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Mortality Improvement Scale MP-2019

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Preface: Substantive Revisions Made to this Report Subsequent to 10/23/2019 Release

10/25/2019 Updates

The annuity factors in Table 3.1 and the corresponding impacts of updating from Scale MP-2018 to Scale MP-2019 in Table 3.2 were incorrect for RP-2006 and the Pub-2010 tables in the originally published version of the report. These have now been updated.

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Section 1: Executive Summary

This report presents Scale MP-2019, the latest iteration of the mortality improvement scales developed annually by the Retirement Plans Experience Committee (RPEC, or "the Committee") of the Society of Actuaries (SOA). Scale MP-2019 is based on the same underlying methodology and committee-selected assumption set used to develop Scale MP-2018 (SOA 2018) and reflects historical U.S. population mortality experience through 2017. The Scale MP-2019 mortality improvement rates can be found on the SOA website at the following link: https://www.soa.org/globalassets/assets/files/resources/experience-studies/2019/scale-mp-2019-rates.xlsx.

The Scale MP-2019 mortality improvement rates presented in this report are slightly lower than the corresponding Scale MP-2018 rates. Table 1 of deferred-to-62 annuity values shows that starting with Pri-2012 base mortality rates, most 2019 pension obligations calculated using Scale MP-2019 (with a discount rate of 4.0%) are anticipated to be 0.3% to 1.0% lower relative to their Scale MP-2018 counterparts. Section 3 illustrates that the annuity factor changes using other base mortality tables are similar.

Table 1.1

MONTHLY DEFERRED-TO-62 ANNUITY-DUE VALUES AT 4.0% AS OF JANUARY 1, 2019
PRI-2012 PROJECTED GENERATIONALLY

	Age	MP-2018	MP-2019	% Change
Females	25	3.7443	3.7304	*-0.37%*
	35	5.4463	5.4274	*-0.35%*
	45	7.9356	7.9105	*-0.32%*
	55	11.6119	11.5757	*-0.31%*
	65	14.2767	14.2366	*-0.28%*
	75	10.2859	10.2340	*-0.50%*
	85	6.2450	6.1966	*-0.78%*
	95	3.3856	3.3519	*-1.00%*
Males	25	3.5116	3.4911	*-0.58%*
	35	5.1095	5.0845	*-0.49%*
	45	7.4480	7.4199	*-0.38%*
	55	10.9073	10.8739	*-0.31%*
	65	13.4072	13.3744	*-0.24%*
	75	9.4920	9.4371	*-0.58%*
	85	5.5376	5.4813	*-1.02%*
	95	2.9144	2.8874	*-0.93%*

In 2018, RPEC began producing an additional model, denoted "RPEC_O2", that utilizes a smoother historical order-2 graduation with the goal of decreasing year-over-year volatility in the measurement of pension obligations. Results for this model are discussed in Section 3.

RPEC believes that Scale MP-2019 produces a reasonable mortality improvement assumption for measuring obligations for most retirement programs in the United States within the context of the "assumption universe" as described in Actuarial Standard of Practice No. 35 (ASOP No. 35) (ASB 2014). However, RPEC also believes that other mortality improvement scales, including those created with an assumption set different from that selected by RPEC or those based on an underlying model other than RPEC_2014 (such as the "order-2" model discussed in subsection 3.3 and introduced in the Scale MP-2018 report) also could fall within the ASOP No. 35 assumption universe. It is the responsibility of the actuary to determine which mortality improvement assumption is appropriate to use for a given purpose.

Section 2: Data Sources, Underlying Model and Recent U.S. Mortality Experience

2.1 Data Sources

The historical mortality information published by the Social Security Administration (SSA) in conjunction with the 2019 Trustees' Report included rates that are smoothed across ages for each individual year through calendar year 2016 (SSA 2018). The data for calendar years 1950 through 2016 were taken directly from these SSA-published mortality rates.

Estimated SSA-style[1] rates for 2017 were calculated using data developed by the Centers for Disease Control and Prevention (CDC), the U.S. Census Bureau and the Centers for Medicare and Medicaid Services (CMS). The methodology used to develop the estimated rates for calendar year 2017 was the same as that described in Appendix C of the Scale MP-2017 report for the estimated SSA-style rates for calendar year 2015.

2.2 Mortality Improvement Model

The 2019 version of the RPEC mortality improvement model, denoted RPEC_2014_v2019, is based on the original RPEC_2014 model updated to reflect the historical mortality data through calendar year 2017 as described in Section 2.1. As in all prior MP scales, historical rates were calculated using a two-dimensional Whittaker-Henderson graduation of the natural logarithm of U.S. population mortality rates with smoothness components based on the sum of the squares of third finite differences. Scale MP-2019 rates were developed from this RPEC_2014_v2019 model, applying the same committee-selected assumption set used to develop Scale MP-2018; specifically:

- Long-term rate of mortality improvement: flat 1.0% rate to age 85, decreasing linearly to 0.85% at age 95, and then decreasing linearly to 0.0% at age 115
- Horizontal convergence period (along fixed ages): 10 years
- Diagonal convergence period (along fixed year-of-birth cohorts): 20 years
- Horizontal/diagonal blending percentages: 50%/50%
- Initial slope constraint: 0

Applying a two-year step-back from 2017, the most recent year of mortality data, along with a 20-year diagonal convergence period results in Scale MP-2018 long-term rates that are fully attained in calendar year 2035.

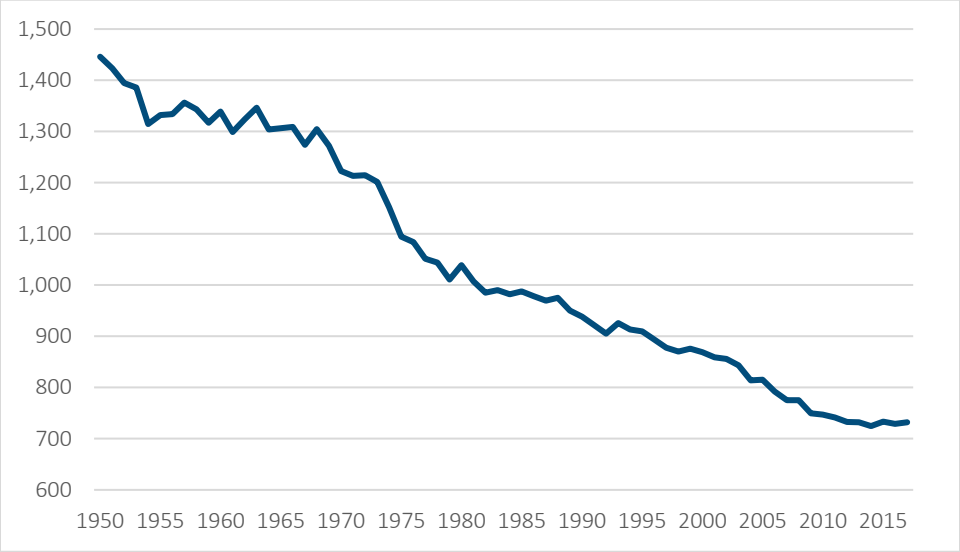
2.3 Recent U.S. Population Mortality Experience

The age-adjusted mortality rate for 2017 was 731.9 (per 100,000), an increase of 0.4% from the 728.8 rate for 2016 (NCHS 2018). Figure 2.1 shows the total (males and females combined) age-adjusted mortality rates in the United States for calendar years 1950 through 2017 (NVSS 2019a).

[1] "SSA-style" rates refer to mortality rates developed by RPEC using the same data sources and methodology used by the Social Security Administration to develop the mortality rates that are published along with the annual Trustees' Report.

Figure 2.1

U.S. AGE-ADJUSTED MORTALITY RATES PER 100,000, CALENDAR YEARS 1950–2017



Mortality rates in calendar year 2017 were lower than those in 2016 for three of the 10 leading causes of death in the United States: heart disease (−0.3%), cancer (−2.1%) and kidney disease (−0.8%). Mortality rates were higher for chronic lower respiratory diseases (+0.7%), stroke (+0.8%), Alzheimer's disease (+2.3%), diabetes (+2.4%), influenza and pneumonia (+5.9%), unintentional injuries (+4.2%), and suicide (+3.7%) (NCHS 2018).

Based on the CDC's age-adjusted death rates (NCHS 2019), the age-adjusted mortality improvement rate averaged approximately 0.3% per year over the period 2010 to 2017, compared to an average of approximately 1.5% per year from 2000 through 2009. The most recent eight-year period with a lower average rate of mortality improvement than 2010–2017 was 1962–1969 (0.2%).

Preliminary analysis by the National Vital Statistics System (NVSS 2019b) indicates that the average age-adjusted death rate in the United States (per 100,000 of population) was 720.2 during 2018, which was 1.6% lower than the corresponding value of 731.9 in 2017. It should be noted that this preliminary information for calendar year 2018 was not reflected in any of the mortality improvement scales presented in this report.

These mortality improvement statistics illustrate age-adjusted mortality improvement rates for the U.S. population as a whole. The trends of mortality improvement vary significantly by gender and age group.

Section 3: Impact of Scale MP-2019

3.1 Comparison of 2019 Annuity Values

Table 3.1 presents a comparison of monthly deferred-to-age-62 annuity-due values using various SOA mortality tables, all calculated generationally as of 2019 ("Generational @ 2019") using Scale MP-2019. These annuity values were computed using the following specifications:

- Employee rates for ages below 62 and Retiree[2] rates for ages 62 and older
- A discount rate of 4.0%.

Table 3.1
MONTHLY DEFERRED-TO-62 ANNUITY-DUE VALUES AT 4.0% AS OF JANUARY 1, 2019
SOA MORTALITY TABLES PROJECTED WITH SCALE MP-2019

	Age	Pri-2012	RP-2006	PubG-2010	PubT-2010	PubS-2010
Females	25	3.7304	3.7189	3.8662	3.9815	3.7706
	35	5.4274	5.4089	5.6347	5.8148	5.4944
	45	7.9105	7.8811	8.2273	8.5049	8.0201
	55	11.5757	11.5437	12.0532	12.4770	11.7357
	65	14.2366	14.2335	14.8289	15.3987	14.3710
	75	10.2340	10.3480	10.7953	11.3114	10.4008
	85	6.1966	6.2778	6.5444	6.9103	6.4000
	95	3.3519	3.3208	3.4822	3.5328	3.4740
Males	25	3.4911	3.4692	3.5921	3.7794	3.5850
	35	5.0845	5.0423	5.2266	5.5092	5.2221
	45	7.4199	7.3451	7.6310	8.0489	7.6203
	55	10.8739	10.7865	11.1990	11.8132	11.1553
	65	13.3744	13.3531	13.7562	14.5231	13.5949
	75	9.4371	9.5222	9.7424	10.3757	9.5071
	85	5.4813	5.6158	5.7349	6.0968	5.5236
	95	2.8874	2.9586	3.0692	3.0997	3.0165

Table 3.2 shows how these annuity factors compare to those calculated using Scale MP-2018. The values in the tables indicate that, generally, updating from scale MP-2018 to MP-2019 will result in a decrease in pension obligations between 0.3% and 1.0%. This impact is relatively consistent for all the base tables shown.

[2] For RP-2006, Healthy Annuitant rates were used for ages 62 and older.

Table 3.2

IMPACT OF UPDATING FROM SCALE MP-2018 TO MP-2019 USING VARIOUS BASE MORTALITY TABLES
COMPARISON OF MONTHLY DEFERRED-TO-62 ANNUITY-DUE VALUES AT 4.0% AS OF JANUARY 1, 2019

	Age	Pri-2012	RP-2006	PubG-2010	PubT-2010	PubS-2010
Females	25	-0.37%	-0.40%	-0.33%	-0.29%	-0.38%
	35	-0.35%	-0.38%	-0.31%	-0.28%	-0.34%
	45	-0.32%	-0.35%	-0.28%	-0.26%	-0.31%
	55	-0.31%	-0.34%	-0.28%	-0.25%	-0.30%
	65	-0.28%	-0.30%	-0.27%	-0.25%	-0.28%
	75	-0.50%	-0.53%	-0.48%	-0.45%	-0.51%
	85	-0.78%	-0.85%	-0.77%	-0.73%	-0.78%
	95	-1.00%	-1.22%	-1.07%	-1.04%	-1.07%
Males	25	-0.58%	-0.62%	-0.53%	-0.42%	-0.51%
	35	-0.49%	-0.55%	-0.46%	-0.38%	-0.43%
	45	-0.38%	-0.43%	-0.36%	-0.31%	-0.34%
	55	-0.31%	-0.35%	-0.29%	-0.27%	-0.29%
	65	-0.24%	-0.28%	-0.25%	-0.25%	-0.25%
	75	-0.58%	-0.64%	-0.59%	-0.55%	-0.60%
	85	-1.02%	-1.09%	-1.04%	-0.97%	-1.06%
	95	-0.93%	-1.12%	-1.02%	-1.01%	-1.03%

3.2 Comparison of 2019 Cohort Life Expectancies

Table 3.3 presents a comparison of 2019 complete cohort life expectancy values[3] at the indicated ages, all calculated assuming:

- Base mortality rates equal to headcount-weighted Pri.H-2012 Employee rates for ages below 62 and Pri-2012 Retiree rates for ages 62 and older, and
- Mortality projection starting in 2012 using Scale MP-2018 for the first columns of annuity values and using Scale MP-2019 for the second columns.

[3] The life expectancy values presented in this report were calculated as complete cohort life expectancies, which are smaller than the corresponding 0.0% monthly annuity values by a constant 1/24th of a year.

Table 3.3
COHORT LIFE EXPECTANCIES (COMPLETE) AS OF JANUARY 1, 2019
PRI.H-2012 PROJECTED GENERATIONALLY

	Age	MP-2018	MP-2019	% Change
Females	25	63.87	63.67	*–0.31%*
	35	53.16	53.00	*–0.30%*
	45	42.55	42.41	*–0.33%*
	55	32.08	31.95	*–0.41%*
	65	22.37	22.26	*–0.49%*
	75	14.04	13.94	*–0.71%*
	85	7.56	7.48	*–1.06%*
	95	3.75	3.71	*–1.07%*
Males	25	60.41	60.11	*–0.50%*
	35	49.86	49.64	*–0.44%*
	45	39.41	39.26	*–0.38%*
	55	29.08	28.96	*–0.41%*
	65	19.70	19.61	*–0.46%*
	75	12.14	12.04	*–0.82%*
	85	6.36	6.28	*–1.26%*
	95	3.16	3.13	*–0.95%*

3.3 Alternative Order-2 Model

Scale MP-2019 and its predecessors have been based on historical U.S. population mortality rates that have been graduated with a two-dimensional "order-3" Whittaker-Henderson model. In this context, order-3 refers to the degree of the finite difference operators used in the smoothness components of the two-dimensional Whittaker-Henderson objective function.

In 2018, RPEC began producing a different version of the RPEC_2014 model, denoted the RPEC_O2 model, that uses order-2 rather than order-3 Whittaker-Henderson graduation. This change in finite difference operators produces a generally smoother two-dimensional surface of mortality improvement rates. RPEC's research has indicated that relative to the order-3 model, the order-2 model tends to improve the year-over-year stability in pension liability calculations. However, the order-2 model will be less sensitive to future changes in U.S. mortality patterns and generally produces a weaker fit when compared to ungraduated historical mortality improvement rates.

For purposes of this report, "O2-2018" is used to designate the scale produced using the order-2 model (RPEC_O2_v2018) released in October 2018 and the committee-selected assumption set. "O2-2019" is used to designate the corresponding scale produced with this year's RPEC_O2 model (RPEC_O2_v2019). Table 3.4 shows a comparison of annuity values produced by the O2-2018 and O2-2019 scales as of January 1, 2019, using Pri-2012 as a base table and a discount rate of 4.0%.

Table 3.4

MONTHLY DEFERRED-TO-62 ANNUITY-DUE VALUES AT 4.0% AS OF JANUARY 1, 2019
PRI-2012 PROJECTED GENERATIONALLY

	Age	O2-2018	O2-2019	% Change
Females	25	3.7742	3.7615	*–0.34%*
	35	5.4912	5.4734	*–0.32%*
	45	8.0015	7.9770	*–0.31%*
	55	11.7129	11.6779	*–0.30%*
	65	14.3923	14.3528	*–0.27%*
	75	10.4212	10.3812	*–0.38%*
	85	6.3344	6.3011	*–0.53%*
	95	3.3791	3.3618	*–0.51%*
Males	25	3.5542	3.5362	*–0.51%*
	35	5.1712	5.1480	*–0.45%*
	45	7.5345	7.5061	*–0.38%*
	55	11.0373	11.0012	*–0.33%*
	65	13.5694	13.5305	*–0.29%*
	75	9.6526	9.6109	*–0.43%*
	85	5.6518	5.6184	*–0.59%*
	95	2.9173	2.9042	*–0.45%*

The order-2 model shows slightly greater stability when updating from the 2018 to 2019 versions than the RPEC_2014 model, though this observation is not uniform across all ages and genders. An order-2 model would be expected to improve stability most when the trend in mortality improvement changes significantly from year to year. The direction of the trend in population-wide mortality improvement rates has been reasonably consistent in recent years. In the absence of significant changes in this trend, the resulting percentage changes in annuity factors are similar for the order-2 and order-3 models, as can be seen when comparing Table 3.4 and Table 3.2.

Table 3.5 shows a comparison of the annuity values produced by the 2019 versions of the order-2 model and the RPEC_2014 model using Pri-2012 as the base table. Generally, the RPEC_2014 model produces lower annuity values.

Table 3.5
MONTHLY DEFERRED-TO-62 ANNUITY-DUE VALUES AT 4.0% AS OF JANUARY 1, 2019
PRI-2012 PROJECTED GENERATIONALLY

	Age	MP-2019	O2-2019	% Change
Females	25	3.7304	3.7615	*0.83%*
	35	5.4274	5.4734	*0.85%*
	45	7.9105	7.9770	*0.84%*
	55	11.5757	11.6779	*0.88%*
	65	14.2366	14.3528	*0.82%*
	75	10.2340	10.3812	*1.44%*
	85	6.1966	6.3011	*1.69%*
	95	3.3519	3.3618	*0.30%*
Males	25	3.4911	3.5362	*1.29%*
	35	5.0845	5.1480	*1.25%*
	45	7.4199	7.5061	*1.16%*
	55	10.8739	11.0012	*1.17%*
	65	13.3744	13.5305	*1.17%*
	75	9.4371	9.6109	*1.84%*
	85	5.4813	5.6184	*2.50%*
	95	2.8874	2.9042	*0.58%*

3.4 History of Impact of Updates to Scale MP-2014

Scale MP-2019 is the fifth annual update to Scale MP-2014 that has been produced by the SOA. Table 3.6 shows the history of changes in annuity factors by age and gender for each of these annual updates. These percentage changes were computed on the following basis:

- Employee rates for ages below 62 and Retiree[4] rates for ages 62 and older
- A discount rate of 4%
- RP-2006 as the base mortality table for all columns except MP-2019, which shows the percentage change of updating from MP-2018 with a Pri-2012 base table to MP-2019 with a Pri-2012 base table

[4] For RP-2006, Healthy Annuitant rates were used for ages 62 and older.

Table 3.6

HISTORY OF IMPACT OF ANNUAL UPDATES TO SCALE MP-2014

	Age	MP-2015	MP-2016	MP-2017	MP-2018	MP-2019
Females	25	−1.4%	−1.3%	−0.7%	−0.4%	−0.4%
	35	−1.4%	−1.4%	−0.7%	−0.4%	−0.3%
	45	−1.5%	−1.5%	−0.7%	−0.4%	−0.3%
	55	−1.5%	−1.5%	−0.7%	−0.3%	−0.3%
	65	−1.7%	−1.3%	−0.6%	−0.2%	−0.3%
	75	−3.0%	−1.8%	−1.0%	−0.3%	−0.5%
	85	−4.5%	−3.2%	−1.5%	−0.2%	−0.8%
Males	25	−0.9%	−1.7%	−0.9%	−0.7%	−0.6%
	35	−1.0%	−1.8%	−0.8%	−0.7%	−0.5%
	45	−1.1%	−1.7%	−0.8%	−0.6%	−0.4%
	55	−1.2%	−1.6%	−0.8%	−0.5%	−0.3%
	65	−1.4%	−1.5%	−0.7%	−0.4%	−0.2%
	75	−2.7%	−1.7%	−1.0%	−0.3%	−0.6%
	85	−3.4%	−2.9%	−1.4%	−0.3%	−1.0%

Scale MP-2014 included historical mortality data through calendar year 2009. As can be seen in the heat maps in the Appendix, mortality improvement for retirement-aged individuals was relatively high through around the end of last decade. Since then, there has been a trend of lower mortality improvement, including negative improvement in certain age groups.

The effects shown for Scale MP-2015 were due to the addition of two new years of historical data for 2010 and 2011. Scale MP-2016[5] added *three* new years of historical mortality information (2012–2014). The updates for Scale MP-2017, Scale MP-2018 and Scale MP-2019 include the addition of only one new year of historical data, with no changes to the underlying model or committee-selected assumption set.

[5] Scale MP-2016 also introduced two changes to the committee-selected assumption set. First, the length of the age-period (horizontal) convergence period used to transition from near-term improvement rates to the long-term improvement rates was shortened from 20 years to 10 years. Second, the initial slope for the cubic polynomials used to transition from near-term improvement rates to the long-term improvement rates was fixed at zero. Previous iterations of the scale based the slope on the most recent two years of historical data, constrained to +/−0.003.

Section 4: Ongoing Mortality Improvement Research

4.1 Socioeconomic Status and Cause of Death

The SOA continues to investigate mortality improvement in the U.S. population. In particular, there has been ongoing analysis as to how to adapt the "full population" mortality improvement concept employed by Scale MP-2019 for use on smaller subpopulations. Efforts are being made to research mortality improvement by various causes of death and by income levels.

In April 2018, the Social Security Administration published a study of mortality by career average earnings level, using the average indexed monthly earnings (AIME) as a measure of a person's income level (SSA 2018). This study broke the Social Security population into quintiles by AIME. Although the spread in relative mortality ratios among the AIME quintiles generally remained steady from 1995-2015, there has been a slight widening in the spread between the top and bottom quintiles over the 20-year period.

The SOA has continued interest in exploring additional data sources to help refine mortality improvement scales in the future.

4.2 Long-Term Rate of Improvement

4.2.1 Considerations for Selecting the Long-Term Rate of Improvement

The committee-selected assumption for the long-term rate of mortality improvement in Scale MP-2019 is a flat 1.0% rate up to age 85, decreasing linearly to 0.85% at age 95, and then decreasing linearly to 0.0% at age 115. While this assumption has remained unchanged since the initial publication of Scale MP-2014, RPEC continues to review new and emerging expert opinions regarding long-term mortality improvement. Subsection 4.2 of the Scale MP-2017 report included sensitivity analysis showing the potential impact of different assumptions for the long-term rate of mortality improvement (SOA 2017).

Generally, future rates of mortality improvement are thought of as forward-looking assumptions. Nevertheless, historical patterns can be helpful in the process of developing those rates. Table 4.1 presents long-term averages of mortality improvement rates for males and females between the ages of 65 and 85[6] over several historical time horizons. While improvement rates have fluctuated by decade, the last 65 years of SSA data indicate a historical average that, for most long time periods, is above the committee-selected 1.0% long-term rate used for ages 65–85 in Scale MP-2019 and its predecessors.

[6] Key ages for valuing retiree benefit obligations

Table 4.1
HISTORICAL IMPROVEMENT IN AGE-ADJUSTED CENTRAL DEATH RATES BASED ON SSA 2019 TRUSTEES' REPORT, AGES 65–85

Year Range	Females	Males
1951–2016	1.12%	1.05%
1961–2016	1.14%	1.21%
1971–2016	1.03%	1.41%
1981–2016	0.84%	1.48%
1991–2016	0.81%	1.56%
2001–2016	1.30%	1.75%

The rates of improvement shown in Table 4.1 are based on data and assumptions used in preparation of the SSA 2019 Trustees' Report. Average rates have been age-adjusted using population distributions for the year 2000 from the Human Mortality Database (HMD 2019). Each value represents an annualized rate of improvement over the respective periods. For example, the average rate of reduction in central death rates for males ages 65 to 85 over the 65-year period from 1951 through 2016 was 1.05%. This is approximately a 50% reduction in annual mortality rates experienced by this segment of the population between 1951 and 2016.

Historical rates of improvement have been changing over time with different patterns observed for each gender. Male improvement rates have been generally increasing over the last 65 years, while female rates have exhibited more volatility. Although not immediately evident from Table 4.1, it is worth pointing out that while historical rates of improvement for males aged 65–85 has been higher than that for females since the 1980s, the opposite is true for earlier periods. Finally, the table indicates that both genders have seen a significant acceleration in improvement rates since 2001, though as mentioned in Section 2, the trend of rapid improvement has slowed since 2010.

Looking forward, the 2019 SSA trust valuation includes an assumption that medium- to long-term future improvements in mortality rates for both genders are expected to slow down gradually, but steadily, over time. Using the same population weightings as previously, Table 4.2 shows the average annual improvement in age-adjusted central death rates implicit in the SSA intermediate projections ("SSA 2019") for ages 65–85 at several future intervals.

Table 4.2
IMPROVEMENT IN AGE-ADJUSTED CENTRAL DEATH RATES BASED ON SSA 2019 TRUSTEES' REPORT INTERMEDIATE PROJECTION, AGES 65–85

Year Range	Females	Males
2025–2034	0.89%	0.97%
2035–2044	0.84%	0.92%
2045–2054	0.79%	0.86%
2055–2064	0.75%	0.81%

4.2.2 Comparison of Scale MP-2019 and 2019 SSA Trustees' Report Mortality Improvement

The following graphs show how the SSA improvement rates compare to Scale MP-2019. The three graphs provide comparisons for an individual aged 55, 65 and 75, respectively, in 2019. Rather than display the rates for a fixed age or age range, these graphs track the assumed improvement rate over time for an individual, taking into account the fact that the person ages as time passes. For example, the age-70 rates shown in Figure 4.1 (in which the assumed individual is age 55 in 2019) are the average of the projected male and female one-year mortality improvement rates for a 70-year-old in 2034. The patterns in the charts illustrate the combined effect of expected mortality improvement changes due to aging and advancing calendar year.

Figure 4.1
PROJECTED ONE-YEAR MORTALITY IMPROVEMENT RATES BY AGE
AVERAGE OF MALES AND FEMALES AGED 55 IN 2019

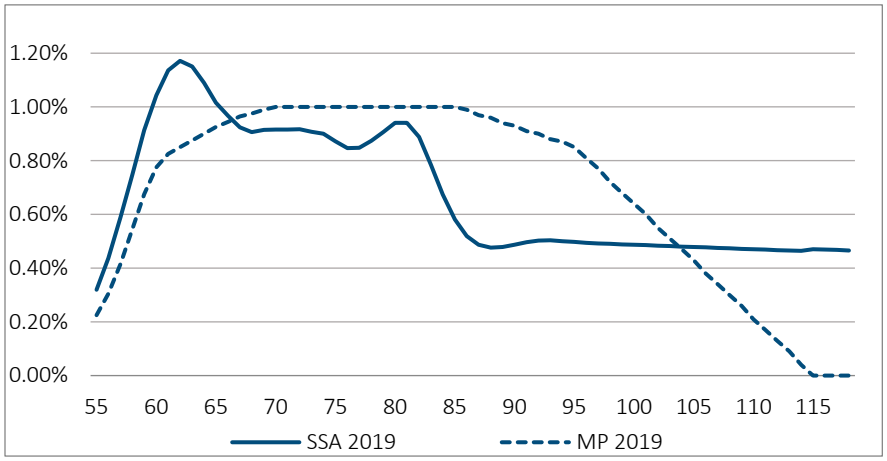


Figure 4.2
PROJECTED ONE-YEAR MORTALITY IMPROVEMENT RATES BY AGE
AVERAGE OF MALES AND FEMALES AGED 65 IN 2019

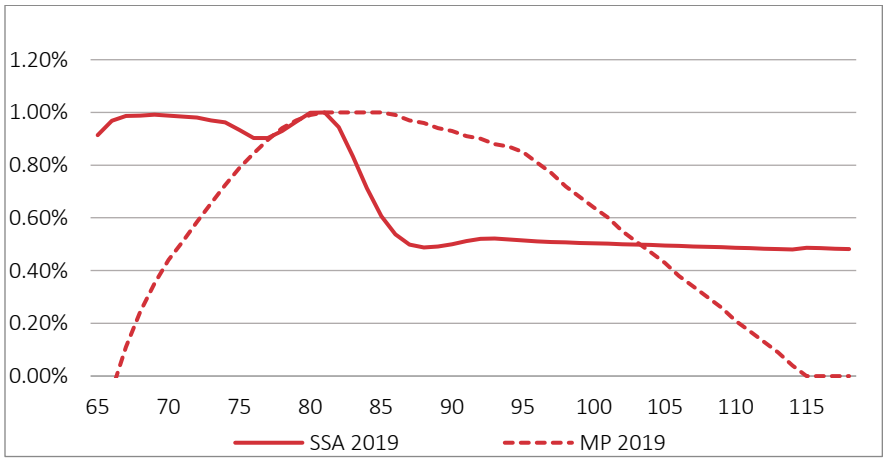
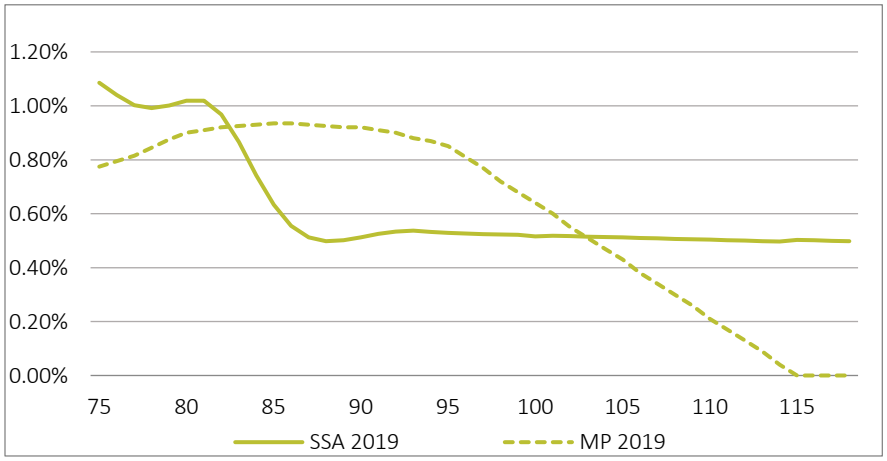


Figure 4.3
PROJECTED ONE-YEAR MORTALITY IMPROVEMENT RATES BY AGE
AVERAGE OF MALES AND FEMALES AGED 75 IN 2019

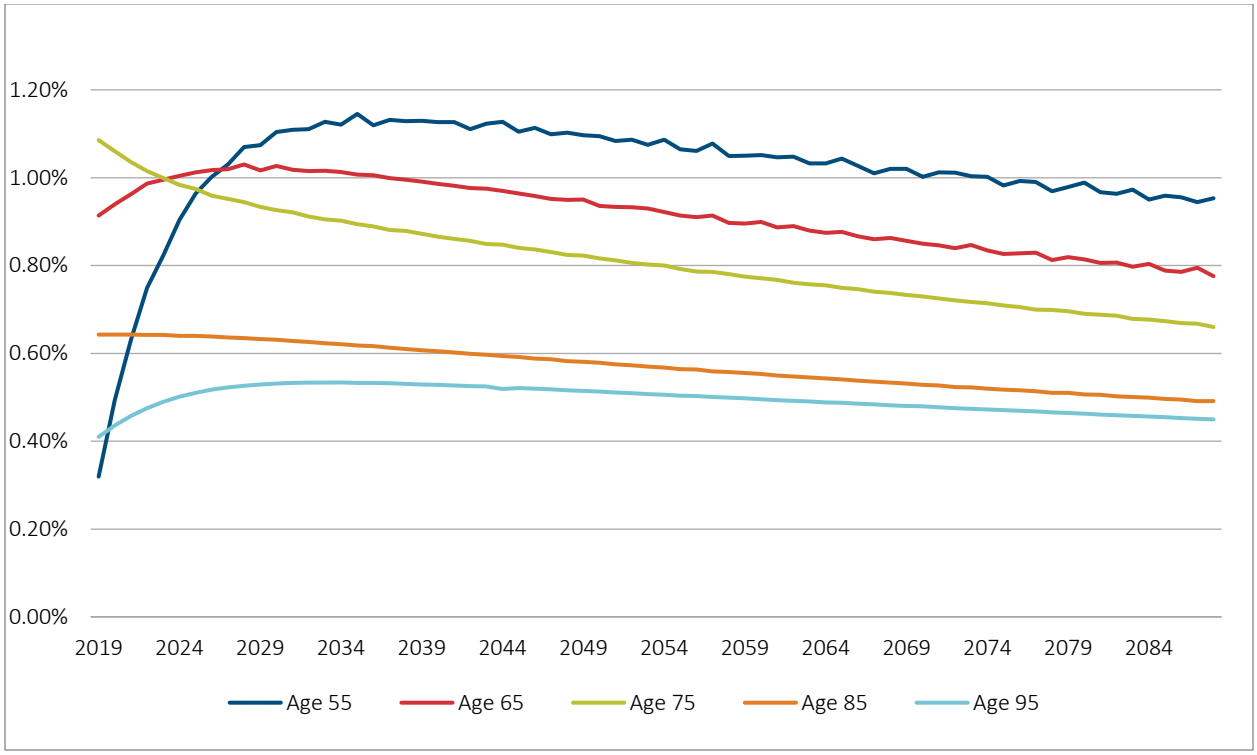


As the graphs indicate, the improvement rates vary significantly between the two assumption sets. Both assumption sets assume the long-term rate begins to taper down above a certain age, but the starting age and the slope of the taper differ. Scale MP-2019 shows a smooth progression to the long-term improvement rate and then grades down to 0% starting at age 85. In contrast, the progression over time is more complex under SSA 2019, with a noticeable drop in assumed improvement in the 80–87 age range.

Figure 4.4 shows the improvement rates under SSA 2019 by calendar year at several fixed ages. Improvement rates are shown for ages 55, 65, 75, 85 and 95. The graph indicates that starting around 2030, there is a steady decline in assumed improvement rates over time, more so for ages 55–75 than for ages 85 and 95.

Figure 4.4

PROJECTED MORTALITY IMPROVEMENT RATES AT FIXED AGES
AVERAGE OF MALE AND FEMALE ONE-YEAR IMPROVEMENT RATES BY CALENDAR YEAR



4.2.3 Conclusions from 2019 Technical Panel Report

The recent report of the 2019 Technical Panel on Assumptions and Methods ("Technical Panel") to the Social Security Advisory Board made a number of observations that are broadly consistent with the methodology RPEC has used in developing the RPEC_2014_v2019 model and the MP-2019 improvement scale. Most notably, the Technical Panel suggested that near-term mortality improvement is likely to be depressed due to recent social issues that have affected mortality trends. The Technical Panel specifically notes drug overdose, obesity, and suicide as likely influencers in the near term.

The 2019 Technical Panel concurred with prior panels in suggesting that the most plausible assumption for long-term improvement would be based upon rates over a long period of history. The Technical Panel observed that for broad cohorts of the population, mortality improvement has on average been roughly 1%. They also, however, noted that they do agree that an age-gradient is warranted, noting that historical improvement for those over age 65 has been only 0.8% per year.

Correlations between historical patterns and various causes of death and socioeconomic status are subjects of ongoing studies undertaken by various groups, with a goal of improving models used in developing future trends. RPEC will continue to monitor those efforts in order to validate or adjust the committee-selected long-term improvement rates.

Section 5: Online Tools

The SOA has made available the following Excel workbooks that users may find helpful:

- Scale MP-2019 rates can be downloaded in Excel format at https://www.soa.org/globalassets/assets/files/resources/experience-studies/2019/scale-mp-2019-rates.xlsx.

- The RPEC_2014_ v2019 tool can be used to reconstruct Scale MP-2019 or construct alternative scales based on the same underlying order-3 graduated historical mortality data; see the workbook for instructions at https://www.soa.org/resources/experience-studies/2019/rpec-2014-v2019-model-implementation-tool/.

- The RPEC_O2_v2019 tool can be used to construct alternative scales based on the order-2 graduated historical mortality data; see the workbook for instructions at https://www.soa.org/resources/experience-studies/2019/rpec-o2-v2019-model/.

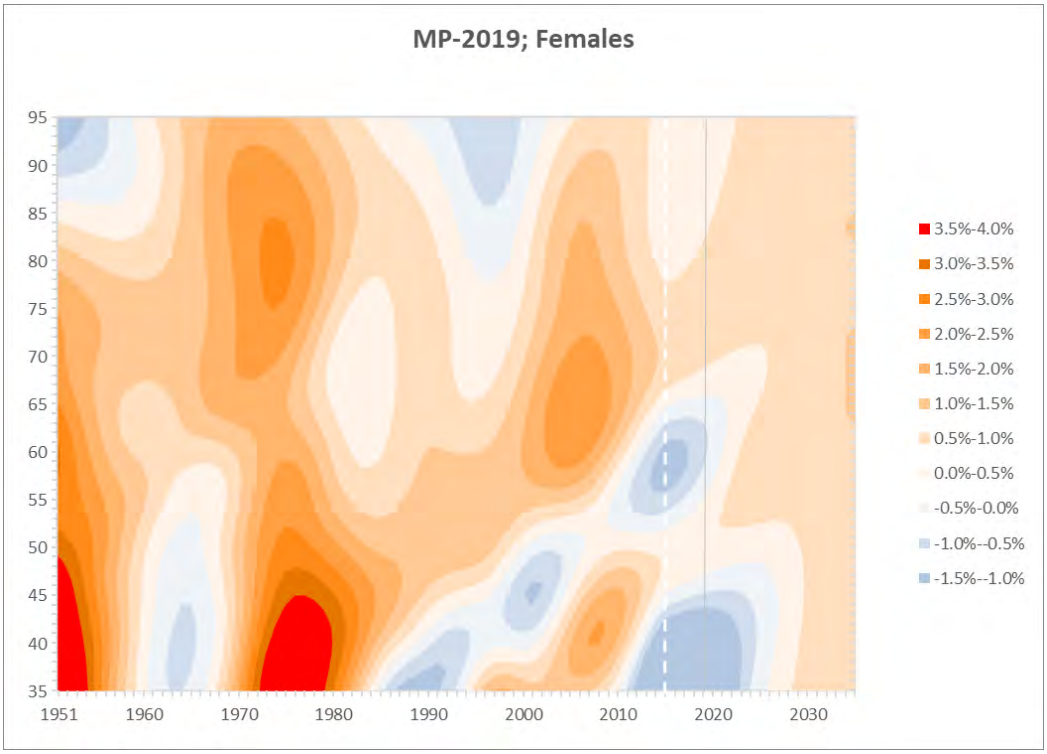
Section 6: Reliance and Limitations

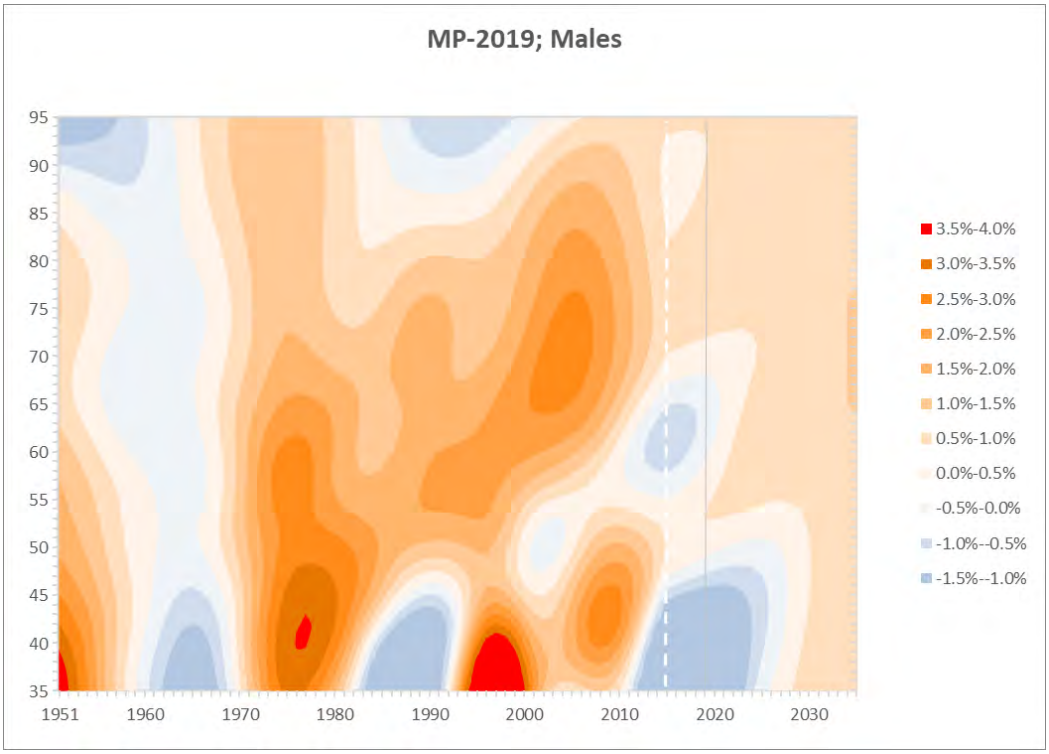
Mortality Improvement Scale MP-2019, the RPEC_2014_v2019 model, and the RPEC_O2_v2019 model have been developed from U.S. population data for the purpose of valuing U.S. pension and other post-retirement benefit (OPEB) obligations. No assessment has been made concerning the applicability of the models and scale to other purposes.

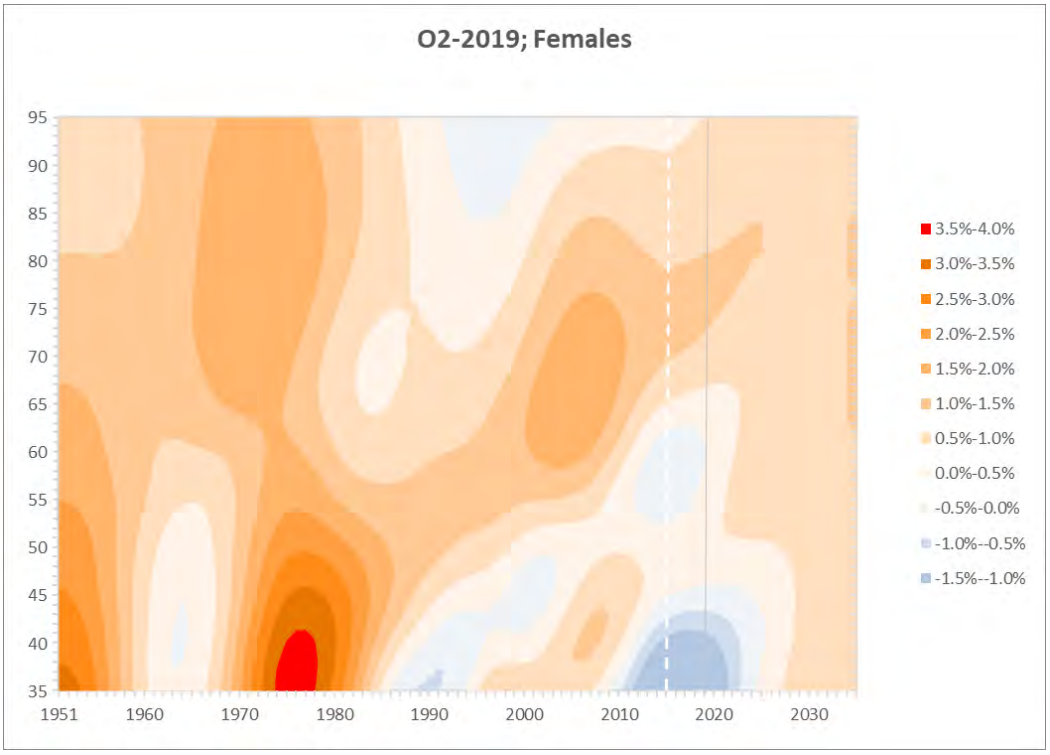
Appendix: Heat Maps

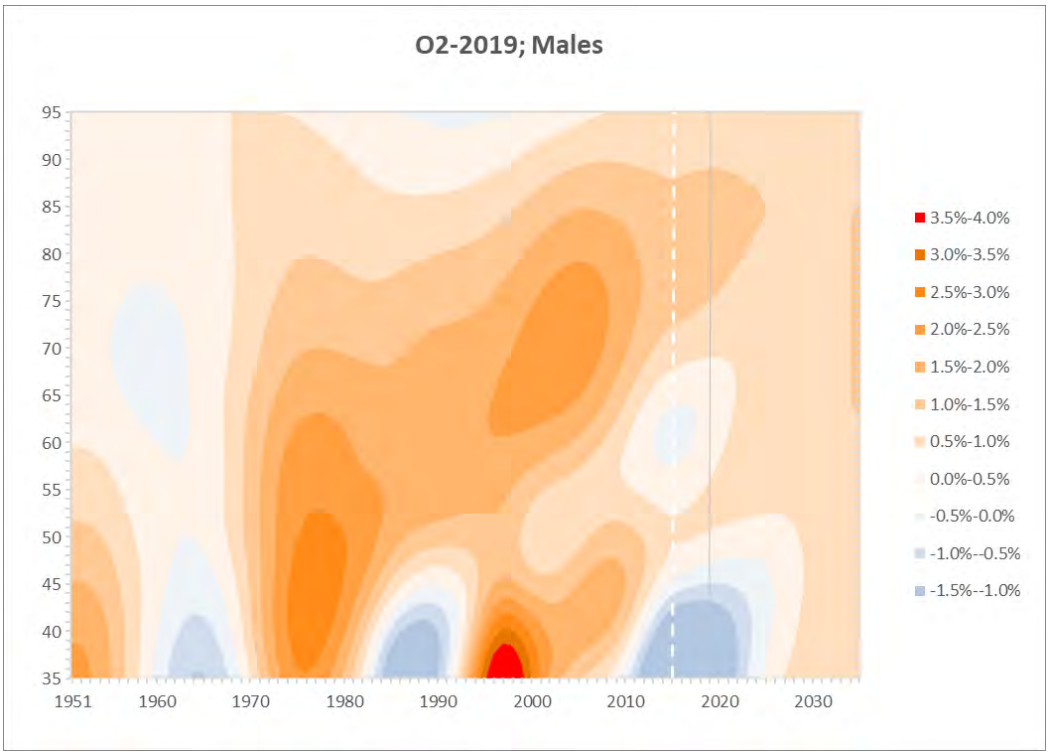
The next two pages compare the MP-2019 and O2-2019 gender-specific heat maps for calendar years 1951 through 2036. Because of the continued use of a two-year step-back in both sets of rates, 2015 is the final year of graduated historical data included explicitly[7] and 2016 is the first year of the projected rates. The vertical dashed white lines on the heat maps distinguish between the historical and projected rates, and the thin vertical gray lines indicate the 2019 rates.

[7] The historical graduation processes (both order-3 and order-2) reflected mortality rates for 2016 and 2017; hence, those years implicitly influenced the final RPEC_2014_v2019 and RPEC_O2_v2019 models.









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