MISCELLANEOUS ASSUMPTIONS   *continued*

Survivor Annuity Assumptions

What are the Survivor Annuity Assumptions and How Do We Use them?

A Survivor Annuity assumption is used to estimate the rate at which survivors receive an annuity benefit when an active or terminated vested member dies. In Plans 1 and Plans 2, eligible survivors have the option to select an annuity or take a refund of the member's contributions and interest. In Plans 3, since members do not contribute to the defined benefit portion, we expect all eligible survivors will receive the annuity benefit.

We also set a Survivor Annuity assumption to model the portion of LEOFF and WSPRS Plans 1 active or terminated vested members we expect will receive a subsidized Joint and Survivor (J&S) benefit in the future.

These assumptions are set by the age of the member at death, the type of benefits a survivor is eligible to receive, and retirement plan.

These assumptions were previously referred to as "Survivors Selecting Annuities". For information about the prior assumptions, please see the [2007-2012 Demographic Experience Study](#).

High-Level Takeaways

Overall, we expect the rates at which eligible survivors receive an annuity benefit to continue to differ by plan and age.

Since survivors of Plan 3 members don't have the option to take a refund of contributions and interest for the defined benefit component of the plan, our assumption approximates the portion of the population that has an eligible survivor. Similarly, all the Plans 1 members are close to normal retirement age and typically have accrued a larger benefit, so we assumed an annuity will be paid for members with a survivor. On the other hand, Plans 2 survivors are less likely to elect an annuity at earlier ages because it is actuarially reduced. Using experience data, population data, and our expectations for the future, we selected general assumptions by plan and age as shown in the following table for non-duty related deaths.

Survivor Annuity Assumption			
Age	**Plans 1***	**Plans 2**	**Plans 3**
20-24	N/A	0.00	0.35
25-29	N/A	0.00	0.35
30-34	N/A	0.00	0.35
35-39	N/A	0.00	0.65
40-44	N/A	0.10	0.65
45-49	N/A	0.20	0.65
50-54	N/A	0.30	0.65
55-59	0.60	0.40	0.65
60-64	0.60	0.50	0.65
65+	0.60	0.60	0.65

*WSPRS and LEOFF Plan 1 uses Plans 3 rates.

THREE: APPENDICES

Data

We began with 23 years of experience study records, from 1995-2017. No special data was added for this assumption, but some data was removed. We removed 2001 and 2007 data for all systems due to odd-length valuation periods. While we recognize the Great Recession may have impacted member behavior, we chose to include that data as part of the analysis. We did not observe any significant variance of the Great Recession observations to the years immediately before and after, as illustrated in the following table for all PERS plans combined.

PERS Annuity Selection Rate			
Year	Male	Female	All
1995	44%	25%	36%
1996	41%	28%	35%
1997	54%	27%	42%
1998	53%	34%	46%
1999	42%	39%	41%
2000	39%	25%	32%
2001			
2002	38%	33%	36%
2003	58%	28%	46%
2004	47%	33%	41%
2005	56%	27%	44%
2006	47%	32%	41%
2007			
2008	47%	32%	41%
2009	53%	41%	49%
2010	62%	26%	48%
2011	56%	33%	46%
2012	62%	33%	50%
2013	54%	40%	49%
2014	57%	34%	47%
2015	55%	37%	48%
2016	55%	42%	49%
2017	53%	29%	42%
Total	52%	33%	44%

Since a member generally must be married for a survivor to receive an annuity benefit, we also gathered data on marriage statistics from the United States Census Bureau. Below is a chart of the percentage of married individuals by age in Washington State as of 2017.

Washington State Percent Married		
Age	Male	Female
15-19	0.01	0.14
20-34	0.30	0.38
35-44	0.63	0.67
45-54	0.65	0.64
55-64	0.65	0.63
65+	0.71	0.47
Total	0.51	0.50

MISCELLANEOUS ASSUMPTIONS *continued*

We do not have sufficient data to set rates for PSERS and WSPRS. Instead, we relied on experience from our larger systems and Washington State marriage data.

General Methodology

We calculated the actual survivor annuity rate by dividing the number of survivors that selected an annuity benefit (observations) by the total number of members who met the service requirements for an annuity option when they died (exposures).

To determine our new assumed rates for active members, we examined the actual rate of survivors receiving annuities over five-year age bands, made comparisons to the Washington State marriage rates, considered historical trend experience, and applied professional judgment with respect to our expectations for the future.

We based our new assumptions more heavily on the Washington State marriage data for the following plans and benefits:

❖ All death benefits in Plans 3;

❖ Duty-related death benefits in all plans;

❖ WSPRS 1 death benefits (since survivors also receive unreduced benefits for non-duty deaths);

❖ LEOFF 1 (since member contributions have ceased); and

❖ Subsidized J&S benefits.

For the active and terminated vested member death benefits in Plans 1 and 2, where survivors have the additional option of selecting a return of contributions, we set our new assumed rates based primarily on historical experience while taking into consideration the age-based marriage data.

For current inactive members, or members that have already terminated from active service, we reviewed the current inactive population that met the service criteria for an annuity death benefit and selected a single rate.

Law Changes

Since the last study, no law changes have impacted our analysis of this assumption.

Analysis and Results

Analysis

Overall, we see the rates at which survivors receive annuities differ more by age and plan than by gender and system.

Differing plan designs impact the rate at which survivors are eligible to receive annuity benefits. In order to qualify for an annuity benefit, the member must have met certain service requirements and the survivor must be a qualified beneficiary such as spouse or minor child. Survivors of Plans 1 and 2 members have the additional option of selecting a return of contributions in lieu of an annuity benefit. In general, we observed higher rates of annuity benefits paid to qualified members of Plans 3 than Plans 1/2.

Our experience indicated that survivors of older members are more likely to select an annuity benefit. This relationship correlates to the likelihood of being married at each age and the average accrued retirement benefit by the member at each age. For Plans 3, we expect the rates of annuity benefits paid to vested members' survivors to generally mirror the proportion of the population that is married. A minor child may also be eligible for an annuity death benefit in the absence of a spouse. We assumed the likelihood of a minor child receiving a benefit is small, and we did not increase our assumptions beyond the Washington State marriage data.

Duty-related death benefits also impact the rate at which annuities are selected. The annuity provided under a duty-related death is more generous than the non-duty-related death annuity for most plans. Systems such as LEOFF may see higher rates of annuity selection due to the higher proportion of duty-related deaths. For more information on duty-related death benefits, please see the section on the **Duty-Related Death Assumption.**

MISCELLANEOUS ASSUMPTIONS *continued*

Lastly, we observed the survivor of a male member to be generally more likely to receive an annuity benefit than the survivor of a female member. However, we expect this difference between male and female rates to erode over time.

Past Experience

We compared the number of active member deaths meeting survivor annuity service requirements (exposures)to our expected number of survivor annuity recipients based on our old assumptions. To determine the expected number of survivors receiving annuities, we multiplied the old assumption by the number of exposures over the study period.

We considered the A/E ratio on an annual basis and as a whole over the entire study period. This helped us identify trends in the data where our old assumptions were over or underestimating the rates at which survivors received an annuity benefit. Generally, we found our old assumptions were close to actual experience in Plans 1 and 2 but underestimated the proportion of annuity recipients in Plans 3.

The following tables show the Actual and Expected number of members who received an annuity based on our old assumptions, along with the A/E Ratio.

PERS Survivor Annuities (1995-2017)				
Plan 1				
Age	**Exposure**	**Actual**	**Expected**	**A/E**
<40	0	0	0	N/A
40-44	20	4	5	0.73
45-49	69	29	31	0.95
50-54	174	100	89	1.13
55-59	225	155	122	1.27
60-64	236	129	139	0.93
65+	122	62	78	0.80
Total	**846**	**479**	**464**	**1.03**

PERS Survivor Annuities (1995-2017)								
Plan 2					**Plan 3**			
Age	**Exposure**	**Actual**	**Expected**	**A/E**	**Exposure**	**Actual**	**Expected**	**A/E**
<40	55	3	0	N/A	10	6	2	3.57
40-44	136	9	8	1.16	19	10	5	1.88
45-49	248	28	39	0.72	34	19	11	1.73
50-54	464	151	123	1.23	58	25	23	1.09
55-59	607	275	216	1.27	80	42	36	1.17
60-64	599	318	292	1.09	61	38	35	1.09
65+	366	161	215	0.75	26	16	16	0.99
Total	**2475**	**945**	**892**	**1.06**	**288**	**156**	**128**	**1.22**

MISCELLANEOUS ASSUMPTIONS *continued*

TRS Survivor Annuities (1995-2017)

	Plan 1			
Age	Exposure	Actual	Expected	A/E
<40	1	0	0	N/A
40-44	7	5	3	1.64
45-49	40	25	18	1.42
50-54	85	49	46	1.06
55-59	84	54	48	1.12
60-64	70	37	43	0.85
65+	32	17	21	0.82
Total	319	187	179	1.04

TRS Survivor Annuities (1995-2017)

	Plan 2				Plan 3			
Age	Exposure	Actual	Expected	A/E	Exposure	Actual	Expected	A/E
<40	5	0	0	N/A	27	14	8	1.75
40-44	10	0	0	N/A	46	20	18	1.14
45-49	26	2	1	2.68	69	32	29	1.09
50-54	23	5	5	0.97	116	69	54	1.29
55-59	49	23	19	1.22	140	95	69	1.38
60-64	52	25	28	0.90	97	59	52	1.14
65+	20	10	13	0.76	32	19	18	1.04
Total	185	65	66	0.99	527	308	248	1.24

SERS Survivor Annuities (1995-2017)

	Plan 2				Plan 3			
Age	Exposure	Actual	Expected	A/E	Exposure	Actual	Expected	A/E
<40	3	0	0	N/A	3	2	1	3.28
40-44	16	0	1	0.00	10	5	3	1.95
45-49	25	6	6	1.08	46	19	16	1.20
50-54	63	17	19	0.91	94	42	36	1.16
55-59	109	48	40	1.20	116	61	47	1.29
60-64	115	58	48	1.20	105	54	49	1.10
65+	103	49	50	0.97	73	38	38	1.00
Total	434	178	163	1.09	447	221	189	1.17

MISCELLANEOUS ASSUMPTIONS
continued

	Plan 1				Plan 2			
Age	Exposure	Actual	Expected	A/E	Exposure	Actual	Expected	A/E
<40	0	0	0	N/A	22	12	7	1.61
40-44	2	2	1	1.57	40	11	19	0.58
45-49	10	7	6	1.10	40	26	22	1.18
50-54	18	16	11	1.40	50	37	30	1.22
55-59	4	3	3	1.18	25	18	17	1.09
60-64	5	5	3	1.54	17	15	12	1.26
65+	1	1	1	1.49	3	1	2	0.44
Total	40	34	26	1.33	197	120	109	1.10

LEOFF Survivor Annuities (1995-2017)

Methods and Format of Assumptions

Given the limited amount of data available to study this assumption and its relatively minor impact to the overall pension liabilities, we made some simplifications to the format of this assumption and how we apply it to the relevant benefits in our valuation software.

Previously, this assumption was set by age, plan, system, and gender. We simplified this format to age-based rates that differ by plan and benefit type only. For PERS, TRS and LEOFF Plans 1, we selected a single rate given the size of the remaining populations and the small variance across member ages.

We considered but did not adopt other alternate formats for the assumption. For reference, we considered:

❖ **Separate rates by gender in PERS, TRS, and SERS.**
   We concluded the added complexity did not improve accuracy or materially impact plan liabilities. Furthermore, due to observed trends, we expect the rates of survivors receiving annuities between males and females to converge over time.

❖ **Separate rates by system.**
   Similar to gender-specific rates, we found that the added complexity did not add significant value to our expectations for the future.

❖ **Combined, blended rates by plan**
   We found that the plan design and actual experience of the plans suggests materially different behavior.

As part of this study, we identified potential areas of improvement in our valuation software. Specifically concerning how we model survivor annuity benefits paid to current active members we project to die after terminating employment. We identified areas for consolidating multiple complex benefit calculations into a few streamlined calculations. This simplification will not result in a material impact to plan liabilities and will reduce the complexity of our valuation model. These improvements may be considered and disclosed as part of a future actuarial valuation report.

Results

All-Plan Summary

Generally, we found similar rates of annuity recipients at various ages across Plans 2 and Plans 3. The exception was LEOFF 2, which has a higher proportion of duty-related deaths that provide more generous annuity benefits.

Observed Survivor Annuity Rates (1995-2017)							
	Plans 2				Plans 3		
Age	**PERS**	**TRS**	**SERS**	**LEOFF**	**PERS**	**TRS**	**SERS**
<40	5%	0%	0%	55%	60%	52%	67%
40-44	7%	0%	0%	28%	53%	43%	50%
45-49	11%	8%	24%	65%	56%	46%	41%
50-54	33%	22%	27%	74%	43%	59%	45%
55-59	45%	47%	44%	72%	53%	68%	53%
60-64	53%	48%	50%	88%	62%	61%	51%
65+	44%	50%	48%	33%	62%	59%	52%
Total	**38%**	**35%**	**41%**	**61%**	**54%**	**58%**	**49%**

For Plans 3 and subsidized J&S benefits, which do not have a return of contributions option, we found our experience generally matches the rate of Washington State marriages because a member must have a qualified beneficiary to receive an annuity death benefit. As such, we set our new assumption for Plans 3, subsidized J&S benefits, and all duty-related death benefits, based on our expectations for the proportion of married members by age.

For Plans 2, we set new rates based largely on average historical experience across the various systems while taking into consideration the age-based portion of the population we expect to be married.

New Survivor Annuity Assumption

The following tables show a summary of old and new probabilities of survivors receiving annuities by age, gender, system, and plan that we use for modeling active member benefits. For WSPRS 1 and duty-related deaths in all Plans 2, we will apply the Plans 3 survivor annuity assumptions because these benefits are not subject to early retirement reduction factors. Likewise, we will apply the Plans 3 survivor annuity assumptions to LEOFF Plan 1 because member contributions have not been collected for several years so we expect a return of contributions benefit to be much smaller than an annuity benefit.

PERS Plan 1			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-39	0.00	0.00	N/A
40-44	0.39	0.14	N/A
45-49	0.52	0.32	N/A
50-54	0.58	0.40	N/A
55-59	0.62	0.46	0.60
60-64	0.68	0.54	0.60
65+	0.70	0.57	0.60

PERS & PSERS Plan 2			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.00
25-29	0.00	0.00	0.00
30-34	0.00	0.00	0.00
35-39	0.00	0.00	0.00
40-44	0.07	0.02	0.10
45-49	0.20	0.09	0.20
50-54	0.32	0.16	0.30
55-59	0.44	0.23	0.40
60-64	0.60	0.34	0.50
65+	0.72	0.41	0.60

PERS Plan 3			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.35
25-29	0.00	0.15	0.35
30-34	0.09	0.17	0.35
35-39	0.19	0.18	0.65
40-44	0.29	0.20	0.65
45-49	0.39	0.22	0.65
50-54	0.49	0.24	0.65
55-59	0.59	0.26	0.65
60-64	0.73	0.31	0.65
65+	0.79	0.32	0.65

MISCELLANEOUS ASSUMPTIONS *continued*

TRS Plan 1			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	N/A
25-29	0.00	0.00	N/A
30-34	0.00	0.00	N/A
35-39	0.00	0.00	N/A
40-44	0.43	0.21	N/A
45-49	0.55	0.37	N/A
50-54	0.61	0.45	N/A
55-59	0.65	0.50	0.60
60-64	0.72	0.57	0.60
65+	0.73	0.59	0.60

TRS Plan 2			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.00
25-29	0.00	0.00	0.00
30-34	0.00	0.00	0.00
35-39	0.00	0.00	0.00
40-44	0.00	0.00	0.10
45-49	0.07	0.01	0.20
50-54	0.26	0.16	0.30
55-59	0.45	0.31	0.40
60-64	0.67	0.50	0.50
65+	0.79	0.59	0.60

TRS Plan 3			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.35
25-29	0.00	0.08	0.35
30-34	0.18	0.25	0.35
35-39	0.29	0.34	0.65
40-44	0.36	0.39	0.65
45-49	0.41	0.43	0.65
50-54	0.45	0.47	0.65
55-59	0.49	0.49	0.65
60-64	0.55	0.55	0.65
65+	0.58	0.57	0.65

SERS Plan 2			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.00
25-29	0.00	0.00	0.00
30-34	0.00	0.00	0.00
35-39	0.00	0.00	0.00
40-44	0.03	0.05	0.10
45-49	0.24	0.20	0.20
50-54	0.34	0.28	0.30
55-59	0.41	0.33	0.40
60-64	0.49	0.40	0.50
65+	0.54	0.43	0.60

SERS Plan 3			
	Old Rates		New Rates
Age	Male	Female	Male & Female
20-24	0.00	0.00	0.35
25-29	0.00	0.00	0.35
30-34	0.00	0.00	0.35
35-39	0.00	0.29	0.65
40-44	0.11	0.33	0.65
45-49	0.32	0.35	0.65
50-54	0.43	0.36	0.65
55-59	0.50	0.37	0.65
60-64	0.58	0.41	0.65
65+	0.62	0.42	0.65

MISCELLANEOUS ASSUMPTIONS   *continued*

LEOFF Plan 1		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-39	0.00	N/A
40-44	0.64	N/A
45-49	0.64	N/A
50-54	0.64	N/A
55-59	0.64	0.65
60-64	0.67	0.65
65+	0.67	0.65

LEOFF Plan 2		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-24	0.00	0.00
25-29	0.00	0.00
30-34	0.12	0.00
35-39	0.35	0.00
40-44	0.47	0.10
45-49	0.55	0.20
50-54	0.61	0.30
55-59	0.66	0.60
60-64	0.73	0.60
65+	0.75	0.60

WSPRS Plan 1		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-24	0.00	0.35
25-29	0.00	0.35
30-34	0.00	0.35
35-39	0.00	0.65
40-44	0.64	0.65
45-49	0.64	0.65
50-54	0.64	0.65
55-59	0.64	0.65
60-64	0.67	0.65
65+	0.67	0.65

WSPRS Plan 2		
	Old Rates	New Rates
Age	Male & Female	Male & Female
20-24	0.00	0.00
25-29	0.00	0.00
30-34	0.12	0.00
35-39	0.35	0.00
40-44	0.47	0.10
45-49	0.55	0.20
50-54	0.61	0.30
55-59	0.66	0.60
60-64	0.73	0.60
65+	0.75	0.60

All Systems – Duty Death	
	New Rates
Age	Male & Female
20-24	0.35
25-29	0.35
30-34	0.35
35-39	0.65
40-44	0.65
45-49	0.65
50-54	0.65
55-59	0.65
60-64	0.65
65+	0.65

To model inactive terminated vested member death benefits, we select a single survivor receiving annuity rate of:

❖ 50 percent for all Plans 2;

❖ 65 percent for all Plans 3;

❖ 60 percent for PERS and TRS Plans 1; and

❖ 65 percent for LEOFF and WSPRS Plans 1.

In addition to inactive member benefits, we use the above rate to model the portion of members' survivors who will receive a subsidized J&S benefit in the future in LEOFF and WSPRS Plans 1 (65 percent).