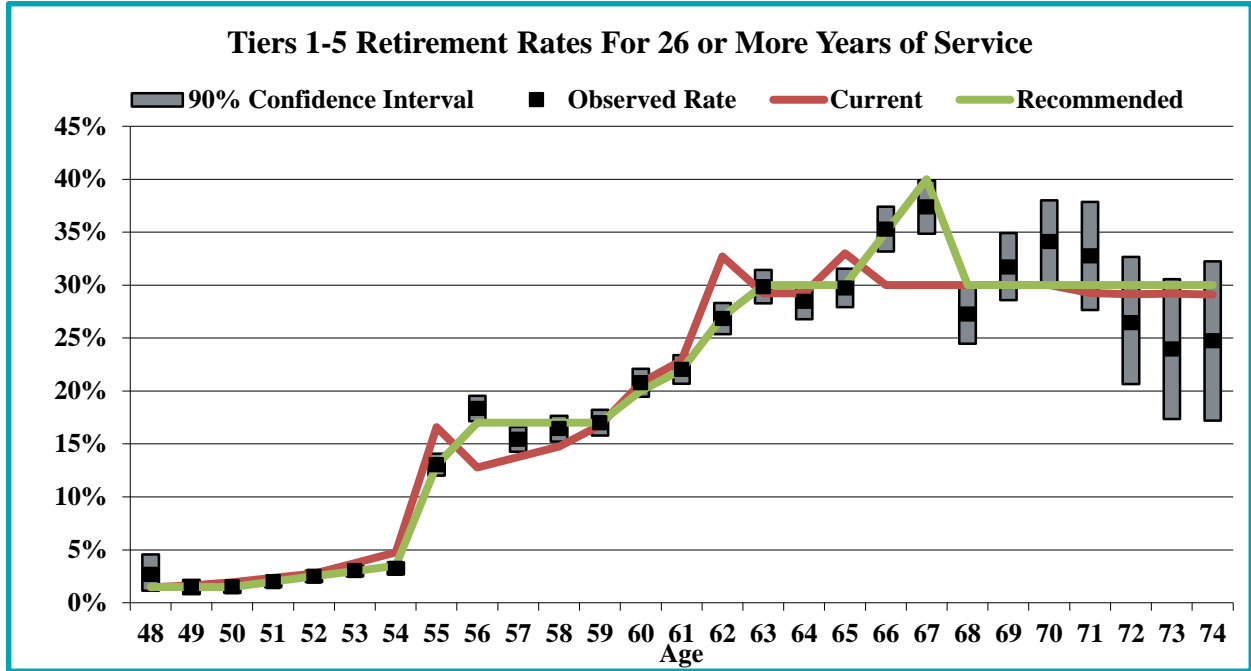
Table III-R3

Tiers 1-5 Retirement Rates For 26 or More Years of Service									
Age	Exposures	Retirements			Retirement Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
45	3	0	0.0	0.0	0.0%	1.2%	1.5%	0%	0%
46	15	1	0.2	0.2	6.7%	1.2%	1.5%	556%	444%
47	29	0	0.3	0.4	0.0%	1.2%	1.5%	0%	0%
48	262	7	3.8	3.9	2.7%	1.5%	1.5%	184%	178%
49	739	11	12.2	11.1	1.5%	1.7%	1.5%	88%	97%
50	1,272	19	24.8	19.1	1.5%	2.0%	1.5%	77%	100%
51	1,774	35	41.7	35.5	2.0%	2.4%	2.0%	84%	99%
52	2,199	55	60.5	55.0	2.5%	2.8%	2.5%	91%	100%
53	2,493	76	93.5	74.8	3.0%	3.8%	3.0%	81%	101%
54	2,753	89	130.8	96.4	3.2%	4.8%	3.5%	68%	93%
55	2,913	380	483.4	378.7	13.0%	16.6%	13.0%	79%	100%
56	2,833	520	362.1	481.6	18.4%	12.8%	17.0%	144%	108%
57	2,603	401	358.6	442.5	15.4%	13.8%	17.0%	112%	91%
58	2,566	422	378.7	436.2	16.4%	14.8%	17.0%	111%	97%
59	2,540	432	425.7	431.8	17.0%	16.8%	17.0%	101%	100%
60	2,585	537	536.5	517.0	20.8%	20.8%	20.0%	100%	104%
61	2,605	574	596.0	573.1	22.0%	22.9%	22.0%	96%	100%
62	2,533	680	828.7	683.9	26.8%	32.7%	27.0%	82%	99%
63	2,301	687	672.8	690.3	29.8%	29.2%	30.0%	102%	99%
64	2,016	574	589.5	604.8	28.5%	29.2%	30.0%	97%	95%
65	1,708	508	563.6	512.4	29.7%	33.0%	30.0%	90%	99%
66	1,363	481	408.9	477.1	35.3%	30.0%	35.0%	118%	101%
67	1,021	382	306.3	408.4	37.4%	30.0%	40.0%	125%	93%
68	707	193	212.1	212.1	27.3%	30.0%	30.0%	91%	91%
69	570	181	171.0	171.0	31.7%	30.0%	30.0%	106%	106%
70	384	131	115.2	115.2	34.1%	30.0%	30.0%	114%	114%
71	235	77	68.7	70.5	32.8%	29.2%	30.0%	112%	109%
72	150	40	43.7	45.0	26.5%	29.1%	30.0%	91%	88%
73	121	29	35.3	36.3	24.0%	29.2%	30.0%	82%	80%
74	93	23	27.1	27.9	24.7%	29.1%	30.0%	85%	82%
Total	43,386	7,542	7,551.8	7,612.2	17.4%	17.4%	17.5%	100%	99%
R-squared			0.955	0.996					

TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Chart III-R3



There is insufficient data to show tables and charts for Tier 5 members separately. The recommended Tier 5 specific retirement rates are shown in Appendix A.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
TERMINATION RATES**

Termination rates reflect the frequency at which active members leave employment for reasons other than retirement, death, or disability. The current assumption varies by age, service, and gender. We recommend changing the assumption to a unisex table based on service only, with rates ultimately reaching 0 when members become retirement eligible. Table III-T1 shows the number of terminations, our recommended termination rates based on years of service, the calculation of actual-to-expected ratios for each year of service and the r-squared statistic. Chart III-T1 shows the information graphically along with the 90% confidence interval.

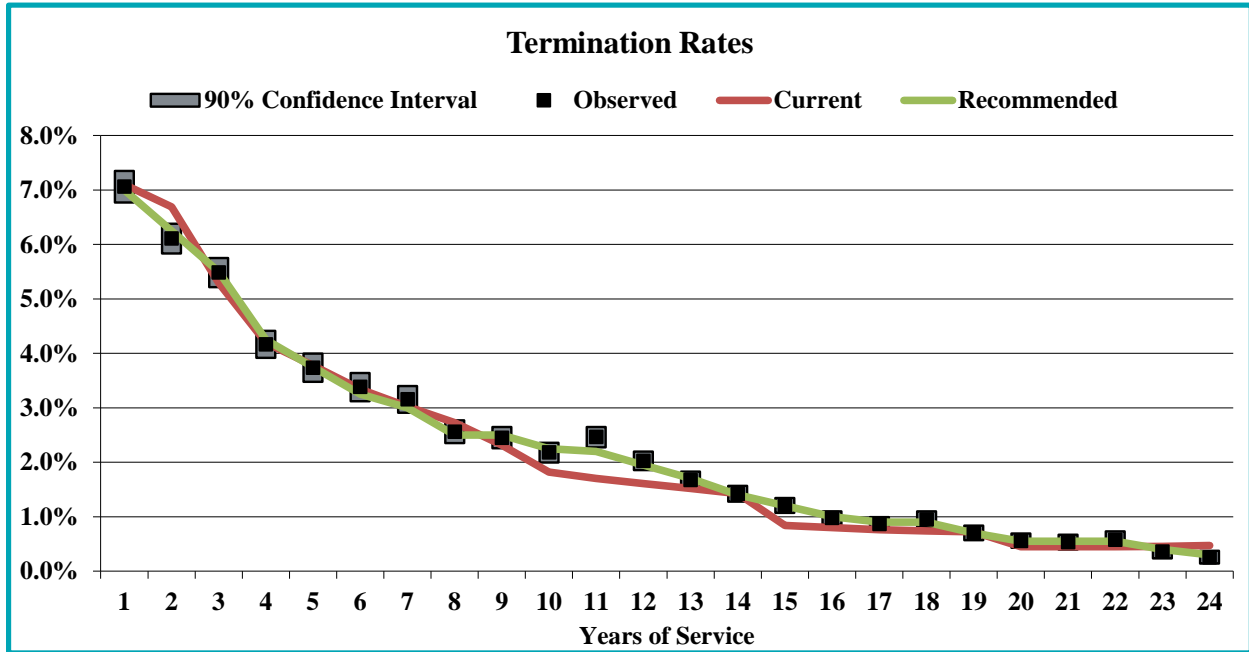
Table III-T1

Termination Rates									
Service	Exposures	Terminations			Termination Rates			A/E Ratios	
		Actual	Current	Proposed	Actual	Current	Proposed	Current	Proposed
1	20,869	1,473	1,482.3	1,460.8	7.06%	7.10%	7.00%	99%	101%
2	20,764	1,268	1,389.2	1,297.8	6.11%	6.69%	6.25%	91%	98%
3	19,368	1,062	1,025.2	1,065.2	5.48%	5.29%	5.50%	104%	100%
4	17,562	731	736.5	746.4	4.16%	4.19%	4.25%	99%	98%
5	14,601	545	551.4	547.5	3.73%	3.78%	3.75%	99%	100%
6	13,352	452	445.9	433.9	3.38%	3.34%	3.25%	101%	104%
7	13,470	425	407.5	404.1	3.15%	3.03%	3.00%	104%	105%
8	15,598	399	425.2	390.0	2.56%	2.73%	2.50%	94%	102%
9	16,926	415	391.8	423.2	2.45%	2.31%	2.50%	106%	98%
10	17,646	384	320.7	397.0	2.18%	1.82%	2.25%	120%	97%
11	18,266	449	311.0	401.9	2.46%	1.70%	2.20%	145%	112%
12	18,117	367	291.7	353.3	2.02%	1.61%	1.95%	126%	104%
13	17,812	297	270.6	302.8	1.67%	1.52%	1.70%	110%	98%
14	17,827	253	254.1	249.6	1.42%	1.43%	1.40%	99%	101%
15	17,746	214	149.2	213.0	1.20%	0.84%	1.20%	143%	100%
16	17,017	166	135.6	170.2	0.98%	0.80%	1.00%	122%	98%
17	14,999	130	114.5	135.0	0.87%	0.76%	0.90%	113%	96%
18	12,964	123	95.6	116.7	0.95%	0.74%	0.90%	129%	106%
19	10,518	74	76.0	73.6	0.70%	0.72%	0.70%	97%	101%
20	8,683	48	38.7	47.8	0.55%	0.45%	0.55%	124%	100%
21	7,313	39	32.7	40.2	0.53%	0.45%	0.55%	118%	96%
22	6,576	38	29.4	36.2	0.58%	0.45%	0.55%	129%	105%
23	5,932	21	26.9	23.7	0.36%	0.45%	0.40%	79%	89%
24	5,055	13	23.7	15.2	0.25%	0.47%	0.30%	54%	84%
Total	348,981	9,385	9,025.5	9,344.9	2.69%	2.59%	2.68%	104%	100%
R-squared			0.988	0.999					

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SECTION III – DEMOGRAPHIC ASSUMPTIONS
TERMINATION RATES

Chart III-T1



The current assumption is that all members who terminate employment with less than 10 years of service are assumed to elect a refund of contributions. Members with 10 or more years of service are assumed to elect deferred annuities at varying rates based on age. Of the 2,615 members who terminated employment with 10 or more years of service in the three year experience study period, 1,746 elected a deferred annuity and 869 elected a refund of contributions. We recommend that 67% of members terminating with 10 or more years of service are assumed to elect a deferred annuity; all other members terminating are assumed to receive a refund of accumulated deductions with credited interest.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES**

Table III-D1 shows the calculation of actual-to-expected ratios and the r-squared statistic for accidental disability. The experience shows very low incidence of accidental disability and therefore we recommend maintaining the current assumption.

Table III-D1

Accidental Disability Rates									
Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
25 - 29	1,396	0	0.1	0.1	0.000%	0.006%	0.006%	0%	0%
30 - 34	33,695	0	2.0	2.0	0.000%	0.006%	0.006%	0%	0%
35 - 39	59,477	0	3.6	3.6	0.000%	0.006%	0.006%	0%	0%
40 - 44	55,972	1	3.4	3.4	0.002%	0.006%	0.006%	30%	30%
45 - 49	53,224	1	3.2	3.2	0.002%	0.006%	0.006%	31%	31%
50 - 54	44,931	5	2.7	2.7	0.011%	0.006%	0.006%	185%	185%
55 - 59	44,326	3	2.7	2.7	0.007%	0.006%	0.006%	113%	113%
60 - 64	36,273	12	2.2	2.2	0.033%	0.006%	0.006%	551%	551%
65 - 69	14,885	1	0.9	0.9	0.007%	0.006%	0.006%	112%	112%
Total	344,179	23	20.7	20.7	0.007%	0.006%	0.006%	111%	111%
R-squared			0.001	0.001					

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES**

Table III-D2 shows the calculation of actual-to-expected ratios and the r-squared statistic for ordinary disability, and Chart III-D2 shows the information graphically along with the 90% confidence interval. Recent experience has been fairly consistent with the current assumption. However, there is insufficient experience to maintain gender specific rates. Therefore, we recommend unisex rates that closely reflect recent experience.

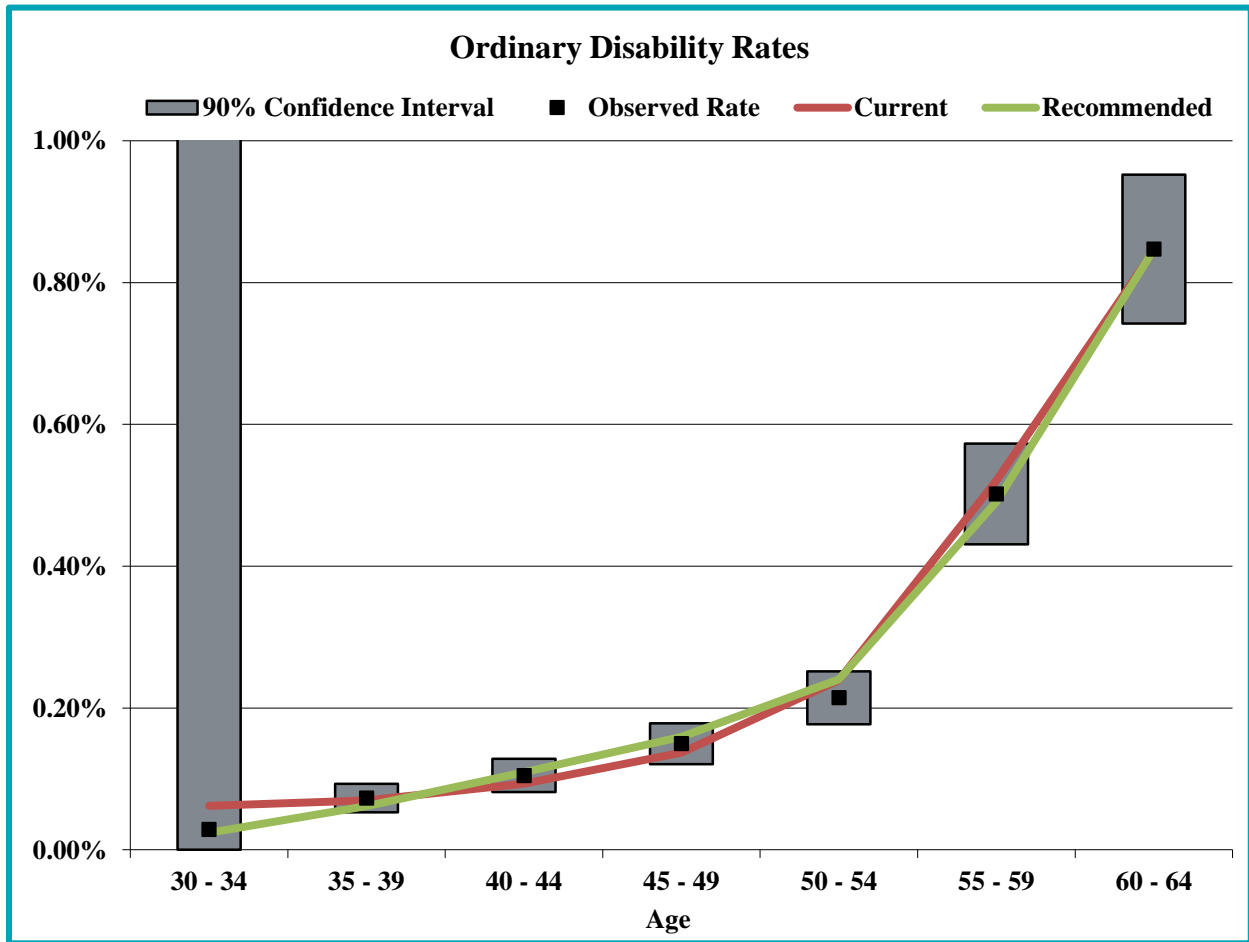
**Table III-D2
Ordinary Disability Rates**

Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
30 - 34	12,255	4	7.6	3.0	0.029%	0.062%	0.024%	46%	119%
35 - 39	49,180	36	34.2	30.2	0.073%	0.070%	0.062%	105%	119%
40 - 44	51,238	54	47.8	56.1	0.105%	0.093%	0.110%	112%	96%
45 - 49	49,131	74	67.4	78.2	0.150%	0.137%	0.159%	109%	94%
50 - 54	41,388	89	99.0	99.4	0.214%	0.239%	0.240%	90%	89%
55 - 59	26,847	135	139.9	131.8	0.502%	0.521%	0.491%	96%	102%
60 - 64	20,619	175	174.4	174.7	0.847%	0.846%	0.847%	100%	100%
65 - 69	7,418	100	94.1	92.4	1.350%	1.269%	1.246%	106%	108%
Total	258,076	665	664.4	665.9	0.258%	0.257%	0.258%	100%	100%
R-squared			0.770	0.790					

TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES

Chart III-D2



**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Mortality assumptions are typically developed separately by gender. Unlike most of the other demographic assumptions that rely exclusively on the experience of the plan, for mortality, standard mortality tables and projection scales serve as the primary basis for the assumption which is then modified to better reflect the Fund's experience.

The Society of Actuaries (SOA) recently completed an extensive mortality study of public pension plan experience and issued a set of mortality tables named the Pub-2010 mortality tables which provide new insights into the composition of gender-specific pension mortality by factors such as job category (e.g. General Employees, Teachers, Public Safety), salary/benefit amount, health status (e.g. healthy or disabled), geographic region and duration since event.

In addition, there has been a long history of mortality improvement among pensioners in the U.S., and there is an expectation that mortality rates will continue to improve in the future. The recently completed project by the SOA concluded that mortality improvement in the U.S over the recent past "differed quite noticeably" from the prior standard projection scales (Scales AA and BB). As a result, we recommend using the MP-2018 scale, which was the most recent mortality improvement projection scale at the time this analysis was prepared.

The steps in our analysis of the mortality assumptions are as follows:

1. Select a standard mortality table that reflects the anticipated experience of the Fund.
2. Compare actual experience of the Fund to what would have been predicted by the selected standard table for the period of the experience study.
3. Adjust the standard table either fully or partially depending on the level of credibility for the Fund's experience. This adjusted table is called the base table.
4. Select an appropriate standard mortality improvement projection scale and apply it to the base table.

Similar to the methodology used to develop the Pub-2010 tables, when actual experience of the Fund is compared to that of the standard table, the experience is weighted based on the amount of income (salary for pre-retirement mortality and pension benefit for post-retirement mortality). Mortality studies in the U.S. have consistently shown that individuals with higher salaries if active or higher benefit income if retired, have longer life expectancies than individuals with lower income. It is important for a pension plan to use assumptions that are weighted by income to reflect not just the incidence of a decrement but the impact on liabilities.

TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

In the prior study, TPAF adopted the following assumptions:

Active members: RP-2006 Employee White Collar Mortality Tables, set back 3 years for males and 5 years for females, projected on a generational basis from a base year of 2006 using a 60-year average of improvement rates based on Social Security data from 1953 to 2013. All pre-retirement deaths are assumed to be ordinary deaths.

Healthy retirees and beneficiaries: RP-2006 Healthy Annuitant White Collar Mortality Tables, with adjustments as described in the prior experience study, projected on a generational basis from a base year of 2006 using a 60-year average of improvement rates based on Social Security data from 1953 to 2013.

Disabled retirees: RP-2006 Disabled Retiree Mortality Tables with rates adjusted by 90%. No mortality improvement is assumed for disabled retiree mortality.

There are enough deaths for TPAF to provide meaningful statistics in the three-year period. For healthy annuitants, there were 6,876 deaths over this period, for disabled retirees there were 385 deaths, and for active members there were 227 deaths. For reference, a fully credible sample would include 1,082 deaths. We therefore recommend using the standard Pub-2010 table for teachers with adjustments to account for TPAF experience.

We recommend the following mortality table assumptions:

Active members (Non-Annuitants): The standard Pub-2010 Teachers Above-Median Income Employee mortality table [*PubT-2010(A) Employee*] as published by the Society of Actuaries with a 93.9% adjustment for males and 85.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. All pre-retirement deaths are assumed to be ordinary deaths.

Healthy retirees and beneficiaries (Healthy Annuitants): The standard Pub-2010 Teachers Above-Median Income Healthy Retiree mortality table [*PubT-2010(A) Healthy Retiree*] as published by the Society of Actuaries with a 114.7% adjustment for males and 99.6% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Disabled retirees (Disabled Annuitants): The Pub-2010 Non-Safety Disabled Retiree mortality table [*PubNS-2010 Disabled Retiree*] as published by the Society of Actuaries with a 106.3% adjustment for males and 100.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

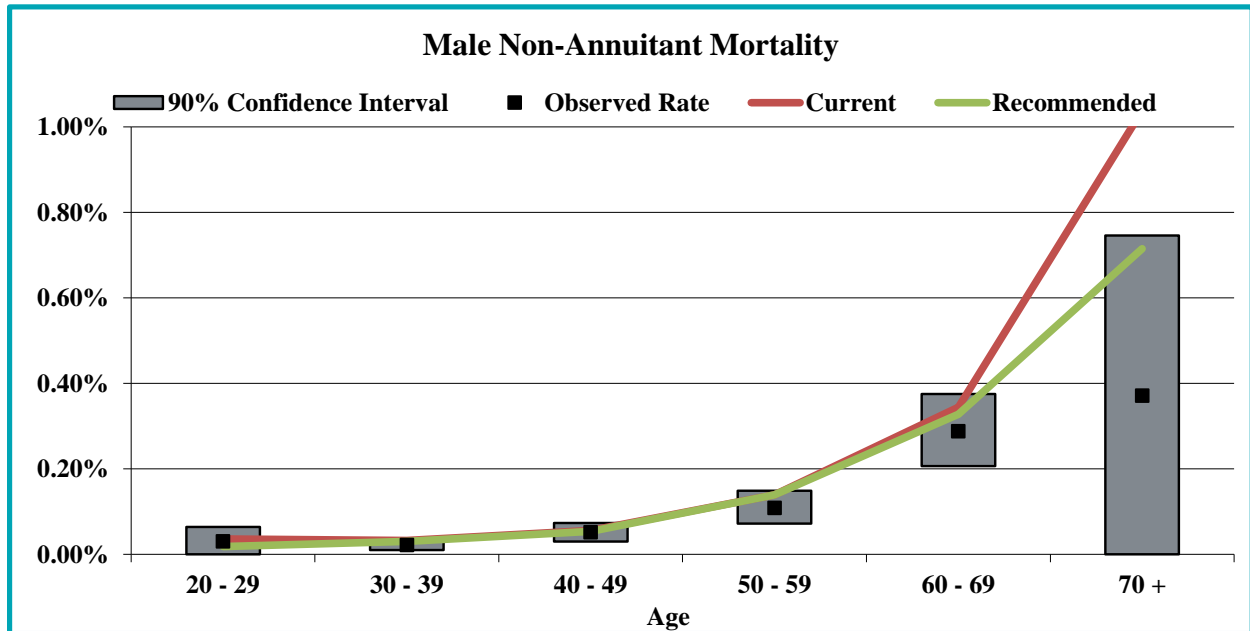
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Table III-M1 – Active Males

Non-Annuitant Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
20 - 29	7,807	3	418,519,516	128,638	151,394	75,610	85%	170%
30 - 39	29,884	8	1,950,658,538	436,029	638,967	589,171	68%	74%
40 - 49	30,013	17	2,555,658,519	1,335,450	1,427,017	1,385,552	94%	96%
50 - 59	19,499	24	1,776,248,906	1,939,436	2,475,696	2,474,667	78%	78%
60 - 69	10,662	33	1,011,861,054	2,921,048	3,483,567	3,317,759	84%	88%
70 +	804	4	82,968,861	308,291	861,228	592,925	36%	52%
Total	98,669	88	7,795,915,394	7,068,892	9,037,868	8,435,685	78%	84%
R-Squared					0.531	0.564		

Chart III-M1



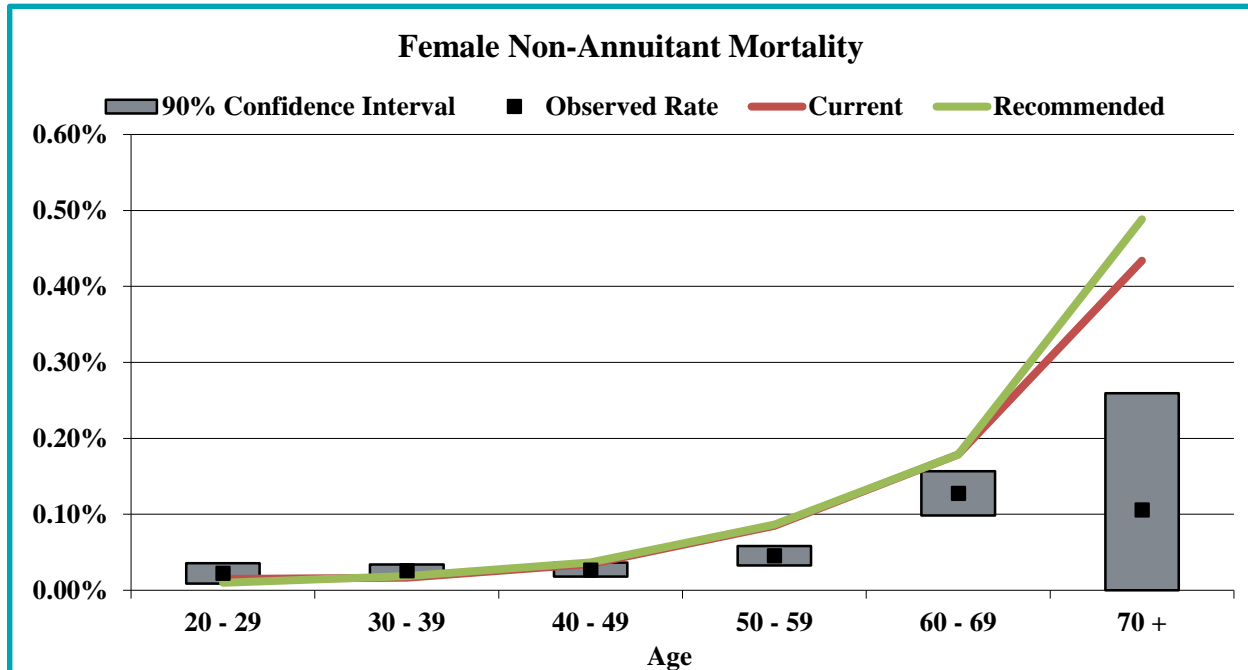
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Table III-M2 – Active Females

Non-Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
20 - 29	33,770	8	1,814,858,238	402,644	273,723	178,116	147%	226%
30 - 39	97,360	24	6,090,629,365	1,551,204	1,022,927	1,130,841	152%	137%
40 - 49	87,688	24	6,720,035,105	1,788,302	2,336,920	2,471,572	77%	72%
50 - 59	70,357	33	5,744,202,122	2,595,419	4,877,416	4,975,009	53%	52%
60 - 69	39,508	48	3,461,972,043	4,416,876	6,183,429	6,187,790	71%	71%
70 +	1,927	2	179,223,026	189,519	777,539	874,823	24%	22%
Total	330,610	139	24,010,919,899	10,943,965	15,471,955	15,818,151	71%	69%
R-Squared					0.566	0.563		

Chart III-M2



During the three-year period, there were 227 deaths in active service. Of these deaths, one was accidental. We recommend maintaining the assumption that all pre-retirement deaths are ordinary deaths.

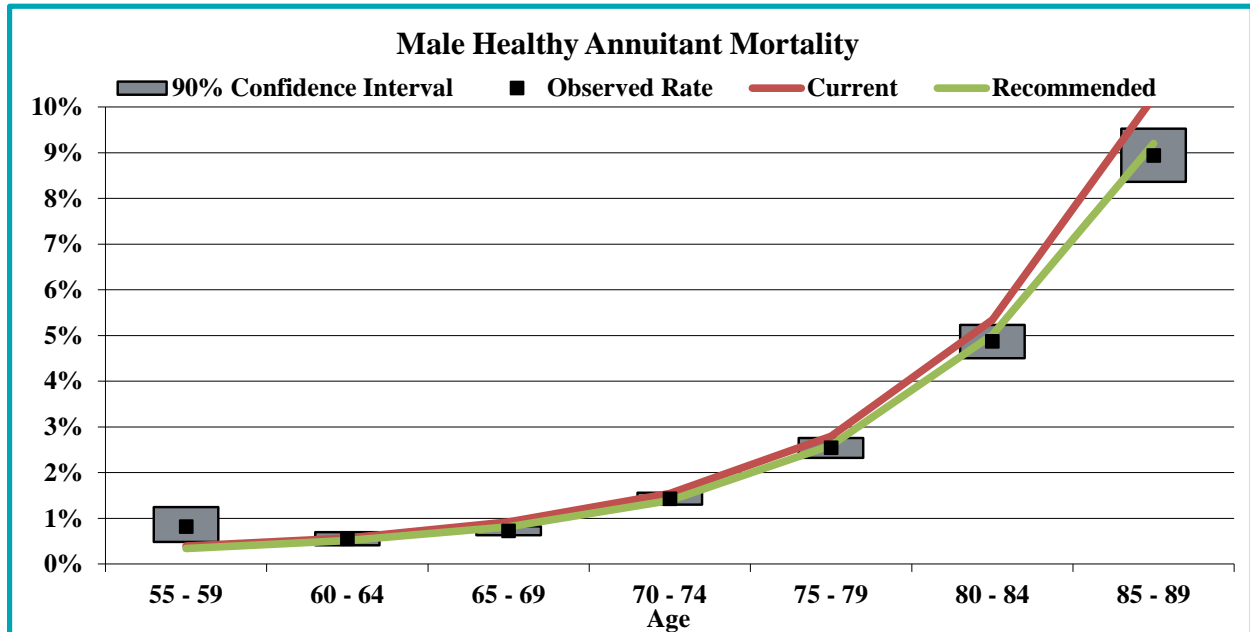
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Table III-M3 – Healthy Annuitant Males

Healthy Annuitant Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
55 - 59	1,445	11	69,363,639	567,706	273,792	233,924	207%	243%
60 - 64	7,302	49	357,875,297	1,968,663	2,026,846	1,845,641	97%	107%
65 - 69	21,005	170	1,031,187,816	7,500,735	9,524,262	8,426,892	79%	89%
70 - 74	23,505	367	1,104,807,106	15,775,009	17,042,671	15,330,215	93%	103%
75 - 79	14,238	384	646,470,644	16,426,220	18,053,638	16,787,459	91%	98%
80 - 84	9,476	483	405,115,906	19,730,353	21,647,046	20,305,092	91%	97%
85 - 89	6,423	583	247,650,085	22,127,778	25,292,410	22,785,563	87%	97%
90 - 94	2,506	453	79,088,041	14,334,053	14,642,108	12,761,449	98%	112%
95 +	511	136	12,454,809	3,420,078	3,707,821	3,350,620	92%	102%
Total	86,411	2,636	3,954,013,343	101,850,595	112,210,594	101,826,855	91%	100%
R-Squared					0.886	0.887		

Chart III-M3



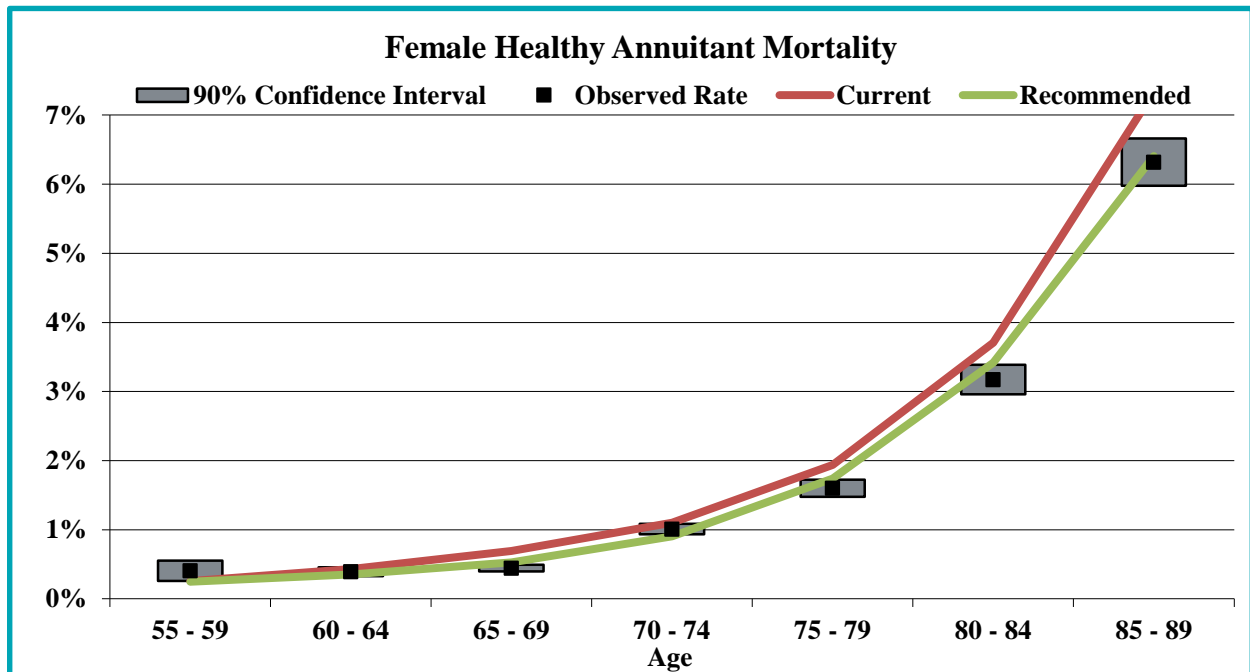
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Table III-M4 – Healthy Annuitant Females

Healthy Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
55 - 59	5,059	23	231,319,958	934,516	594,403	575,991	157%	162%
60 - 64	24,679	101	1,075,590,494	4,217,559	4,652,412	3,793,559	91%	111%
65 - 69	55,424	257	2,373,517,748	10,554,477	16,487,749	12,523,691	64%	84%
70 - 74	47,610	481	1,914,933,042	19,298,924	21,069,788	17,322,287	92%	111%
75 - 79	27,808	452	1,040,615,823	16,664,148	20,168,551	18,098,808	83%	92%
80 - 84	18,124	588	617,262,562	19,575,501	22,869,085	21,087,678	86%	93%
85 - 89	13,632	896	404,806,062	25,579,439	29,698,672	25,935,009	86%	99%
90 - 94	7,029	910	165,518,228	21,118,976	22,502,479	18,928,680	94%	112%
95 +	2,610	532	51,892,696	10,870,485	11,777,953	10,514,063	92%	103%
Total	201,975	4,240	7,875,456,613	128,814,025	149,821,091	128,779,765	86%	100%
R-Squared					0.769	0.781		

Chart III-M4



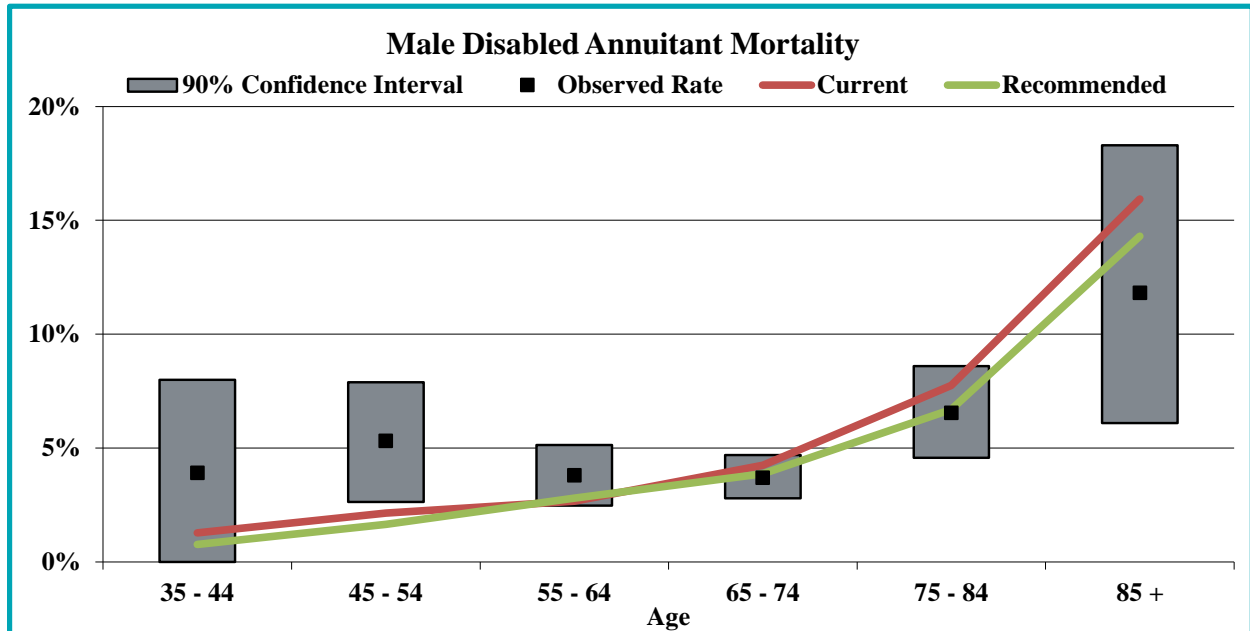
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Table III-M5 – Disabled Annuitant Males

Disabled Annuitant Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
35 - 44	50	2	1,401,053	54,834	17,921	10,716	306%	512%
45 - 54	190	11	5,932,297	315,731	127,141	97,807	248%	323%
55 - 64	526	22	16,245,283	617,894	432,283	455,249	143%	136%
65 - 74	1,002	38	29,931,456	1,107,741	1,270,956	1,159,121	87%	96%
75 - 84	372	27	9,650,281	632,377	747,236	645,852	85%	98%
85 +	82	10	1,411,109	166,874	224,782	201,735	74%	83%
Total	2,222	110	64,571,479	2,895,451	2,820,319	2,570,480	103%	113%
R-Squared					0.434	0.454		

Chart III-M5



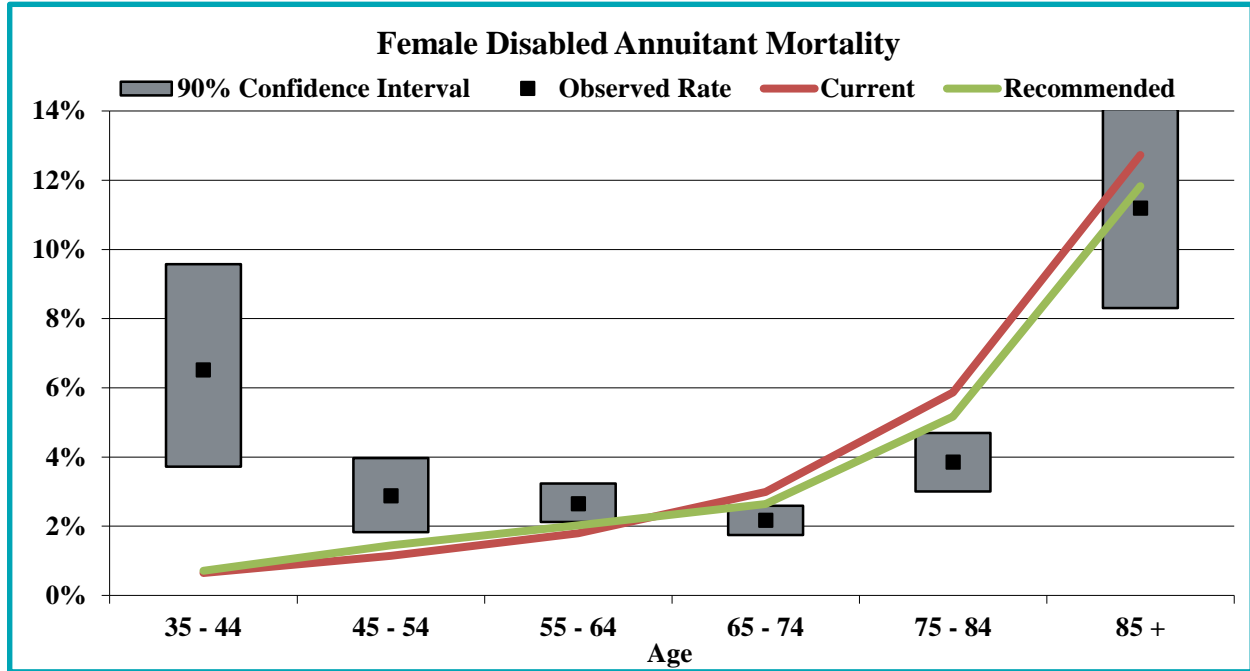
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES**

Table III-M6 – Disabled Annuitant Females

Disabled Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
35 - 44	188	12	4,832,315	314,995	31,487	34,501	1000%	913%
45 - 54	655	22	19,676,963	566,439	224,513	284,801	252%	199%
55 - 64	2,259	64	69,515,939	1,841,110	1,250,585	1,407,185	147%	131%
65 - 74	3,322	79	97,075,749	2,102,086	2,905,200	2,565,803	72%	82%
75 - 84	1,364	59	36,298,488	1,397,402	2,131,079	1,876,121	66%	74%
85 +	313	39	6,176,285	691,253	786,175	730,354	88%	95%
Total	8,101	275	233,575,739	6,913,285	7,329,038	6,898,764	94%	100%
R-Squared					0.456	0.521		

Chart III-M6



SECTION IV – ECONOMIC ASSUMPTIONS

The economic assumptions used in actuarial valuations are intended to be long-term in nature, and should be both individually reasonable and consistent with each other. The specific assumptions analyzed in this report are:

- **Price inflation** – used to project increases in the 401(a)(17) pay limit and to determine Local employer Early Retirement Incentive Program (ERI) payments for those Local employers who elected to amortize their ERI liability as a level percent of payroll. This assumption is also used indirectly as an underlying component of other economic assumptions.
- **Wage inflation** – across the board wage growth which is used to project the Social Security Wage Base.
- **Salary increase rate** – used to project expected increases in pay for active members in determining liabilities and costs of the Fund.

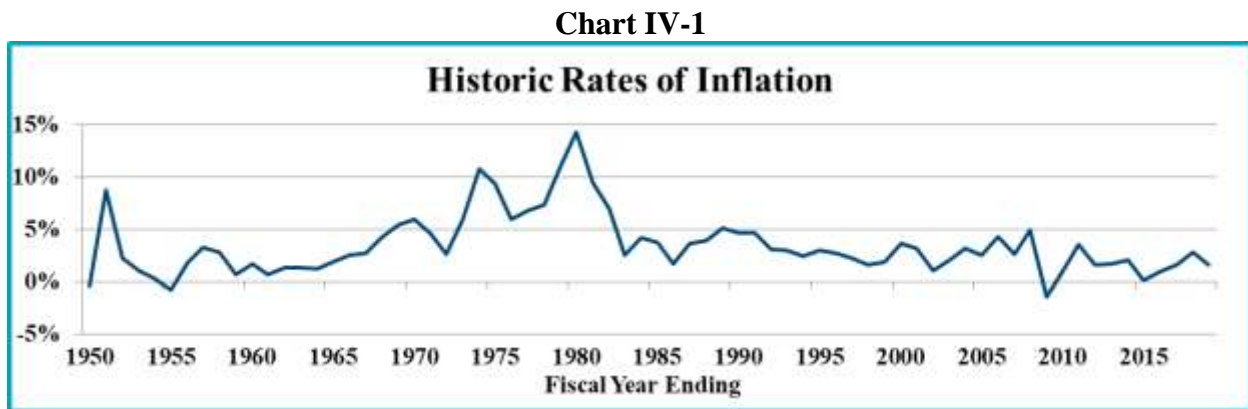
In order to develop recommendations for each of these assumptions, we considered historical data, both nationally and for the Fund, expectations for the future and assumptions used by other public sector plans.

PRICE INFLATION

Long-term price inflation rates are the foundation of other economic assumptions and needs to be reviewed within this study. In a growing economy, wages and investments are expected to grow at the underlying inflation rate plus an additional real growth rate, whether it reflects productivity in terms of wages, or risk premiums in terms of investments.

Historical Data

Chart IV-1 below shows the CPI-U inflation for the U.S. from 1950 through 2019.



Over the 50 years ending June 2019, the geometric average inflation rate for the U.S. has been about 4.0%, but this average is heavily influenced by the high inflation rates in the 1970s and early 1980s. Over the last 30 years, the geometric average inflation rate has been 2.5%, and it has been only 1.7% over the last ten years.

SECTION IV – ECONOMIC ASSUMPTIONS

Future Expectations

A measure of the market consensus of expected future inflation rates is the difference in yields between conventional Treasury bonds and Treasury inflation-protected securities (TIPS) at the same maturity. Table IV-1 shows the yields on both types of bonds and the break-even inflation rate as of August 2019. Break-even inflation is the level of inflation needed for an investment in TIPS to “break even” with an investment in conventional treasury bonds of the same maturity.

Table IV-1

Break-Even Inflation Based on Treasury Bond Yields			
Time to Maturity	Conventional Yield	TIPS Yield	Break Even Inflation
5 Years	1.83%	0.25%	1.58%
10 Years	2.06%	0.31%	1.75%
20 Years	2.36%	0.54%	1.82%

Data Source: Federal Reserve, Constant Maturity Yields, Monthly Series

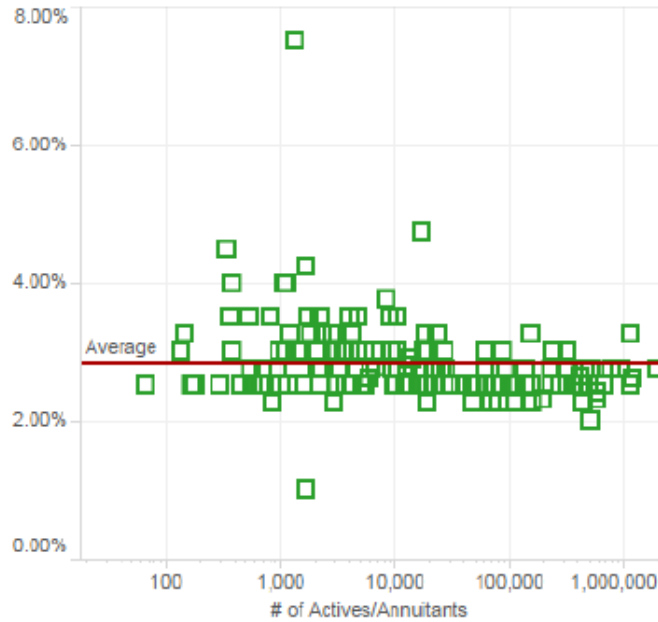
The Federal Reserve Bank of Philadelphia publishes a quarterly survey of professional economic forecasters that includes their forecasts of inflation over the next 10 years. The survey for the third quarter of 2019 shows a median inflation forecast of 2.2%, a minimum forecast of about 1.9%, and a maximum forecast of 3.1%.

The National Conference on Public Employee Retirement Systems (NCPERS) January 2019 Public Retirement Systems Study includes the following graphic of respondents' inflation assumptions:

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SECTION IV – ECONOMIC ASSUMPTIONS

Chart IV-2



The average inflation assumption among the 167 systems that responded to this study was 2.80%.

Based on all of these considerations, we believe a reasonable range for long-term price inflation for use in the Fund’s actuarial valuations is between 2.0% and 3.0%. We recommend an inflation assumption of 2.75%.

This recommendation represents an increase from the prior long-term inflation assumption of 2.60%. Another factor in setting this assumption is consistency with the assumptions used for the other New Jersey Retirement Systems. For those systems, we have recommended decreasing the long-term inflation assumption from 3.00% to 2.75%.

WAGE INFLATION

Wage inflation can be thought of as the annual across-the-board increase in wages. Individuals often receive salary increases in excess of the wage inflation rate, and we study these increases as a part of the merit salary scale assumption. Wage inflation generally exceeds price inflation by some margin reflecting the history of increased purchasing power.

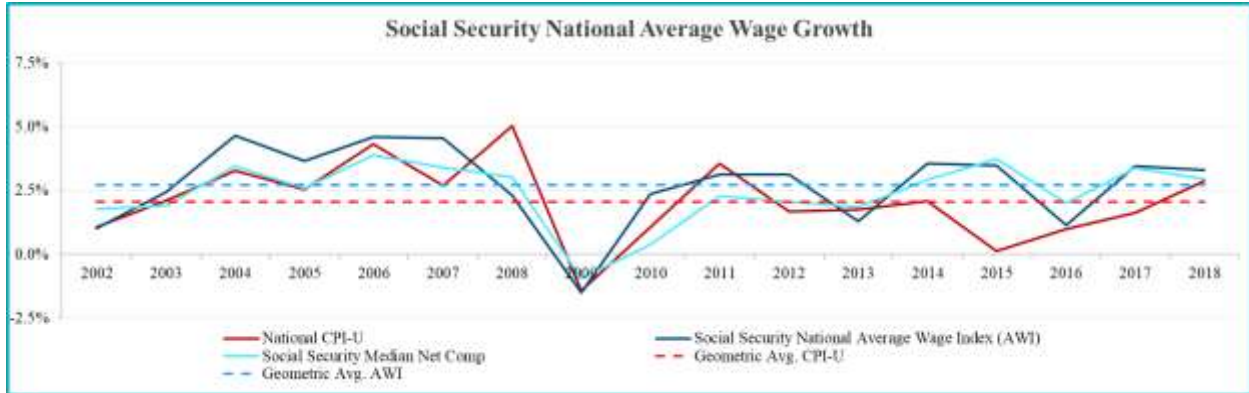
Wage inflation is used in the actuarial valuation to project the Social Security Wage Base in determining the actuarial liability.

Chart IV-3 shows the increase in national average wages (as reported by the Social Security Administration) compared to inflation from 2002 through 2018.

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SECTION IV – ECONOMIC ASSUMPTIONS

Chart IV-3



Over this period, national wage inflation averaged approximately 2.7% compared to annual price inflation of 2.00%, making real wage increases about 0.7% above inflation. However, over the same time period, the increase in the median real wage was only 0.3% per year, as much of the growth in wages was clustered at the top end of the wage scale.

It is acceptable to assume some additional level of base payroll increase beyond general inflation. Potential reasons contributing to the increase may include the presence of strong union representation in the collective bargaining process, competition in hiring among other similar employers, and regional factors – such as the local inflation index exceeding the national average. Also, the Social Security Administration projects real wage growth of 0.6% - 1.8% going forward in their Social Security solvency projections. However, governmental entities remain under financial stress, and other areas of employee compensation – most notably health care costs and pension contributions – have continued to increase faster than the CPI.

We recommend maintaining a small non-inflationary base payroll growth assumption of 0.5% annually. As a result, after factoring in inflation, the annual expected wage base increase assumption is expected to be 3.25%.

SALARY INCREASE RATE

The salary increase rate represents the year over year increase in pay of continuing actives. Salary increases generally consist of three components: Increases due to cost of living maintenance (inflation), increases related to non-inflationary pressures on base pay (such as productivity increases), and increases in individual pay due to merit, promotion, and longevity.

The current assumption varies by years of service and time period as shown in the following table. Salary increases are assumed to occur on October 1.

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SECTION IV – ECONOMIC ASSUMPTIONS

Years of Service	Period Ending June 30, 2026	Ultimate Period
0-8	3.80%	4.90%
9-12	4.55	5.45
13	4.30	5.30
14	4.15	4.95
15	3.95	4.55
16	3.40	4.00
17	3.15	3.65
18	2.85	3.45
19	2.70	3.20
20	2.50	3.10
21	2.25	2.75
22	2.00	2.60
23-25	1.90	2.45
26-30	1.70	2.30
31+	1.55	2.00

Generally, newer employees are more likely to earn a longevity increase or receive a promotion, so their salary increases tend to be greater than those for longer service employees. Therefore, we recommend continuing using a service-based salary increase assumption.

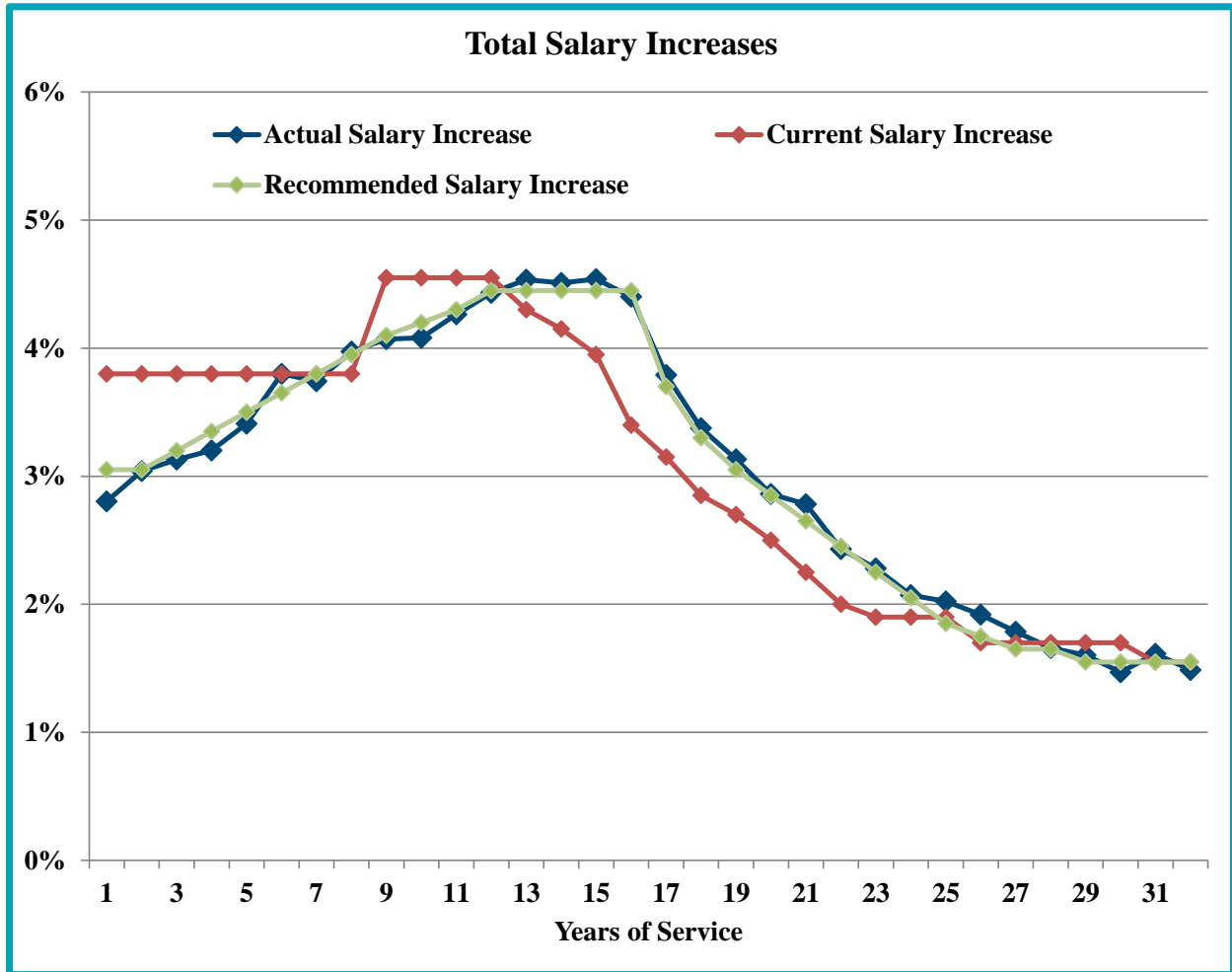
The State Treasurer previously recommended using lower salary increases through fiscal year ending 2026 to reflect short-term expectations and higher salary increases thereafter. TPAF experience for the period FYE 2016 through FYE 2018 shows that actual salary increases have been relatively close to expected based on the salary increase assumption in effect for those fiscal years. Therefore, we recommend continuing the current select and ultimate salary increase assumptions. For the select period through fiscal year ending 2026, we recommend modifying the rates to better reflect actual experience. The recommended salary increase rates after fiscal year ending 2026 are higher than the select period rates by 1.20% for each year of service, reflecting the long term inflation assumption of 2.75%.

In Chart IV-4 we show the average weighted actual total salary increases based on years of service for continuing active members for FYE 2016 through FYE 2018 (blue line), the current assumed increases through June 30, 2026 (red line) and the recommended assumption through June 30, 2026 (green line).

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SECTION IV – ECONOMIC ASSUMPTIONS

Chart IV-4



**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

1. Salary Increases

Salary increases vary by years of service and time period. Annual salary increases are shown below.

Years of Service	Period Ending June 30, 2026	Ultimate Period
0-2	3.05%	4.25%
3	3.20	4.40
4	3.35	4.55
5	3.50	4.70
6	3.65	4.85
7	3.80	5.00
8	3.95	5.15
9	4.10	5.30
10	4.20	5.40
11	4.30	5.50
12-16	4.45	5.65
17	3.70	4.90
18	3.30	4.50
19	3.05	4.25
20	2.85	4.05
21	2.65	3.85
22	2.45	3.65
23	2.25	3.45
24	2.05	3.25
25	1.85	3.05
26	1.75	2.95
27-28	1.65	2.85
29+	1.55	2.75

Salary increases are assumed to occur on October 1.

2. 401(a)(17) Pay Limit

\$275,000 in 2018 increasing 2.75% per annum, compounded annually.

3. Social Security Wage Base

\$128,400 in 2018 increasing 3.25% per annum, compounded annually.

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APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

4. Termination

Termination rates are as follows:

Service	Rates
0	7.00%
1	7.00
2	6.25
3	5.50
4	4.25
5	3.75
6	3.25
7	3.00
8	2.50
9	2.50
10	2.25
11	2.20
12	1.95
13	1.70
14	1.40
15	1.20
16	1.00
17	0.90
18	0.90
19	0.70
20	0.55
21	0.55
22	0.55
23	0.40
24-29	0.30

No termination is assumed after attainment of retirement eligibility.

67% of members with 10 or more years of service at termination are assumed to elect a deferred retirement benefit.

All other members are assumed to receive a refund of Accumulated Deductions with credited interest.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

5. Disability

Disability rates are as follows:

Age	Ordinary Disability	Accidental Disability	Age	Ordinary Disability	Accidental Disability
20	0.005%	0.006%	48	0.170%	0.006%
21	0.005	0.006	49	0.180	0.006
22	0.005	0.006	50	0.200	0.006
23	0.005	0.006	51	0.220	0.006
24	0.005	0.006	52	0.240	0.006
25	0.005	0.006	53	0.260	0.006
26	0.005	0.006	54	0.280	0.006
27	0.005	0.006	55	0.350	0.006
28	0.005	0.006	56	0.420	0.006
29	0.005	0.006	57	0.490	0.006
30	0.005	0.006	58	0.560	0.006
31	0.010	0.006	59	0.630	0.006
32	0.015	0.006	60	0.710	0.006
33	0.020	0.006	61	0.790	0.006
34	0.030	0.006	62	0.870	0.006
35	0.040	0.006	63	0.950	0.006
36	0.050	0.006	64	1.030	0.006
37	0.060	0.006	65	1.120	0.006
38	0.070	0.006	66	1.210	0.006
39	0.080	0.006	67	1.300	0.006
40	0.090	0.006	68	1.390	0.006
41	0.100	0.006	69	1.480	0.006
42	0.110	0.006	70	1.580	0.006
43	0.120	0.006	71	1.680	0.006
44	0.130	0.006	72	1.780	0.006
45	0.140	0.006	73	1.880	0.006
46	0.150	0.006	74	1.980	0.006
47	0.160	0.006			

Accidental disability rates apply at all ages.

Ordinary disability rates apply upon attainment of 10 years of service until the attainment of unreduced retirement eligibility with at least 25 years of service.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

Members are assumed to receive the greater of the applicable disability benefit or the early or service retirement benefit, depending on eligibility.

Tier 4 and Tier 5 members are not eligible for the Ordinary or Accidental Disability benefits but the disability rates still apply. Such members terminating under the disability decrement are assumed to separate from service and elect a deferred retirement benefit.

6. Mortality

Pre-Retirement Mortality: The standard Pub-2010 Teachers Above-Median Income Employee mortality table [*PubT-2010(A) Employee*] as published by the Society of Actuaries with a 93.9% adjustment for males and 85.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. All pre-retirement deaths are assumed to be ordinary deaths.

Healthy Retirees and Beneficiaries (Healthy Annuitants): The standard Pub-2010 Teachers Above-Median Income Healthy Retiree mortality table [*PubT-2010(A) Healthy Retiree*] as published by the Society of Actuaries with a 114.7% adjustment for males and 99.6% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Disabled Retirees (Disabled Annuitants): The Pub-2010 Non-Safety Disabled Retiree mortality table [*PubNS-2010 Disabled Retiree*] as published by the Society of Actuaries with a 106.3% adjustment for males and 100.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

7. Retirement

Retirement rates for Tier 1-4 members are as follows:

Age	Less Than 25 Years of Service	25 Years of Service	26 or More Years of Service
< 50	N/A	1.5%	1.5%
50	N/A	1.5	1.5
51	N/A	2.0	2.0
52	N/A	3.0	2.5
53	N/A	4.0	3.0
54	N/A	6.0	3.5
55	N/A	10.0	13.0
56	N/A	18.0	17.0
57	N/A	18.0	17.0
58	N/A	20.0	17.0
59	N/A	25.0	17.0
60	4.0	25.0	20.0
61	6.0	25.0	22.0
62	6.0	33.0	27.0
63	8.0	42.0	30.0
64	8.0	42.0	30.0
65	12.0	42.0	30.0
66	18.0	55.0	35.0
67	18.0	55.0	40.0
68	18.0	55.0	30.0
69	18.0	55.0	30.0
70	18.0	55.0	30.0
71	18.0	55.0	30.0
72	18.0	55.0	30.0
73	18.0	55.0	30.0
74	18.0	55.0	30.0
75	100.0	100.0	100.0

Rates apply upon retirement eligibility by tier.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

Retirement rates for Tier 5 members are as follows:

Age	Less Than 25 Years of Service	25 Years of Service	26 to 29 Years of Service	30 Years of Service	31 or More Years of Service
< 50	N/A	N/A	N/A	1.5%	1.5%
50	N/A	N/A	N/A	1.5	1.5
51	N/A	N/A	N/A	2.0	2.0
52	N/A	N/A	N/A	3.0	2.5
53	N/A	N/A	N/A	4.0	3.0
54	N/A	N/A	N/A	6.0	3.5
55	N/A	N/A	N/A	10.0	13.0
56	N/A	N/A	N/A	18.0	17.0
57	N/A	N/A	N/A	18.0	17.0
58	N/A	N/A	N/A	20.0	17.0
59	N/A	N/A	N/A	25.0	17.0
60	N/A	N/A	N/A	25.0	20.0
61	N/A	N/A	N/A	25.0	22.0
62	N/A	N/A	N/A	33.0	27.0
63	N/A	N/A	N/A	42.0	30.0
64	N/A	N/A	N/A	42.0	30.0
65	12.0	42.0	42.0	42.0	30.0
66	18.0	55.0	35.0	35.0	35.0
67	18.0	55.0	40.0	40.0	40.0
68	18.0	55.0	30.0	30.0	30.0
69	18.0	55.0	30.0	30.0	30.0
70	18.0	55.0	30.0	30.0	30.0
71	18.0	55.0	30.0	30.0	30.0
72	18.0	55.0	30.0	30.0	30.0
73	18.0	55.0	30.0	30.0	30.0
74	18.0	55.0	30.0	30.0	30.0
75	100.0	100.0	100.0	100.0	100.0

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

The following are the assumptions used in the actuarial valuation as of July 1, 2018. The economic and demographic assumptions and methods for that valuation were determined in the Actuarial Experience Study performed by the prior actuary covering the period July 1, 2012 – June 30, 2015 and were subsequently approved by the Board of Trustees.

- 1. Salary Increases** Salary increases vary by years of service and time period.
Annual salary increases are shown below.

Years of Service	Period Ending June 30, 2026	Ultimate Period
0-8	3.80%	4.90%
9-12	4.55	5.45
13	4.30	5.30
14	4.15	4.95
15	3.95	4.55
16	3.40	4.00
17	3.15	3.65
18	2.85	3.45
19	2.70	3.20
20	2.50	3.10
21	2.25	2.75
22	2.00	2.60
23-25	1.90	2.45
26-30	1.70	2.30
31+	1.55	2.00

Salary increases are assumed to occur on October 1.

- 2. 401(a)(17) Pay Limit** \$275,000 in 2018 increasing 2.30% per annum through June 30, 2026 and 2.60% thereafter, compounded annually.
- 3. Social Security Wage Base** \$128,400 in 2018 increasing 3.30% per annum through June 30, 2026 and 3.60% thereafter, compounded annually.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

4. Termination

Representative termination rates are as follows:

Less than 10 Years of Service			
Years of Service	Male	Female	
		<Age 40	Age 40+
0	10.23%	9.66%	10.96%
1	7.64	6.80	7.57
2	6.89	6.58	6.85
3	5.12	5.39	5.16
4	3.46	4.76	3.18
5	2.77	4.49	2.75
6	2.09	4.30	2.07
7	1.85	3.98	1.78
8	1.50	3.80	1.38
9	1.25	3.23	1.39

Age	10-14 Years of Service		15-19 Years of Service		20-24 Years of Service	
	Male	Female	Male	Female	Male	Female
30	1.12%	3.07%	0.78%	2.77%	0.45%	0.74%
35	1.05	2.50	0.70	1.87	0.45	0.74
40	0.99	1.56	0.63	0.94	0.44	0.57
45	1.05	0.99	0.61	0.61	0.41	0.36
50	1.10	0.96	0.72	0.64	0.44	0.37
55	1.38	1.41	1.04	0.94	0.67	0.62

No termination is assumed after attainment of retirement eligibility.

Members with 10 or more years of service at termination are assumed to elect a deferred retirement benefit at the following rates:

Age	Male	Female
Under 50	60%	75%
50 – 54	70	75
55 or Older	80	85

All other members are assumed to receive a refund of Accumulated Deductions with applicable interest.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

5. Disability

Representative disability rates are as follows:

Age	Ordinary		Accidental	
	Male	Female	Male	Female
25	0.0301%	0.0379%	0.0060%	0.0060%
30	0.0473	0.0550	0.0060	0.0060
35	0.0609	0.0674	0.0060	0.0060
40	0.0701	0.0893	0.0060	0.0060
45	0.1023	0.1317	0.0060	0.0060
50	0.1421	0.1759	0.0060	0.0060
55	0.4686	0.3506	0.0060	0.0060

Accidental disability rates apply at all ages.

Ordinary disability rates apply upon attainment of 10 years of service until the attainment of unreduced retirement eligibility with at least 25 years of service.

Members are assumed to receive the greater of the applicable disability benefit or the early or service retirement benefit, depending on eligibility.

Tier 4 and Tier 5 members are not eligible for the Ordinary or Accidental Disability benefits but the disability rates still apply. Such members terminating under the disability decrement are assumed to separate from service and elect a deferred retirement benefit.

6. Mortality

Pre-Retirement Mortality: RP-2006 Employee White Collar Mortality Tables, set back 3 years for males and 5 years for females, projected on a generational basis from a base year of 2006 using a 60-year average of improvement rates based on Social Security data from 1953 to 2013.

All pre-retirement deaths are assumed to be ordinary deaths.

Post-Retirement Healthy Mortality: RP-2006 Healthy Annuitant White Collar Mortality Tables, with adjustments as described in the latest experience study, projected on a generational basis from a base year of 2006 using a 60-year average of improvement rates based on Social Security data from 1953 to 2013.

Disabled Mortality: RP-2006 Disabled Retiree Mortality Tables with rates adjusted by 90%. No mortality improvement is assumed for disabled retiree mortality.

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

7. Retirement

Representative retirement rates for Tier 1 members are as follows:

Age	Less Than Age 55 or Less Than 25 Years of Service		Attainment of Age 55 and 25 Years of Service			
	Male	Female	First Eligible		After First Eligible	
			Male	Female	Male	Female
<48	1.20%	1.20%	N/A	N/A	N/A	N/A
48	1.45	1.45	N/A	N/A	N/A	N/A
49	1.65	1.65	N/A	N/A	N/A	N/A
50	1.95	1.95	N/A	N/A	N/A	N/A
51	2.35	2.35	N/A	N/A	N/A	N/A
52	2.75	2.75	N/A	N/A	N/A	N/A
53	3.75	3.75	N/A	N/A	N/A	N/A
54	4.75	4.75	N/A	N/A	N/A	N/A
55	N/A	N/A	15.00%	17.00%	N/A	N/A
56	N/A	N/A	22.00	19.00	12.00%	13.00%
57	N/A	N/A	22.00	19.00	13.00	14.00
58	N/A	N/A	28.00	27.00	14.00	15.00
59	N/A	N/A	28.00	27.00	16.00	17.00
60	7.00	5.00	35.00	33.00	20.00	21.00
61	6.50	5.00	32.00	38.00	22.50	23.00
62	8.00	7.50	45.00	50.00	35.00	32.00
63	9.00	7.50	45.00	50.00	30.00	29.00
64	9.00	7.50	45.00	50.00	30.00	29.00
65	14.00	12.00	50.00	55.00	33.00	33.00
66-70	18.00	15.00	55.00	55.00	30.00	30.00
71-74	19.00	16.00	55.00	55.00	27.00	30.00
75	100.00	100.00	100.00	100.00	100.00	100.00

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
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APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

Representative retirement rates for Tier 2 members are as follows:

Age	Less Than Age 60 or Less Than 25 Years of Service		Attainment of Age 60 and 25 Years of Service			
	Male	Female	First Eligible		After First Eligible	
			Male	Female	Male	Female
<48	0.60%	0.60%	N/A	N/A	N/A	N/A
48	0.75	0.75	N/A	N/A	N/A	N/A
49	0.85	0.85	N/A	N/A	N/A	N/A
50	1.00	1.00	N/A	N/A	N/A	N/A
51	1.20	1.20	N/A	N/A	N/A	N/A
52	1.40	1.40	N/A	N/A	N/A	N/A
53	1.90	1.90	N/A	N/A	N/A	N/A
54	2.40	2.40	N/A	N/A	N/A	N/A
55	11.50	11.50	N/A	N/A	N/A	N/A
56	12.00	12.00	N/A	N/A	N/A	N/A
57	12.50	12.50	N/A	N/A	N/A	N/A
58	13.50	13.50	N/A	N/A	N/A	N/A
59	14.00	14.00	N/A	N/A	N/A	N/A
60	7.00	5.00	32.00%	31.00%	N/A	N/A
61	6.50	5.00	32.00	38.00	22.50%	23.00%
62	8.00	7.50	45.00	50.00	35.00	32.00
63	9.00	7.50	45.00	50.00	30.00	29.00
64	9.00	7.50	45.00	50.00	30.00	29.00
65	14.00	12.00	50.00	55.00	33.00	33.00
66-70	18.00	15.00	55.00	55.00	30.00	30.00
71-74	19.00	16.00	55.00	55.00	27.00	30.00
75	100.00	100.00	100.00	100.00	100.00	100.00

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

Representative retirement rates for Tier 3 and Tier 4 members are as follows:

Age	Less Than Age 62 or Less Than 25 Years of Service		Attainment of Age 62 and 25 Years of Service			
	Male	Female	First Eligible Male	First Eligible Female	After First Eligible Male	After First Eligible Female
<48	0.55%	0.55%	N/A	N/A	N/A	N/A
48	0.70	0.70	N/A	N/A	N/A	N/A
49	0.75	0.75	N/A	N/A	N/A	N/A
50	0.90	0.90	N/A	N/A	N/A	N/A
51	1.10	1.10	N/A	N/A	N/A	N/A
52	1.25	1.25	N/A	N/A	N/A	N/A
53	1.70	1.70	N/A	N/A	N/A	N/A
54	2.15	2.15	N/A	N/A	N/A	N/A
55	10.50	10.50	N/A	N/A	N/A	N/A
56	10.75	10.75	N/A	N/A	N/A	N/A
57	11.00	11.00	N/A	N/A	N/A	N/A
58	12.00	12.00	N/A	N/A	N/A	N/A
59	12.50	12.50	N/A	N/A	N/A	N/A
60	20.00	20.00	N/A	N/A	N/A	N/A
61	22.00	22.00	N/A	N/A	N/A	N/A
62	30.00	24.00	50.00%	46.00%	N/A	N/A
63	9.00	7.50	45.00	50.00	30.00%	29.00%
64	9.00	7.50	45.00	50.00	30.00	29.00
65	14.00	12.00	50.00	55.00	33.00	33.00
66-70	18.00	15.00	55.00	55.00	30.00	30.00
71-74	19.00	16.00	55.00	55.00	27.00	30.00
75	100.00	100.00	100.00	100.00	100.00	100.00

**TEACHERS' PENSION AND ANNUITY FUND OF NEW JERSEY
EXPERIENCE STUDY AS OF JUNE 30, 2018**

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

Age	Less Than Age 65 or Less Than 30 Years of Service		Attainment of Age 65 and 30 Years of Service			
	Male	Female	First Eligible		After First Eligible	
			Male	Female	Male	Female
<48	0.30%	0.30%	N/A	N/A	N/A	N/A
48	0.35	0.35	N/A	N/A	N/A	N/A
49	0.40	0.40	N/A	N/A	N/A	N/A
50	0.45	0.45	N/A	N/A	N/A	N/A
51	0.55	0.55	N/A	N/A	N/A	N/A
52	0.65	0.65	N/A	N/A	N/A	N/A
53	0.85	0.85	N/A	N/A	N/A	N/A
54	1.10	1.10	N/A	N/A	N/A	N/A
55	5.00	5.00	N/A	N/A	N/A	N/A
56	6.00	6.00	N/A	N/A	N/A	N/A
57	7.00	7.00	N/A	N/A	N/A	N/A
58	8.00	8.00	N/A	N/A	N/A	N/A
59	9.00	9.00	N/A	N/A	N/A	N/A
60	15.00	15.00	N/A	N/A	N/A	N/A
61	16.00	16.00	N/A	N/A	N/A	N/A
62	36.00	32.00	N/A	N/A	N/A	N/A
63	28.00	28.00	N/A	N/A	N/A	N/A
64	28.00	28.00	N/A	N/A	N/A	N/A
65	40.00	40.00	50.00%	55.00%	N/A	N/A
66-70	18.00	15.00	55.00	55.00	30.00%	30.00%
71-74	19.00	16.00	55.00	55.00	27.00	30.00
75	100.00	100.00	100.00	100.00	100.00	100.00



Classic Values, Innovative Advice