

## **Police and Firemen's Retirement System of New Jersey**

**Actuarial Experience Study for  
July 1, 2013 through June 30, 2018**

**Produced by Cheiron**

**January 2020**

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January 7, 2020

Board of Trustees  
Police and Firemen's Retirement System 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 an Actuarial Experience Study of the Police and Firemen's Retirement System of New Jersey (PFRS, the System) in accordance with Title 43, Chapter 16A-13 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 System at least once in every three year period. This experience study covers the actuarial experience from July 1, 2013 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.

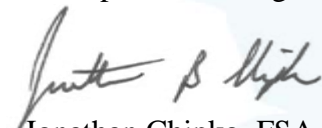
Sincerely,  
Cheiron



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



Anu Patel, FSA, MAAA, EA  
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Jonathan Chipko, FSA, MAAA, EA  
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cc: Kenneth Kent, FSA, FCA, MAAA, EA

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 PFRS, 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 PFRS's membership 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 service based termination rate table.
- **Disability rates** – Modify 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** – Decrease the inflation assumptions based on recent experience.
- **Salary increase rates** – Update to use a service based salary increase table.

The recommended changes to the assumptions in the aggregate would increase the total System actuarial liability and Statutory contributions.

Further information about the impact of these changes to overall contribution rates can be found on the following pages. 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.

Chapter 109, P.L. 1979, Chapter 511, P.L. 1991, Chapter 247, P.L. 1993 and Chapter 248, P.L. 1989 provided for additional benefits payable to members and beneficiaries. These Chapters also required the State to pay for the additional liability created by the additional benefits. The cost impact of the recommended assumption changes are shown both prior to as well as after the adjustments for these State paid Local obligations. Please refer to the July 1, 2018 actuarial valuation report for additional benefit and funding information regarding these Chapters.

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

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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  
State**

	Current Assumptions	Recommended Assumptions	Change
<b><u>Assets and Liabilities</u></b>			
Actuarial Liability	\$ 4,983,733,970	\$ 5,007,344,758	\$ 23,610,788
Actuarial Value of Assets (AVA) <sup>1</sup>	<u>1,872,048,766</u>	<u>1,872,048,766</u>	<u>0</u>
Unfunded Actuarial Liability/(Surplus)	\$ 3,111,685,204	\$ 3,135,295,992	\$ 23,610,788
Funded Ratio	37.6%	37.4%	-0.2%
<b><u>Contribution Amounts (Prior to Statutory State-Paid Local Adjustments)</u></b>			
State Normal Cost at End of Year	\$ 53,824,713	\$ 53,089,491	\$ (735,222)
Amortization Payment of UAL	<u>263,490,559</u>	<u>265,489,712</u>	<u>1,999,153</u>
Total Statutory Contribution for FYE	\$ 317,315,272	\$ 318,579,203	\$ 1,263,931
<b><u>Contribution Amounts (After Statutory State-Paid Local Adjustments)</u></b>			
State Normal Cost at End of Year <sup>2</sup>	\$ 122,009,526	\$ 116,593,347	\$ (5,416,179)
Amortization Payment of UAL <sup>2</sup>	<u>422,569,740</u>	<u>424,845,986</u>	<u>2,276,246</u>
Total Statutory Contribution for FYE	\$ 544,579,266	\$ 541,439,333	\$ (3,139,933)

<sup>1</sup> Includes discounted State receivable contributions and Lottery proceeds

<sup>2</sup> Includes Local obligations payable by the State

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**SECTION I – EXECUTIVE SUMMARY**

**Table I-2  
Cost Impact of Assumption Changes on July 1, 2018 Valuation Results  
Local Employers**

	Current Assumptions	Recommended Assumptions	Change
<b><u>Assets and Liabilities</u></b>			
Actuarial Liability	\$35,523,376,524	\$35,674,988,752	\$151,612,228
Actuarial Value of Assets (AVA) <sup>1</sup>	26,109,128,660	26,109,128,660	0
Unfunded Actuarial Liability/(Surplus)	\$ 9,414,247,864	\$ 9,565,860,092	\$151,612,228
Funded Ratio	73.5%	73.2%	-0.3%
<b><u>Contribution Amounts (Prior to Statutory State-Paid Local Adjustments)</u></b>			
Employer Normal Cost at End of Year	\$ 393,618,474	\$ 386,132,043	\$ (7,486,431)
Amortization Payment of UAL	797,293,562	810,130,757	12,837,195
ERI and Chapter 19 Payments	28,138,356	28,146,086	7,730
Total Statutory Contribution for FYE	\$ 1,219,050,392	\$ 1,224,408,886	\$ 5,358,494
<b><u>Contribution Amounts (After Statutory State-Paid Local Adjustments)</u></b>			
Employer Normal Cost at End of Year <sup>2</sup>	\$ 325,433,661	\$ 322,628,187	\$ (2,805,474)
Amortization Payment of UAL <sup>2</sup>	638,214,381	650,774,483	12,560,102
ERI and Chapter 19 Payments	28,138,356	28,146,086	7,730
Total Statutory Contribution for FYE	\$ 991,786,398	\$ 1,001,548,756	\$ 9,762,358
Non-Contributory Group Insurance Contribution	\$ 46,564,731	\$ 35,439,091	\$ (11,125,640)

<sup>1</sup> Includes discounted State receivable contributions

<sup>2</sup> Excludes Local obligations payable by the State

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 Police and Firemen's Retirement System of New Jersey (PFRS) covering actuarial experience over a five year period from July 1, 2013 through June 30, 2018. This report is for the use of the Division of Pensions and Benefits and the PFRS 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 43, Chapter 16A-13 of the NJ State Statute which requires periodic review of the experience of the System.

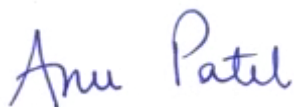
In preparing our report, we relied on information (some oral and some written) supplied by the Division of Pensions and Benefits. This information includes, but is not limited to, the plan provisions, employee data, and financial information. We performed an informal examination of the obvious characteristics 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.

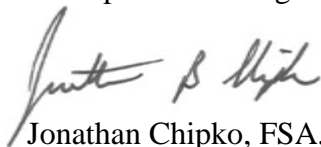
This report was prepared for the Police and Firemen's Retirement System of New Jersey for the purposes described herein. This report is not intended to benefit any other party, and Cheiron assumes no duty or liability to any such party.



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Principal Consulting Actuary



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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 PFRS, with some adjustments where future experience is expected to differ from historical experience and with deference to standard tables where PFRS 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 number of decrements for each membership group compared to the expected 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 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 PFRS's experience to that of a standard table.



**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
RETIREMENT RATES**

**RETIREMENT RATES**

The current retirement rates vary by age and service and are applied to all members who are eligible to retire. As a result, a member who is age 50 with 20 years of service, for example, is assumed to be less likely to retire than a member who is age 50 with 25 years of service. In reviewing the data for PFRS, we find that at many ages, members are most likely to retire with 25 years of service, and those with more or less than 25 years of service are less likely to retire. Mandatory retirement is age 65. PFRS is not large enough to justify assumptions for each age and service combination, so we propose separate assumptions by service groups:

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

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 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 generally increasing the retirement rates for most ages except for ages 40-42 and age 64.

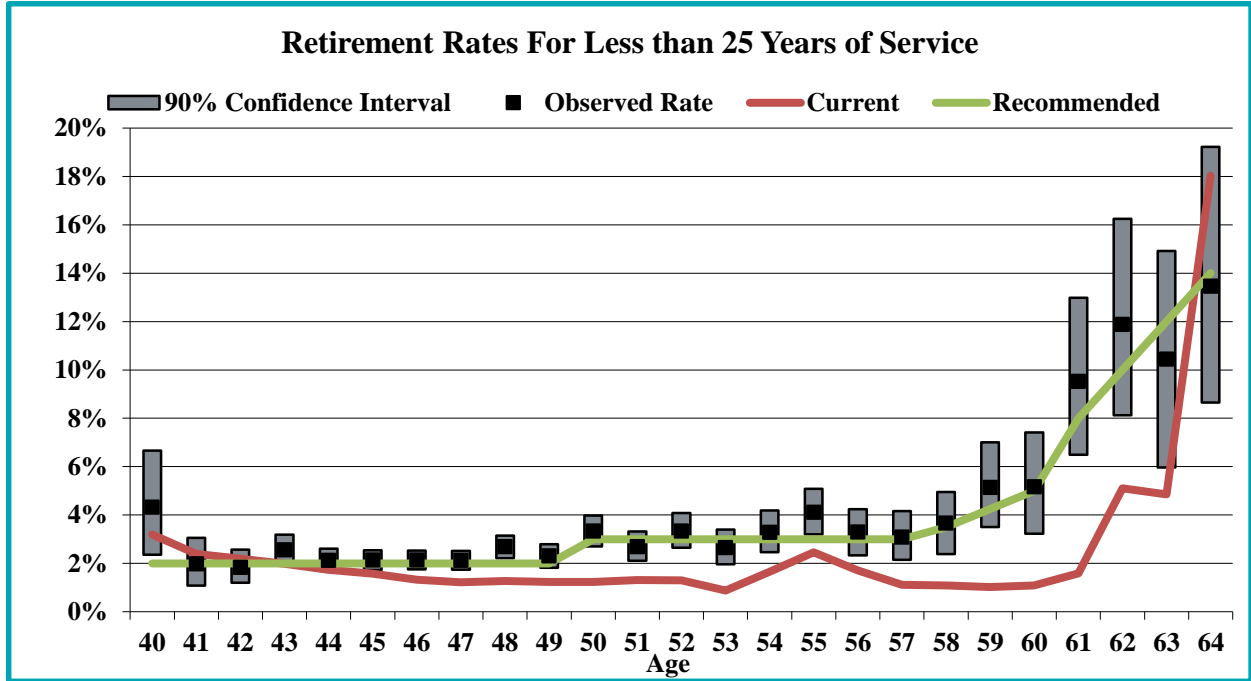
**Table III-R1**

<b>Retirement Rates For Less than 25 Years of Service</b>									
<b>Age</b>	<b>Exposures</b>	<b>Retirements</b>			<b>Retirement Rates</b>			<b>A/E Ratios</b>	
		<b>Actual</b>	<b>Current</b>	<b>Recommended</b>	<b>Actual</b>	<b>Current</b>	<b>Recommended</b>	<b>Current</b>	<b>Recommended</b>
40	255	11	8.1	5.1	4.3%	3.2%	2.0%	135%	216%
41	556	11	13.3	11.1	2.0%	2.4%	2.0%	83%	99%
42	1,091	20	23.9	21.8	1.8%	2.2%	2.0%	84%	92%
43	1,917	49	38.1	38.3	2.6%	2.0%	2.0%	129%	128%
44	2,729	58	47.2	54.6	2.1%	1.7%	2.0%	123%	106%
45	3,429	73	53.8	68.6	2.1%	1.6%	2.0%	136%	106%
46	3,756	80	49.6	75.1	2.1%	1.3%	2.0%	161%	106%
47	3,689	78	45.1	73.8	2.1%	1.2%	2.0%	173%	106%
48	3,246	87	41.2	64.9	2.7%	1.3%	2.0%	211%	134%
49	2,691	62	33.0	53.8	2.3%	1.2%	2.0%	188%	115%
50	2,190	73	27.1	65.7	3.3%	1.2%	3.0%	270%	111%
51	1,897	51	24.7	56.9	2.7%	1.3%	3.0%	206%	90%
52	1,591	53	20.6	47.7	3.3%	1.3%	3.0%	257%	111%
53	1,325	35	11.6	39.8	2.6%	0.9%	3.0%	303%	88%
54	1,098	36	18.1	32.9	3.3%	1.6%	3.0%	199%	109%
55	1,219	50	29.9	36.6	4.1%	2.5%	3.0%	167%	137%
56	943	31	16.1	28.3	3.3%	1.7%	3.0%	192%	110%
57	745	23	8.3	22.4	3.1%	1.1%	3.0%	279%	103%
58	546	20	5.9	19.1	3.7%	1.1%	3.5%	338%	105%
59	428	22	4.4	18.2	5.1%	1.0%	4.3%	506%	121%
60	310	16	3.4	15.5	5.2%	1.1%	5.0%	476%	103%
61	231	22	3.7	18.5	9.5%	1.6%	8.0%	602%	119%
62	160	19	8.2	16.0	11.9%	5.1%	10.0%	233%	119%
63	134	14	6.5	16.1	10.4%	4.9%	12.0%	215%	87%
64	104	14	18.8	14.6	13.5%	18.0%	14.0%	75%	96%
<b>Total</b>	<b>36,280</b>	<b>1,008</b>	<b>560.4</b>	<b>915.3</b>	<b>2.8%</b>	<b>1.5%</b>	<b>2.5%</b>	<b>180%</b>	<b>110%</b>
<b>R-squared</b>			<b>0.753</b>	<b>0.952</b>					

POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS  
RETIREMENT RATES

Chart III-R1



**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 lower than expected, so we recommend reducing the retirement rates at all ages.

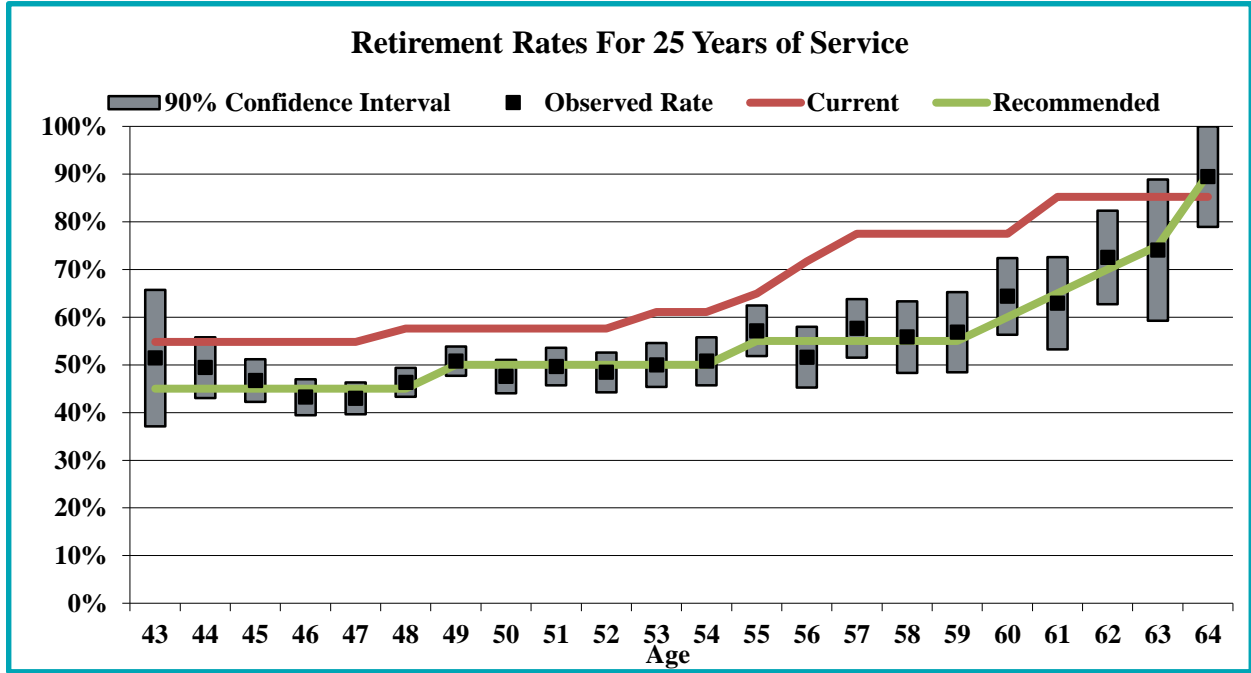
**Table III-R2**

Retirement Rates For 25 Years of Service									
Age	Exposures	Retirements			Retirement Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
43	35	18	19.2	15.8	51.4%	54.8%	45.0%	94%	114%
44	172	85	94.3	77.4	49.4%	54.8%	45.0%	90%	110%
45	334	156	183.1	150.3	46.7%	54.8%	45.0%	85%	104%
46	479	207	262.6	215.6	43.2%	54.8%	45.0%	79%	96%
47	568	244	311.4	255.6	43.0%	54.8%	45.0%	78%	95%
48	723	335	416.6	325.4	46.3%	57.6%	45.0%	80%	103%
49	719	365	414.3	359.5	50.8%	57.6%	50.0%	88%	102%
50	572	272	329.6	286.0	47.6%	57.6%	50.0%	83%	95%
51	457	227	263.3	228.5	49.7%	57.6%	50.0%	86%	99%
52	384	186	221.3	192.0	48.4%	57.6%	50.0%	84%	97%
53	304	152	185.8	152.0	50.0%	61.1%	50.0%	82%	100%
54	258	131	157.7	129.0	50.8%	61.1%	50.0%	83%	102%
55	245	140	159.1	134.8	57.1%	64.9%	55.0%	88%	104%
56	157	81	112.6	86.4	51.6%	71.7%	55.0%	72%	94%
57	163	94	126.3	89.7	57.7%	77.5%	55.0%	74%	105%
58	120	67	93.0	66.0	55.8%	77.5%	55.0%	72%	102%
59	95	54	73.6	52.3	56.8%	77.5%	55.0%	73%	103%
60	87	56	67.4	52.2	64.4%	77.5%	60.0%	83%	107%
61	62	39	52.8	40.3	62.9%	85.2%	65.0%	74%	97%
62	51	37	43.5	35.7	72.5%	85.2%	70.0%	85%	104%
63	27	20	23.0	20.3	74.1%	85.2%	75.0%	87%	99%
64	19	17	16.2	17.1	89.5%	85.2%	90.0%	105%	99%
<b>Total</b>	<b>6,031</b>	<b>2,983</b>	<b>3,626.8</b>	<b>2,981.5</b>	<b>49.5%</b>	<b>60.1%</b>	<b>49.4%</b>	<b>82%</b>	<b>100%</b>
<b>R-squared</b>			<b>0.993</b>	<b>0.997</b>					

POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS  
RETIREMENT RATES

Chart III-R2



**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 increasing the retirement rates for ages 53 and younger, and decreasing the rates for ages 54 and older.

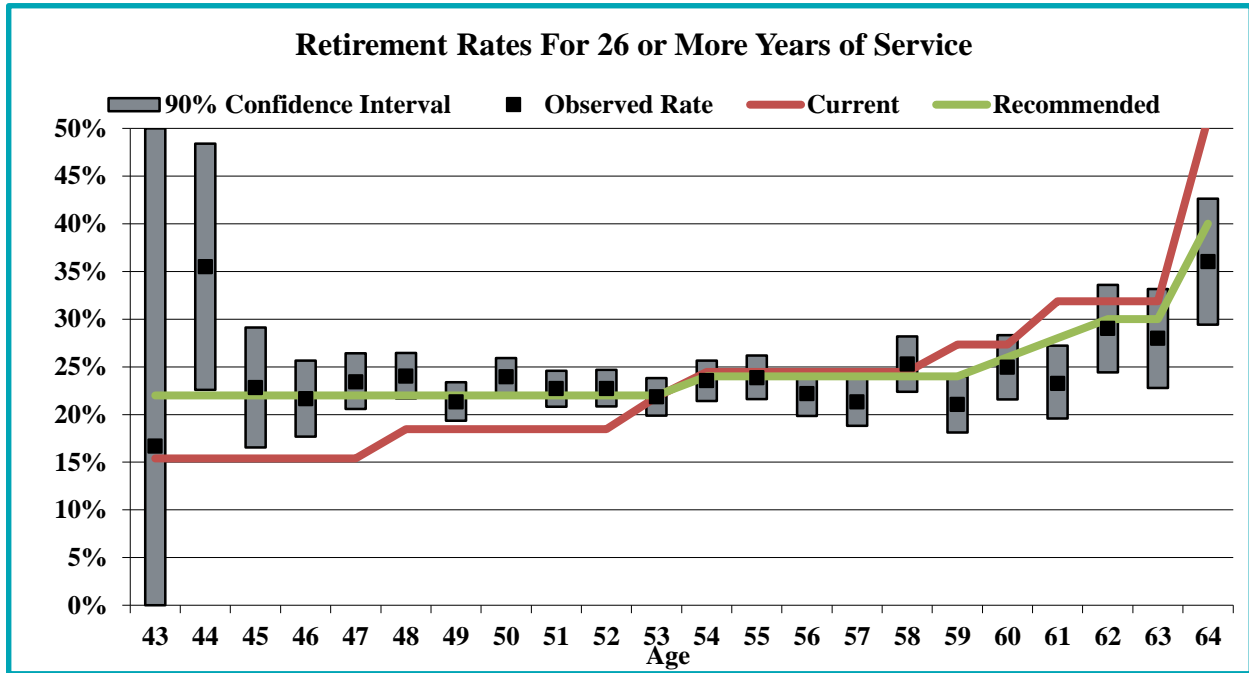
**Table III-R3**

<b>Retirement Rates For 26 or More Years of Service</b>									
<b>Age</b>	<b>Exposures</b>	<b>Retirements</b>			<b>Retirement Rates</b>			<b>A/E Ratios</b>	
		<b>Actual</b>	<b>Current</b>	<b>Recommended</b>	<b>Actual</b>	<b>Current</b>	<b>Recommended</b>	<b>Current</b>	<b>Recommended</b>
43	6	1	0.9	1.3	16.7%	15.4%	22.0%	108%	76%
44	31	11	4.8	6.8	35.5%	15.4%	22.0%	230%	161%
45	127	29	19.6	27.9	22.8%	15.4%	22.0%	148%	104%
46	300	65	46.2	66.0	21.7%	15.4%	22.0%	141%	98%
47	568	133	87.5	125.0	23.4%	15.4%	22.0%	152%	106%
48	858	206	158.6	188.8	24.0%	18.5%	22.0%	130%	109%
49	1,116	238	206.2	245.5	21.3%	18.5%	22.0%	115%	97%
50	1,315	315	243.0	289.3	24.0%	18.5%	22.0%	130%	109%
51	1,321	300	244.1	290.6	22.7%	18.5%	22.0%	123%	103%
52	1,276	290	235.8	280.7	22.7%	18.5%	22.0%	123%	103%
53	1,213	265	265.0	266.9	21.8%	21.9%	22.0%	100%	99%
54	1,087	256	266.0	260.9	23.6%	24.5%	24.0%	96%	98%
55	935	223	228.8	224.4	23.9%	24.5%	24.0%	97%	99%
56	852	189	208.5	204.5	22.2%	24.5%	24.0%	91%	92%
57	718	153	175.7	172.3	21.3%	24.5%	24.0%	87%	89%
58	621	157	152.0	149.0	25.3%	24.5%	24.0%	103%	105%
59	513	108	140.3	123.1	21.1%	27.3%	24.0%	77%	88%
60	445	111	121.7	115.7	24.9%	27.3%	26.0%	91%	96%
61	327	76	104.3	91.6	23.2%	31.9%	28.0%	73%	83%
62	262	76	83.6	78.6	29.0%	31.9%	30.0%	91%	97%
63	193	54	61.5	57.9	28.0%	31.9%	30.0%	88%	93%
64	136	49	69.4	54.4	36.0%	51.0%	40.0%	71%	90%
<b>Total</b>	<b>14,220</b>	<b>3,305</b>	<b>3,123.3</b>	<b>3,321.2</b>	<b>23.2%</b>	<b>22.0%</b>	<b>23.4%</b>	<b>106%</b>	<b>100%</b>
<b>R-squared</b>			<b>0.915</b>	<b>0.989</b>					

POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS  
RETIREMENT RATES

Chart III-R3



**POLICE AND FIREMEN’S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**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 and service. We recommend changing the assumption to a table based on service only, with rates ultimately reaching 0 when members reach 20 years of service and 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 and the r-squared statistic for each year of service, and Chart III-T1 shows the information graphically along with the 90% confidence interval.

**Table III-T1  
Termination Rates**

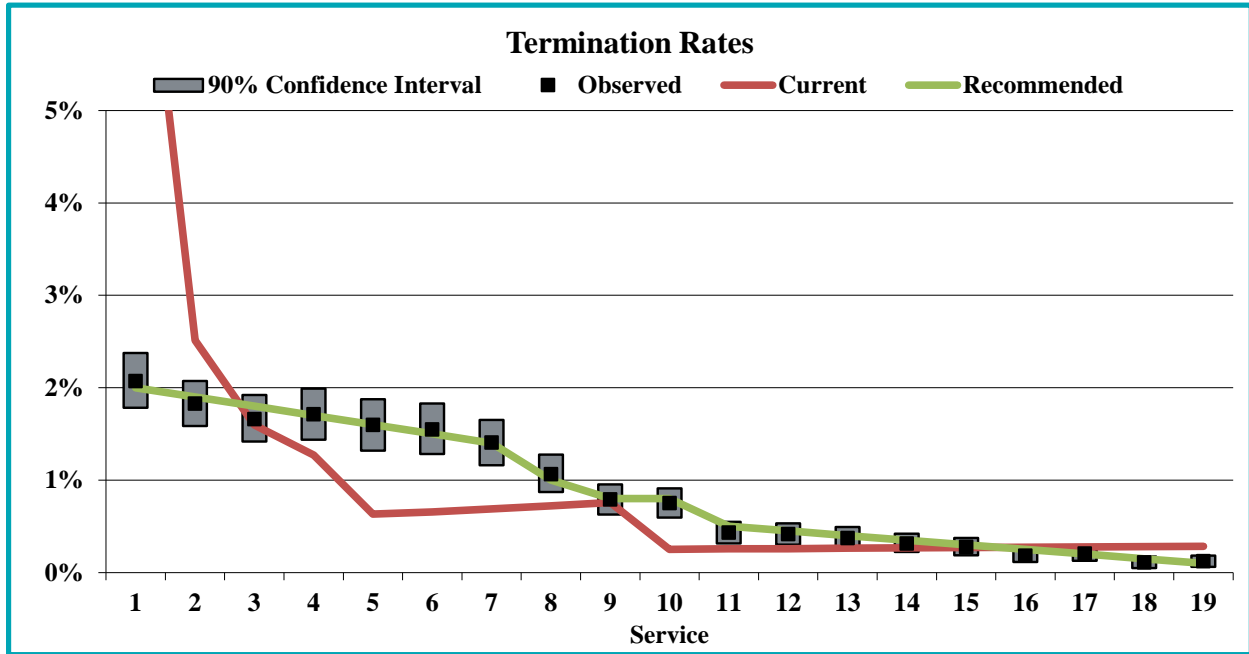
Service	Exposures	Terminations			Termination Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
1	6,226	129	504.43	124.52	2.07%	8.10%	2.00%	26%	104%
2	8,201	150	206.13	155.82	1.83%	2.51%	1.90%	73%	96%
3	6,917	115	110.51	124.51	1.66%	1.60%	1.80%	104%	92%
4	5,780	99	73.49	98.26	1.71%	1.27%	1.70%	135%	101%
5	5,382	86	34.00	86.11	1.60%	0.63%	1.60%	253%	100%
6	5,685	88	37.31	85.28	1.55%	0.66%	1.50%	236%	103%
7	6,115	86	42.13	85.61	1.41%	0.69%	1.40%	204%	100%
8	7,127	76	51.44	71.27	1.07%	0.72%	1.00%	148%	107%
9	7,957	63	60.21	63.66	0.79%	0.76%	0.80%	105%	99%
10	8,226	62	20.74	65.81	0.75%	0.25%	0.80%	299%	94%
11	8,560	37	21.90	42.80	0.43%	0.26%	0.50%	169%	86%
12	8,645	36	22.38	38.90	0.42%	0.26%	0.45%	161%	93%
13	8,551	32	22.45	34.20	0.37%	0.26%	0.40%	143%	94%
14	8,571	27	22.85	30.00	0.32%	0.27%	0.35%	118%	90%
15	8,568	24	23.22	25.70	0.28%	0.27%	0.30%	103%	93%
16	8,696	16	23.85	21.74	0.18%	0.27%	0.25%	67%	74%
17	8,663	18	24.06	17.33	0.21%	0.28%	0.20%	75%	104%
18	8,110	9	22.75	12.17	0.11%	0.28%	0.15%	40%	74%
19	8,160	10	23.07	8.16	0.12%	0.28%	0.10%	43%	123%
<b>Total</b>	<b>144,140</b>	<b>1,163</b>	<b>1,346.9</b>	<b>1,191.8</b>	<b>0.8%</b>	<b>0.9%</b>	<b>0.8%</b>	<b>86%</b>	<b>98%</b>
<b>R-squared</b>			<b>0.423</b>	<b>0.992</b>					



**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
TERMINATION RATES**

**Chart III-T1**



The current assumption is that all members who terminate employment with 10 or more years of service are assumed to elect a deferred retirement benefit. Of the 271 members who terminated employment with 10 or more years of service in the five year experience study period, 8 elected a deferred annuity and 263 elected a refund of contributions. Therefore, we recommend changing the assumption such that all members terminating with 10 or more years of service are assumed to take a refund of contributions.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 terminations due to accidental disability, and Chart III-D1 shows the information graphically along with the 90% confidence interval. The experience shows that the current rates overestimated the number of disabilities prior to age 45 and underestimated the number of disabilities from ages 45 to 60. We recommend decreasing the rates prior to age 45 and increasing them for ages 45 to 60.

**Table III-D1**

<b>Accidental Disability Rates</b>									
<b>Age Band</b>	<b>Exposures</b>	<b>Disabilities</b>			<b>Disability Rates</b>			<b>A/E Ratios</b>	
		<b>Actual</b>	<b>Current</b>	<b>Recommended</b>	<b>Actual</b>	<b>Current</b>	<b>Recommended</b>	<b>Current</b>	<b>Recommended</b>
20 - 24	1,975	0	0.54	0.55	0.00%	0.03%	0.03%	0%	0%
25 - 29	18,247	7	36.31	8.33	0.04%	0.20%	0.05%	19%	84%
30 - 34	32,200	49	110.70	52.52	0.15%	0.34%	0.16%	44%	93%
35 - 39	36,481	103	139.03	113.21	0.28%	0.38%	0.31%	74%	91%
40 - 44	40,301	165	183.06	161.20	0.41%	0.45%	0.40%	90%	102%
45 - 49	40,854	138	109.21	140.06	0.34%	0.27%	0.34%	126%	99%
50 - 54	21,695	56	40.88	53.53	0.26%	0.19%	0.25%	137%	105%
55 - 59	8,431	18	13.57	13.98	0.21%	0.16%	0.17%	133%	129%
60 - 64	2,600	4	4.19	4.16	0.15%	0.16%	0.16%	96%	96%
<b>Total</b>	<b>202,784</b>	<b>540</b>	<b>637.5</b>	<b>547.5</b>	<b>0.3%</b>	<b>0.3%</b>	<b>0.3%</b>	<b>85%</b>	<b>99%</b>
<b>R-squared</b>			<b>0.674</b>	<b>0.908</b>					

POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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SECTION III – DEMOGRAPHIC ASSUMPTIONS  
DISABILITY RATES

Chart III-D1



**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
DISABILITY RATES**

Table III-D2 shows the calculation of actual-to-expected ratios and the r-squared statistic for terminations due to ordinary disability, and Chart III-D2 shows the information graphically along with the 90% confidence interval. The experience shows that the current rates overestimate the number of disabilities at all ages. We recommend decreasing these rates to more closely reflect current experience.

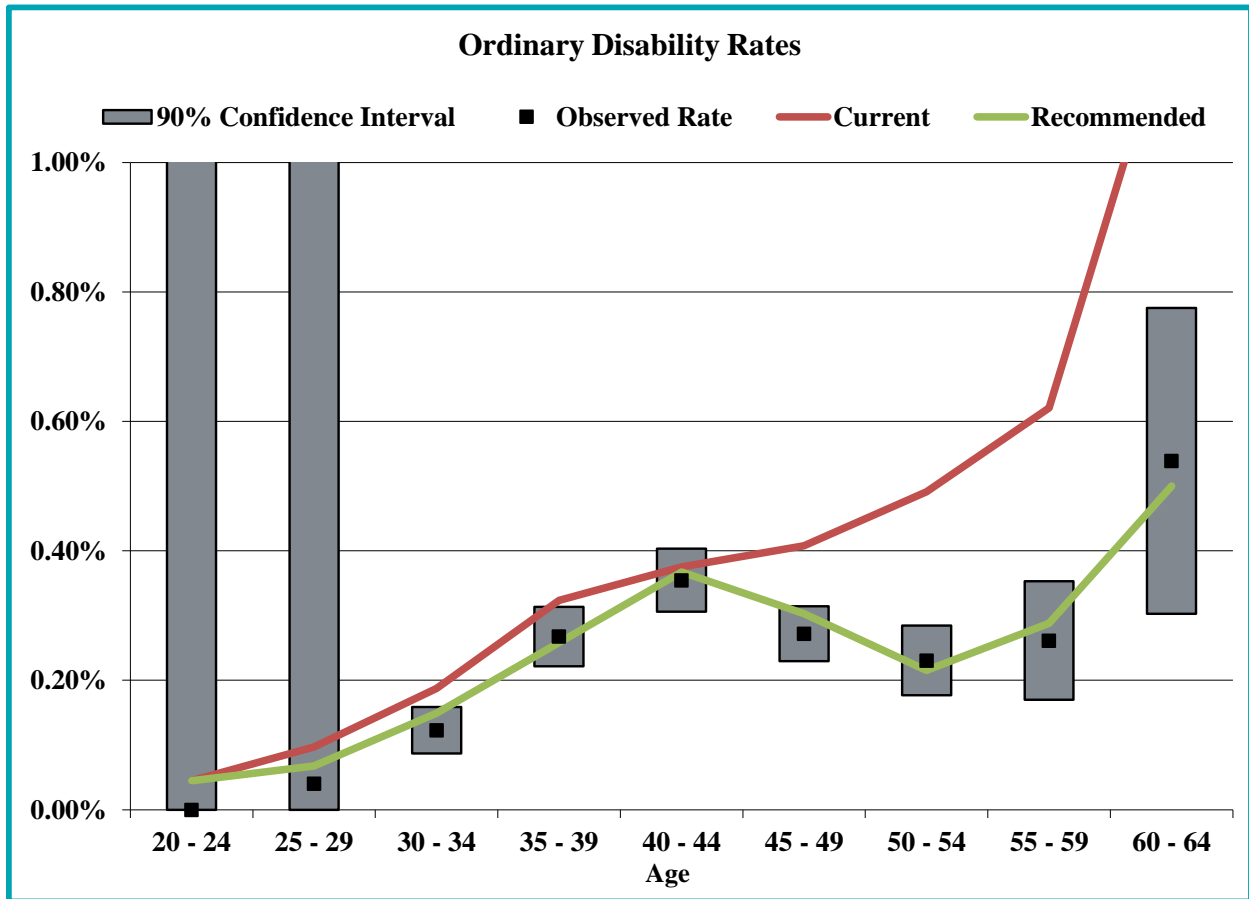
**Table III-D2**

Ordinary Disability Rates									
Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
20 - 24	81	0	0.04	0.04	0.00%	0.04%	0.04%	0%	0%
25 - 29	7,391	3	7.17	4.99	0.04%	0.10%	0.07%	42%	60%
30 - 34	26,032	32	48.77	38.89	0.12%	0.19%	0.15%	66%	82%
35 - 39	34,379	92	111.19	88.78	0.27%	0.32%	0.26%	83%	104%
40 - 44	40,036	142	150.13	147.03	0.35%	0.37%	0.37%	95%	97%
45 - 49	40,820	111	166.53	123.62	0.27%	0.41%	0.30%	67%	90%
50 - 54	21,670	50	106.41	46.71	0.23%	0.49%	0.22%	47%	107%
55 - 59	8,418	22	52.26	24.25	0.26%	0.62%	0.29%	42%	91%
60 - 64	2,598	14	32.23	12.99	0.54%	1.24%	0.50%	43%	108%
<b>Total</b>	<b>181,425</b>	<b>466</b>	<b>674.7</b>	<b>487.3</b>	<b>0.3%</b>	<b>0.4%</b>	<b>0.3%</b>	<b>69%</b>	<b>96%</b>
<b>R-squared</b>			<b>0.828</b>	<b>0.906</b>					

POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018

SECTION III – DEMOGRAPHIC ASSUMPTIONS  
DISABILITY RATES

Chart III-D2



**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 System'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 System.
2. Compare actual experience of the System 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 System'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 System 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.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

In the prior study, PFRS adopted the following assumptions:

**Active members:**

- Ordinary Death: RP-2000 Combined Healthy Mortality Tables projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection Scale thereafter.
- Accidental Death: Representative mortality rates as follows. No mortality improvement is assumed for this purpose.

Age	Rates
25	0.006%
30	0.006
35	0.008
40	0.008
45	0.009
50	0.009
55	0.014
60	0.013
64	0.008
65+	0.000

**Healthy female retirees and all beneficiaries:** RP-2000 Combined Healthy Mortality Tables projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection Scale thereafter.

**Healthy male retirees:** RP-2000 Combined Healthy Mortality Tables projected on a generational basis from the base year of 2012 to 2013 using Projection Scale AA and the Conduent Modified 2014 Projection Scale thereafter.

**Disabled members:** Representative mortality rates as follows. No mortality improvement is assumed for this purpose.

Age	Rates
35	0.598%
40	0.634
45	0.803
50	1.058
55	1.210
60	1.426
65	1.949

**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

There are enough deaths for PFRS to provide meaningful statistics in the five-year period. For healthy retirees, there were 3,199 deaths over this period, for survivors there were 1536 deaths, for disabled retirees there were 529 deaths, and for active members there were 189 deaths. For reference, a fully credible sample would include 1,082 deaths. We therefore recommend using the standard Pub-2010 table for Public Safety with adjustments to account for PFRS experience.

We recommend the following mortality table assumptions:

**Active members (Non-Annuitants):** The standard Pub-2010 Safety Employee mortality table [*PubS-2010 Employee*] as published by the Society of Actuaries with a 105.6% adjustment for males and 102.5% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. 5% of the deaths are assumed to be accidental.

**Healthy Retirees (Healthy Annuitants):** The standard Pub-2010 Safety Retiree Below-Median Income Weighted mortality table [*PubS-2010(B) Healthy Retiree*] as published by the Society of Actuaries with a 96.7% adjustment for males and 96.0% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

**Beneficiaries (Contingent Annuitants):** The standard Pub-2010 General Retiree Below-Median Income Weighted mortality table [*PubG-2010(B) Healthy Retiree*] as published by the Society of Actuaries unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. Mortality tables specifically designed for public safety employees may reflect higher mortality rates than expected for beneficiaries of public safety employees. We therefore recommend using mortality tables designed for general employees for the beneficiaries of public safety employees.

**Disabled retirees (Disabled Annuitants):** The Pub-2010 Safety Disabled Retiree mortality table [*PubS-2010 Disabled Retiree*] as published by the Society of Actuaries with a 152.0% adjustment for males and 109.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.



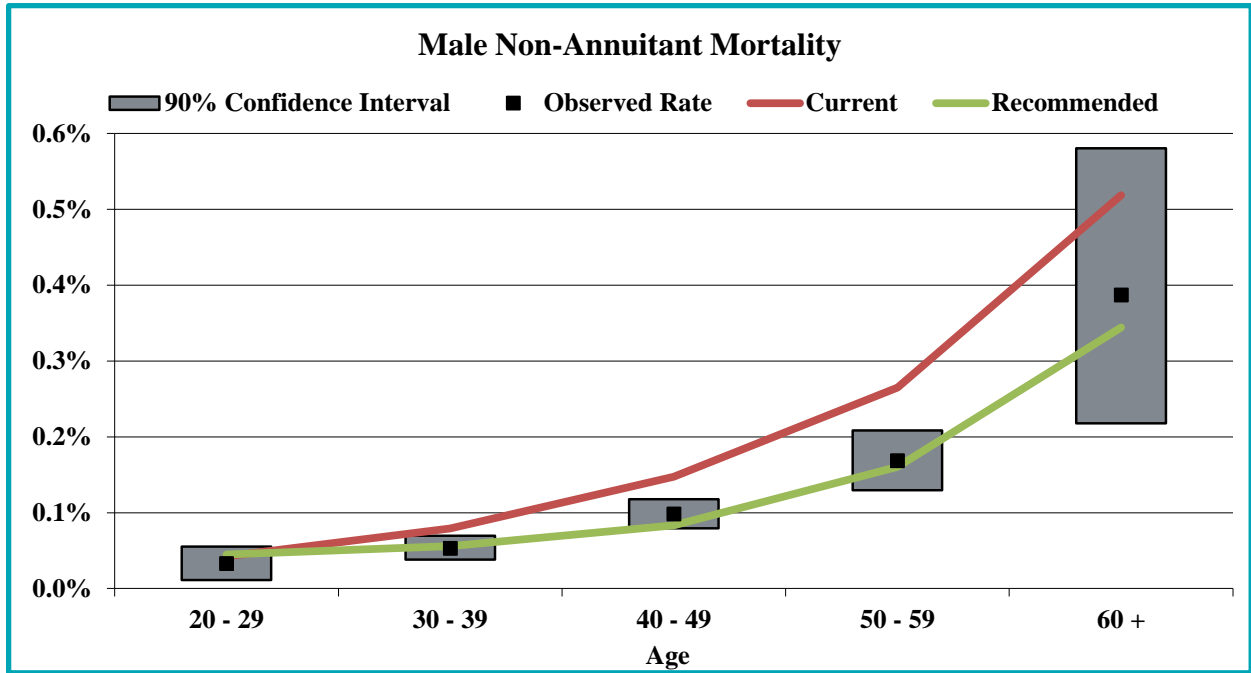
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**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	18,151	5	990,728,195	323,852	422,111	445,685	77%	73%
30 - 39	60,516	32	5,051,260,042	2,669,733	4,007,291	2,823,759	67%	95%
40 - 49	72,995	75	7,720,780,257	7,567,286	11,375,082	6,418,835	67%	118%
50 - 59	27,800	51	3,207,880,244	5,404,605	8,497,751	5,148,193	64%	105%
60 +	2,756	11	316,656,739	1,224,747	1,642,782	1,090,210	75%	112%
<b>Total</b>	<b>182,218</b>	<b>174</b>	<b>17,287,305,477</b>	<b>17,190,223</b>	<b>25,945,018</b>	<b>15,926,681</b>	<b>66%</b>	<b>108%</b>
<b>R-Squared</b>					<b>0.773</b>	<b>0.765</b>		

**Chart III-M1**



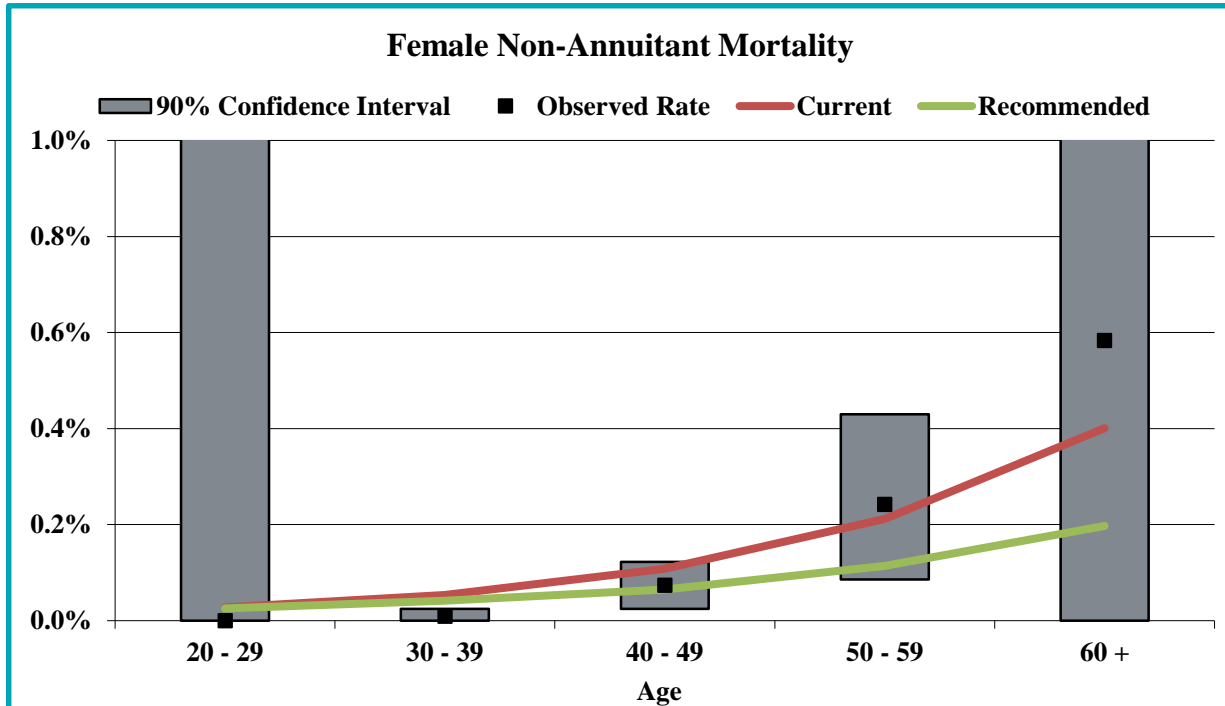
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**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	2,071	0	107,853,620	0	29,588	27,269	0%	0%
30 - 39	8,165	1	644,657,449	58,571	342,976	267,736	17%	22%
40 - 49	8,160	7	776,661,319	570,823	840,376	503,365	68%	113%
50 - 59	2,326	6	229,393,734	555,978	485,659	261,230	114%	213%
60 +	207	1	18,818,241	109,776	75,466	37,140	145%	296%
<b>Total</b>	<b>20,929</b>	<b>15</b>	<b>1,777,384,363</b>	<b>1,295,148</b>	<b>1,774,064</b>	<b>1,096,740</b>	<b>73%</b>	<b>118%</b>
<b>R-Squared</b>					<b>0.114</b>	<b>0.099</b>		

**Chart III-M2**



During the five-year period, there were 189 deaths in active service. Of these deaths, five were accidental. We recommend assuming that 5% of the deaths in active service are accidental deaths.

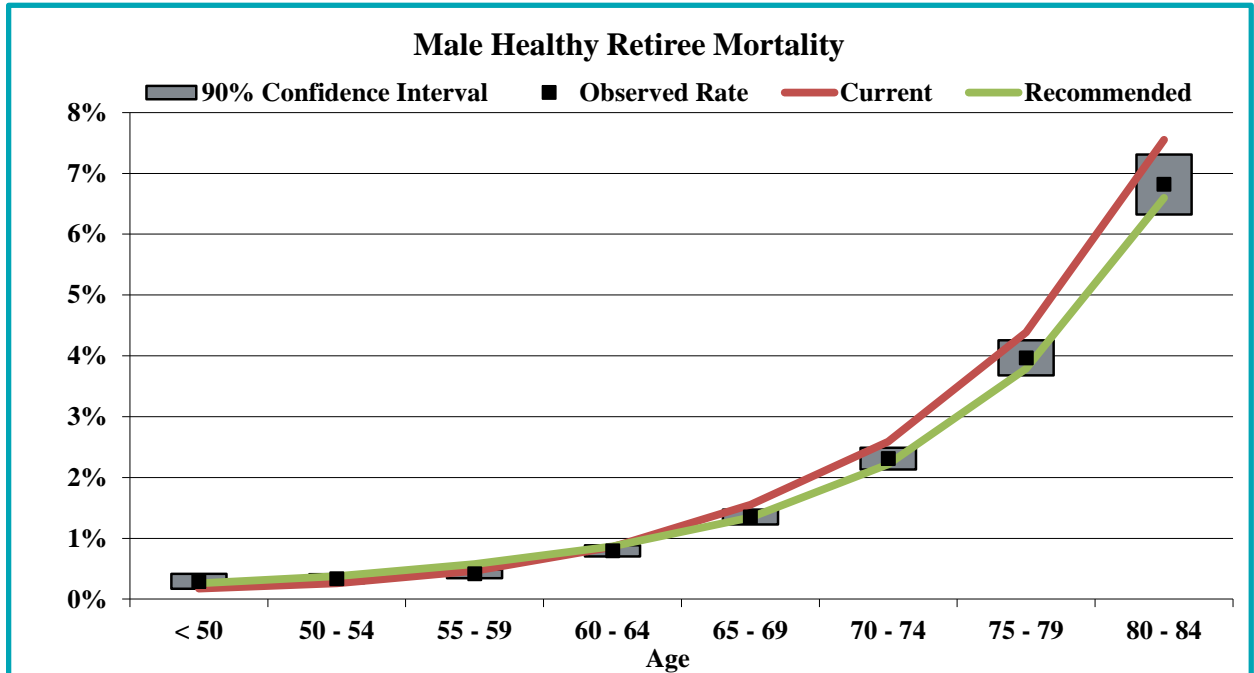
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**Table III-M3 – Healthy Retiree Males**

Healthy Retiree Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
< 50	5,311	17	351,996,772	1,010,706	613,081	917,537	165%	110%
50 - 54	17,028	63	1,195,666,997	4,014,888	3,095,593	4,523,592	130%	89%
55 - 59	22,378	100	1,555,357,605	6,456,195	7,199,228	8,937,833	90%	72%
60 - 64	24,024	207	1,612,701,316	12,781,631	13,823,012	14,007,012	92%	91%
65 - 69	24,072	352	1,500,535,226	20,235,611	23,265,646	20,124,665	87%	101%
70 - 74	19,358	473	1,076,726,424	24,871,984	27,854,142	23,834,679	89%	104%
75 - 79	12,531	518	632,143,058	25,067,283	27,731,229	23,942,766	90%	105%
80 - 84	7,115	519	313,605,095	21,380,805	23,679,396	20,683,468	90%	103%
85 - 89	4,070	477	154,127,407	17,448,069	19,718,796	17,314,643	88%	101%
90 - 94	1,786	333	60,619,324	11,342,827	12,137,963	10,679,890	93%	106%
95 +	331	96	9,993,350	2,824,359	2,829,356	2,466,558	100%	115%
<b>Total</b>	<b>138,004</b>	<b>3,155</b>	<b>8,463,472,574</b>	<b>147,434,358</b>	<b>161,947,442</b>	<b>147,432,643</b>	<b>91%</b>	<b>100%</b>
<b>R-Squared</b>					<b>0.961</b>	<b>0.954</b>		

**Chart III-M3**



We focused our analysis on ages 50 to 84, which is the age range that encompasses most of the retirees.

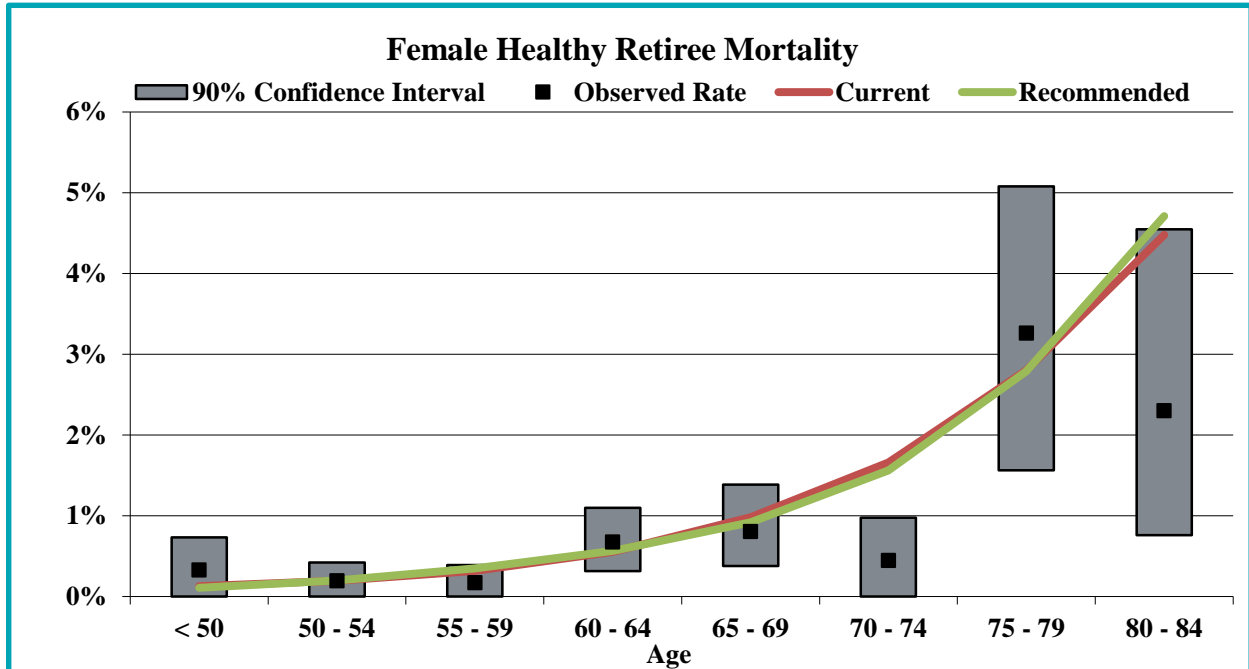
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**Table III-M4 – Healthy Retiree Females**

Healthy Retiree Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
< 50	548	2	32,447,203	107,203	41,720	34,908	257%	307%
50 - 54	1,430	3	89,067,790	173,421	173,672	177,279	100%	98%
55 - 59	1,534	3	92,310,409	159,161	291,566	319,663	55%	50%
60 - 64	1,273	9	70,466,013	476,358	390,786	397,317	122%	120%
65 - 69	794	6	42,089,023	338,893	413,591	386,343	82%	88%
70 - 74	410	2	18,600,118	83,509	308,784	290,110	27%	29%
75 - 79	256	9	8,682,986	283,387	243,302	242,273	116%	117%
80 - 84	132	4	4,430,499	102,066	198,456	208,665	51%	49%
85 - 89	39	4	1,047,273	106,132	77,553	83,013	137%	128%
90 - 94	20	2	488,128	48,763	65,703	69,371	74%	70%
95 +	9	0	218,950	0	41,399	43,782	0%	0%
<b>Total</b>	<b>6,445</b>	<b>44</b>	<b>359,848,392</b>	<b>1,878,893</b>	<b>2,246,530</b>	<b>2,252,724</b>	<b>84%</b>	<b>83%</b>
<b>R-Squared</b>					<b>0.284</b>	<b>0.273</b>		

**Chart III-M4**



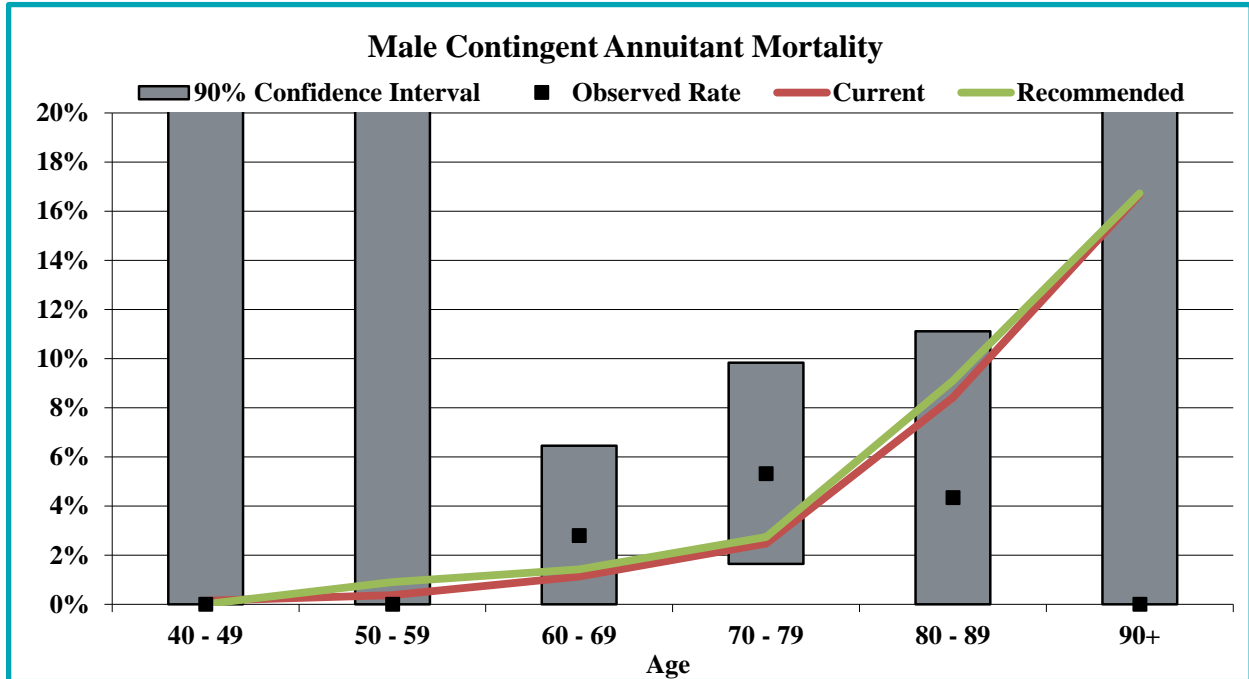
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**Table III-M5 – Male Beneficiaries**

Contingent Annuitant Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
40 - 49	48	0	1,829,267	0	2,539	0	0%	0%
50 - 59	49	0	1,877,318	0	6,838	16,869	0%	0%
60 - 69	62	2	2,239,683	62,534	25,128	31,819	249%	197%
70 - 79	61	4	2,009,745	106,650	49,663	55,005	215%	194%
80 - 89	36	1	1,049,889	45,541	88,229	95,416	52%	48%
90+	4	0	134,849	0	22,478	22,556	0%	0%
<b>Total</b>	<b>260</b>	<b>7</b>	<b>9,140,751</b>	<b>214,725</b>	<b>194,875</b>	<b>221,665</b>	<b>110%</b>	<b>97%</b>
<b>R-Squared</b>					<b>0.029</b>	<b>0.031</b>		

**Chart III-M5**



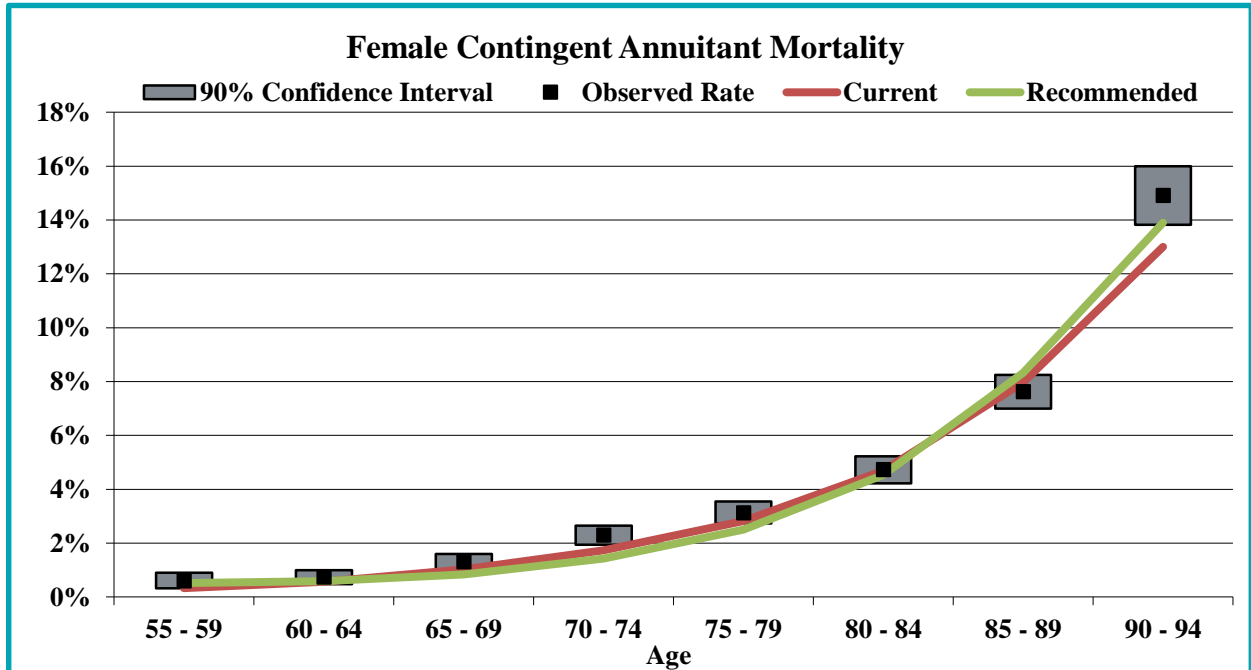
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**Table III-M6 –Female Beneficiaries**

Contingent Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
< 45	587	1	24,066,104	45,163	16,640	0	271%	0%
45 - 49	698	1	29,003,804	24,839	36,754	0	68%	0%
50 - 54	1,169	5	48,494,342	186,273	94,714	216,483	197%	86%
55 - 59	1,890	12	76,596,260	458,085	248,609	392,895	184%	117%
60 - 64	2,724	20	105,415,418	770,051	599,231	618,831	129%	124%
65 - 69	3,754	49	136,945,982	1,780,307	1,395,983	1,137,252	128%	157%
70 - 74	4,730	110	159,512,534	3,652,650	2,768,077	2,281,933	132%	160%
75 - 79	4,914	154	151,417,514	4,731,645	4,276,526	3,781,601	111%	125%
80 - 84	4,901	230	134,303,719	6,343,817	6,295,146	6,088,192	101%	104%
85 - 89	4,778	370	117,965,547	8,985,226	9,397,655	9,819,329	96%	92%
90 - 94	2,850	420	65,116,644	9,709,911	8,469,715	9,050,198	115%	107%
95 +	624	157	13,227,452	3,422,817	2,501,524	2,745,462	137%	125%
<b>Total</b>	<b>33,619</b>	<b>1,529</b>	<b>1,062,065,320</b>	<b>40,110,784</b>	<b>36,100,573</b>	<b>36,132,176</b>	<b>111%</b>	<b>111%</b>
<b>R-Squared</b>					<b>0.956</b>	<b>0.949</b>		

**Chart III-M6**



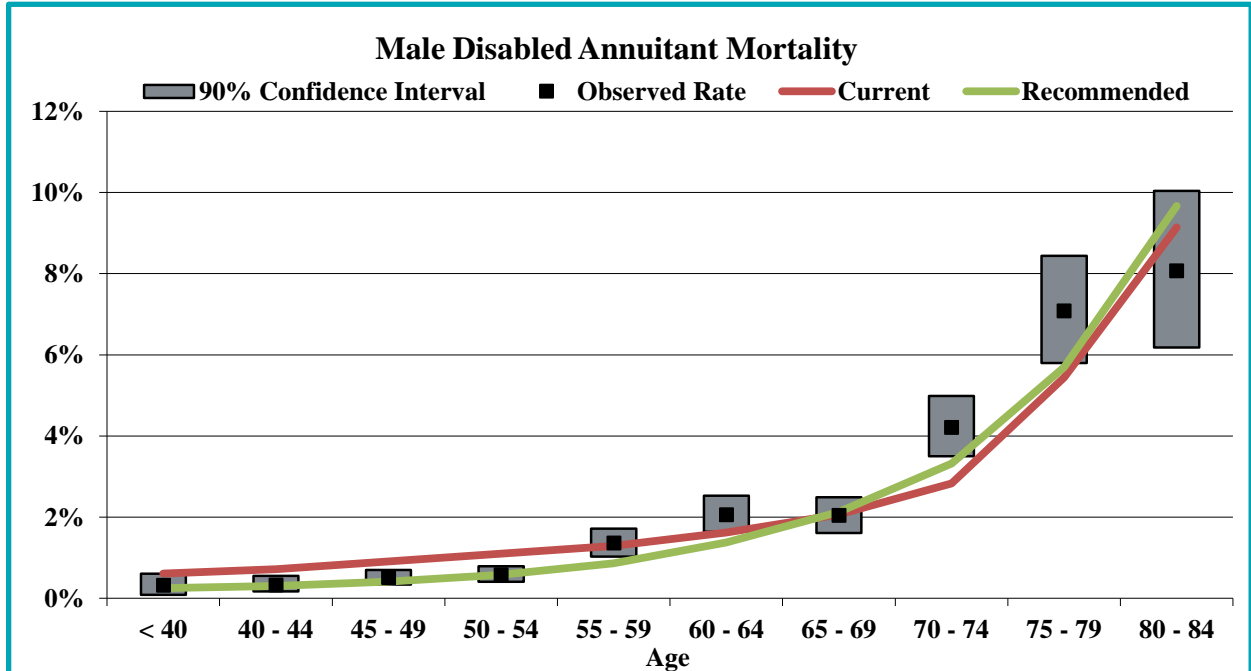
**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**Table III-M7 – Disabled Retiree 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
< 40	1,161	6	53,806,019	174,797	326,623	132,195	54%	132%
40 - 44	2,365	9	112,193,065	367,637	803,379	340,961	46%	108%
45 - 49	4,161	23	193,150,800	983,976	1,755,087	783,341	56%	126%
50 - 54	4,173	29	187,701,134	1,095,590	2,058,516	1,086,319	53%	101%
55 - 59	3,210	45	133,263,017	1,818,069	1,718,927	1,148,615	106%	158%
60 - 64	2,812	55	98,356,504	2,026,114	1,589,990	1,355,305	127%	149%
65 - 69	2,736	65	81,353,082	1,663,895	1,680,403	1,729,339	99%	96%
70 - 74	1,945	87	47,438,041	1,999,106	1,342,767	1,574,959	149%	127%
75 - 79	983	66	21,522,484	1,524,814	1,171,087	1,225,639	130%	124%
80 - 84	518	44	10,464,613	844,919	956,737	1,011,787	88%	84%
85 - 89	224	35	4,265,854	652,066	562,415	699,128	116%	93%
90 - 94	132	26	2,617,313	547,190	460,292	696,566	119%	79%
95 +	7	4	145,023	85,905	32,062	51,522	268%	167%
<b>Total</b>	<b>24,427</b>	<b>494</b>	<b>946,276,949</b>	<b>13,784,078</b>	<b>14,458,283</b>	<b>11,835,675</b>	<b>95%</b>	<b>116%</b>
<b>R-Squared</b>					<b>0.495</b>	<b>0.702</b>		

**Chart III-M7**



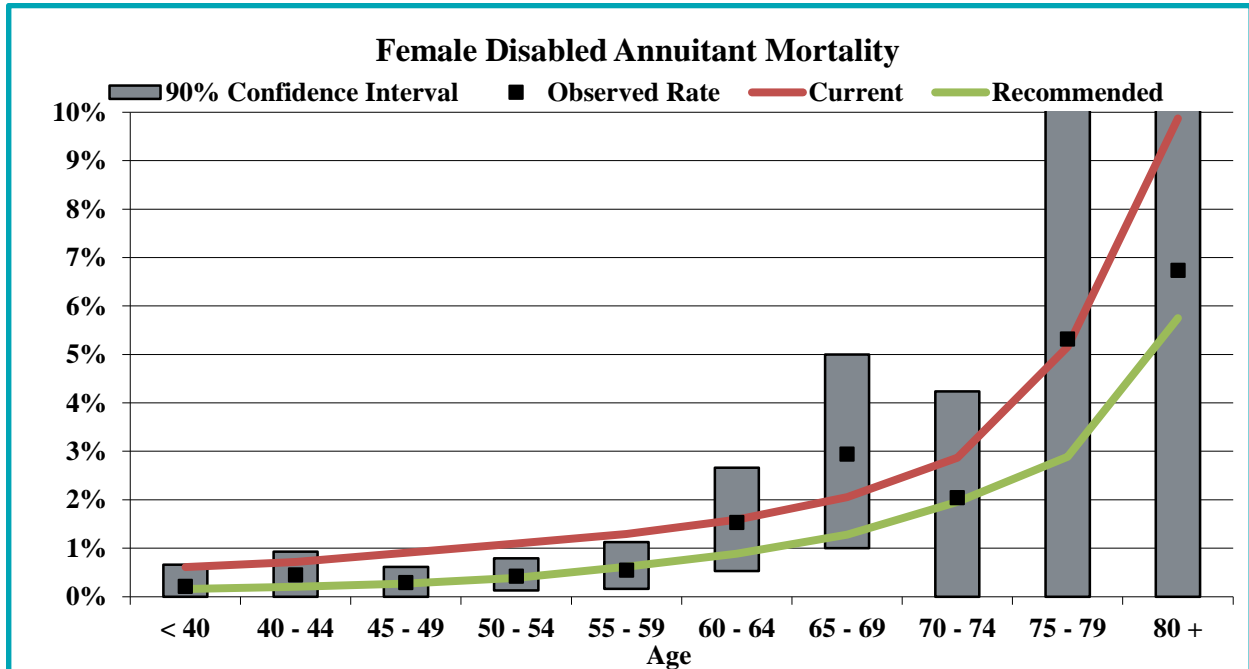
**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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**SECTION III – DEMOGRAPHIC ASSUMPTIONS  
MORTALITY RATES**

**Table III-M8 – Disabled Retiree 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
< 40	302	1	12,466,976	26,847	76,061	19,974	35%	134%
40 - 44	536	3	21,605,899	96,791	154,711	44,584	63%	217%
45 - 49	810	3	31,348,140	92,287	284,368	83,969	32%	110%
50 - 54	760	3	27,366,680	115,599	299,358	106,862	39%	108%
55 - 59	620	5	21,717,786	119,268	280,758	134,492	42%	89%
60 - 64	376	6	12,145,908	186,233	193,241	107,425	96%	173%
65 - 69	200	6	5,832,151	171,597	119,820	74,692	143%	230%
70 - 74	118	3	3,317,038	67,774	95,159	64,820	71%	105%
75 - 79	48	3	1,248,044	66,365	64,399	36,013	103%	184%
80 +	30	2	600,273	40,424	59,245	34,527	68%	117%
<b>Total</b>	<b>3,800</b>	<b>35</b>	<b>137,648,895</b>	<b>983,185</b>	<b>1,627,121</b>	<b>707,358</b>	<b>60%</b>	<b>139%</b>
<b>R-Squared</b>					<b>0.133</b>	<b>0.185</b>		

**Chart III-M8**





## 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 System.

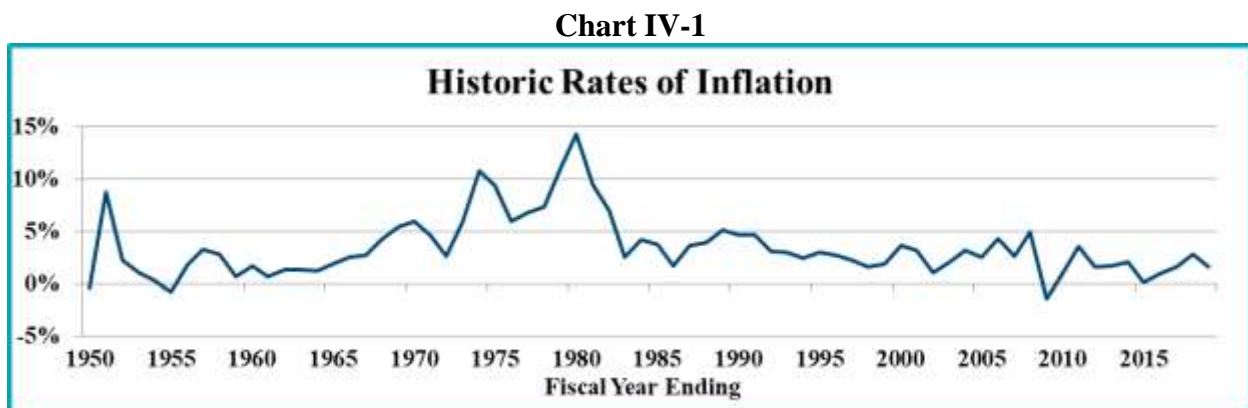
In order to develop recommendations for each of these assumptions, we considered historical data, both nationally and for the System, expectations for the future and assumptions used by other public sector plans.

### 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**

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

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

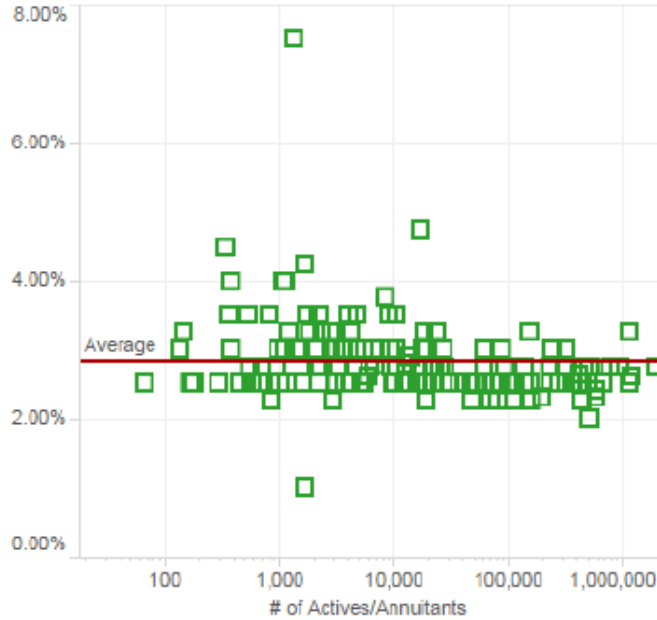
The Federal Reserve Bank of Philadelphia publishes a quarterly survey of professional economic forecasters that includes their forecasts of inflation over the next 10 years. The survey for the third quarter of 2019 shows a median inflation forecast of 2.2%, a minimum forecast of about 1.9%, and a maximum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

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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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 System's actuarial valuations is between 2.0% and 3.0%. Given the lower expected inflation, we recommend reducing the assumption from 3.00% to 2.75%. If, at the time of the next review of economic assumptions, the markets and forecasters continue to indicate lower expectations of future inflation, further reductions in the assumption could be considered.

**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.

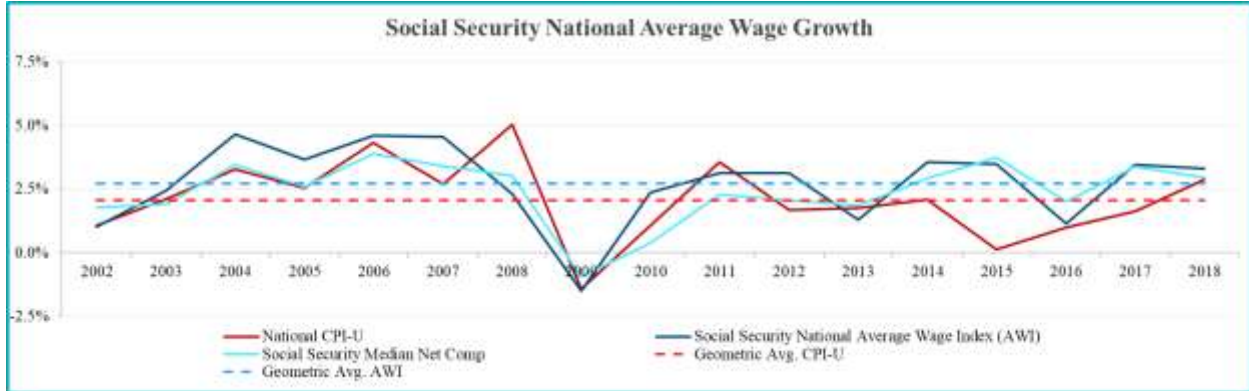
Wage inflation is used in the actuarial valuation to project the Social Security Wage Base in determining the actuarial liability.

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

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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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 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 age and time period as shown in the table on the next page. Salary increases are assumed to occur on July 1.

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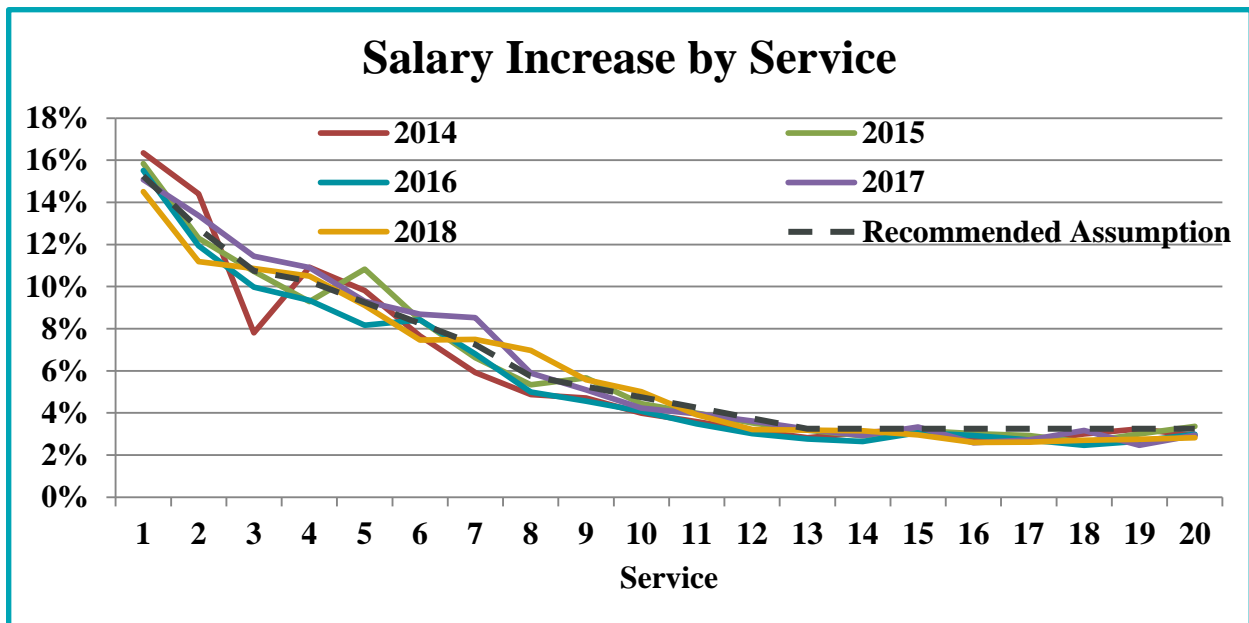
**SECTION IV – ECONOMIC ASSUMPTIONS**

Age	Prior to FYE 2026	FYE 2026 and thereafter
25	8.98%	9.98%
30	5.97	6.97
35	4.17	5.17
40	3.33	4.43
45	2.90	3.90
50	2.75	3.75
55	2.60	3.60
60	2.35	3.35
64	2.10	3.10

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 a service-based salary increase assumption. Chart IV-4 shows the total salary increases based on years of service for continuing active members for FYE 2014 through FYE 2018 and the recommended assumption.

When setting the recommended assumption, we reviewed the merit component of the actual salary increases. The recommended total salary increase assumption is the sum of the merit increase assumption plus assumed inflation (2.75%) plus assumed productivity (0.50%). Due to the current low inflation environment, the recommended salary increase assumption is slightly higher than the average actual salary increases over the past five years.

**Chart IV-4**



**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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**APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS**

The demographic assumptions are based on an experience study covering the period July 1, 2013 through June 30, 2018.

**1. Salary Increases**      Salaries increase rates are as follows:

Service	Rates
0	15.25%
1	15.25
2	12.75
3	10.75
4	10.25
5	9.25
6	8.25
7	7.25
8	5.75
9	5.25
10	4.75
11	4.25
12	3.75
13+	3.25

Salary increases are assumed to occur on July 1.

**2. 401(a)(17) Pay Limit**      \$275,000 in 2018 increasing 2.75% per annum, compounded annually.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS**

**3. Social Security Wage Base**      \$128,400 in 2018 increasing 3.25% per annum, compounded annually.

**4. Termination**      Termination rates are as follows:

Service	Rates
0	2.00%
1	2.00
2	1.90
3	1.80
4	1.70
5	1.60
6	1.50
7	1.40
8	1.00
9	0.80
10	0.80
11	0.50
12	0.45
13	0.40
14	0.35
15	0.30
16	0.25
17	0.20
18	0.15
19	0.10
20	0.00

No termination is assumed after attainment of retirement eligibility.

All members are assumed to elect a refund of contributions.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS**

**5. Disability**

Disability rates are as follows:

<b>Age</b>	<b>Ordinary Disability</b>	<b>Accidental Disability</b>
20	0.030%	0.020%
21	0.030	0.020
22	0.030	0.025
23	0.045	0.025
24	0.045	0.030
25	0.045	0.030
26	0.045	0.035
27	0.045	0.035
28	0.065	0.040
29	0.085	0.070
30	0.105	0.100
31	0.125	0.130
32	0.145	0.160
33	0.165	0.190
34	0.185	0.220
35	0.205	0.250
36	0.225	0.280
37	0.255	0.310
38	0.285	0.340
39	0.315	0.370
40	0.345	0.400
41	0.375	0.400
42	0.375	0.400
43	0.380	0.400
44	0.360	0.400
45	0.340	0.380
46	0.320	0.360
47	0.300	0.340
48	0.280	0.320
49	0.260	0.300
50	0.240	0.280
51	0.220	0.260
52	0.200	0.240
53	0.200	0.220
54	0.200	0.200
55	0.200	0.180
56	0.200	0.160
57	0.300	0.160
58	0.400	0.160
59+	0.500	0.160



POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

Both ordinary and accidental disability rates apply at all ages until the mandatory retirement age of 65.

No ordinary disability is assumed prior to attainment of ordinary disability retirement eligibility at four years of service.

No members are assumed to receive the involuntary disability retirement benefit.

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

**6. Mortality**

Pre-Retirement: The standard Pub-2010 Safety Employee mortality table [*PubS-2010 Employee*] as published by the Society of Actuaries with a 105.6% adjustment for males and 102.5% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. 5% of the deaths are assumed to be accidental.

Healthy Retirees (Healthy Annuitants): The standard Pub-2010 Safety Retiree Below-Median Income Weighted mortality table [*PubS-2010(B) Healthy Retiree*] as published by the Society of Actuaries with a 96.7% adjustment for males and 96.0% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Beneficiaries (Contingent Annuitants): The standard Pub-2010 General Retiree Below-Median Income Weighted mortality table [*PubG-2010(B) Healthy Retiree*] as published by the Society of Actuaries unadjusted, 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 Safety Disabled Retiree mortality table [*PubS-2010 Disabled Retiree*] as published by the Society of Actuaries with a 152.0% adjustment for males and 109.3% adjustment for females, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
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**APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS**

**7. Retirement** For those with less than 25 years of service:

Age	Rates
40-49	2.00%
50-57	3.00
58	3.50
59	4.25
60	5.00
61	8.00
62	10.00
63	12.00
64	14.00

For those with 25 years of service:

Age	Rates
48 or younger	45.00%
49-54	50.00
55-59	55.00
60	60.00
61	65.00
62	70.00
63	75.00
64	90.00

For those with 26 or more years of service:

Age	Rates
53 or younger	22.00%
54-59	24.00
60	26.00
61	28.00
62-63	30.00
64	40.00

Mandatory retirement at age 65.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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, 2010 – June 30, 2013 and adopted by the Board on February 9, 2015.

- 1. Salary Increases**      Salary increases vary by age and time period. Representative salary increase rates are shown below.

Age	Prior to FYE 2026	FYE 2026 and thereafter
25	8.98%	9.98%
30	5.97	6.97
35	4.17	5.17
40	3.33	4.43
45	2.90	3.90
50	2.75	3.75
55	2.60	3.60
60	2.35	3.35
64	2.10	3.10

Salary increases are assumed to occur on July 1.

- 2. 401(a)(17) Pay Limit**      \$275,000 in 2018 increasing 3.00% per annum, compounded annually.

- 3. Social Security Wage Base**      \$128,400 in 2018 increasing 4.00% per annum, compounded annually.

- 4. Termination**      Representative termination rates are as follows:

Age	Years of Service					
	0 - 1	2	3	4	5 - 9	10+
25	6.90%	2.03%	1.18%	0.60%	0.35%	0.00%
30	9.30	2.75	1.76	1.31	0.60	0.24
35	9.80	3.17	1.76	1.57	0.77	0.24
40	13.70	2.25	1.85	1.74	0.67	0.27
45	3.50	2.25	1.85	2.32	1.35	0.28
50	0.00	2.25	1.85	2.00	1.60	0.30
55	0.00	0.00	0.00	0.00	0.00	0.00

No termination is assumed after attainment of retirement eligibility.

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

**POLICE AND FIREMEN'S RETIREMENT SYSTEM 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 Disability	Accidental Disability
25	0.045%	0.029%
30	0.147	0.278
35	0.265	0.393
40	0.362	0.423
45	0.394	0.396
50	0.449	0.179
55	0.554	0.161
60	1.024	0.161
64	1.680	0.161
65+	0.000	0.000

Both ordinary and accidental disability rates apply at all ages until the mandatory retirement age of 65.

Members retiring under the ordinary disability decrement with less than four years of service are assumed to receive a return of Aggregate Contributions.

No members are assumed to receive the involuntary disability retirement benefit.

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

**6. Mortality**

Pre-Retirement Accidental Mortality: Custom table with representative rates as follows.

Age	Rates
25	0.006%
30	0.006
35	0.008
40	0.008
45	0.009
50	0.009
55	0.014
60	0.013
64	0.008
65+	0.000

No mortality improvement is assumed for pre-retirement accidental mortality.

**POLICE AND FIREMEN'S RETIREMENT SYSTEM OF NEW JERSEY  
EXPERIENCE STUDY AS OF JUNE 30, 2018**

**APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS**

Pre-Retirement Ordinary Mortality: RP-2000 Combined Healthy Mortality Tables projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection Scale thereafter.

Post-Retirement Healthy Female Retiree and Beneficiary Mortality: RP-2000 Combined Healthy Mortality Tables projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection Scale thereafter.

Post-Retirement Healthy Male Retiree Mortality: RP-2000 Combined Healthy Mortality Tables projected on a generational basis using Projection Scale AA from the base year of 2012 to 2013 and the Conduent Modified 2014 Projection Scale thereafter.

Disabled Retiree Mortality: Custom table with representative rates as follows.

Age	Rates
35	0.598%
40	0.634
45	0.803
50	1.058
55	1.210
60	1.426
65	1.949

No mortality improvement is assumed for disabled retiree mortality.

**7. Retirement**

Representative retirement rates are as follows:

Age	Years of Service			
	Less Than 21	21 - 24	25	26+
40	4.00%	0.60%	45.57%	15.40%
45	4.00	0.60	54.83	15.40
50	4.30	0.60	57.62	18.48
55	6.00	0.00	64.94	24.47
60	3.20	0.00	77.49	27.34
64	37.50	0.00	85.24	51.03

Mandatory retirement at age 65.

Retirement rates for less than 25 years of service prior to age 55 apply only to members enrolled as of January 18, 2000 upon completion of 20 years of service.



*Classic Values, Innovative Advice*