

The background of the slide features a photograph of the United States Capitol dome in Washington, D.C., partially obscured by cherry blossom trees in the foreground. The dome is a large, white, neoclassical structure with a prominent dome and a statue on top. The cherry blossoms are in full bloom, with light pink and white flowers. The overall scene is bright and clear, suggesting a spring day.

ENROLLED ACTUARIES MEETING

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Consulting Actuaries



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39 Years of Joint Sponsorship

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MARRIOTT WARDMAN PARK HOTEL, WASHINGTON DC

General Session #2

Mortality in 2-D

Christopher Bone

PBGC

Laurence Pinzur

Aon Hewitt

March 25, 2014

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Agenda

- It's About Time...
- Pension Mortality Study: Process Overview
- Basics of Scale MP-2014 Mortality Projection
- Basics of RP-2014 Base Mortality Tables
- Financial Impact of New Mortality Assumptions
- Observations
- Implications For Regulations
- How Important Are the Details?

Overview of Exposure Drafts

Larry Pinzur

It's About Time...

- It's about our time on earth – lifespans are increasing!
- It's about a time dimension in the new mortality projection Scale MP-2014
- *"It's about time..."*
 - Pension-related mortality assumptions are out-of-date
 - UP-94 (central year 1987)
 - RP-2000 (central year 1992)
 - Scale AA (mortality improvement experience between 1977 and 1993)
 - Scale BB was "interim"

It's About Time...

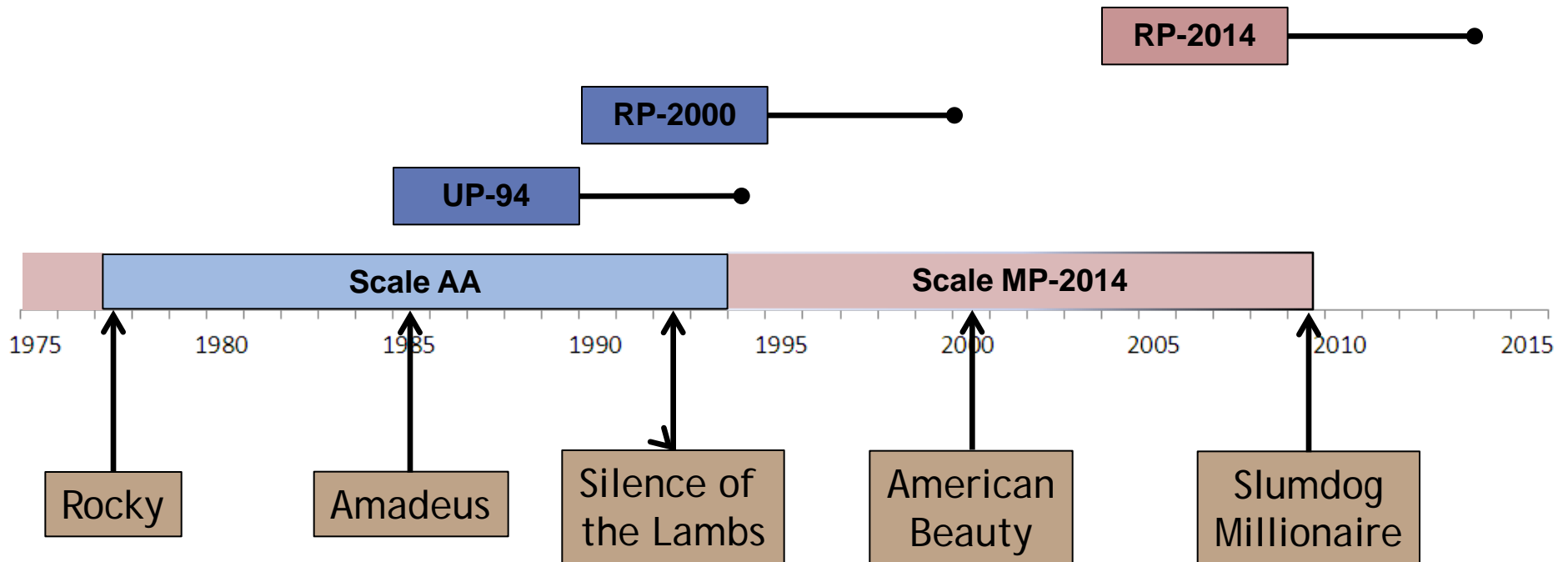
- RPEC Recommendations (RP-2014 report § 1.5)

"Subject to standard materiality criteria (including ASOP # 35) and the user's specific knowledge of the covered group, the Committee recommends that the measurement of U.S. private retirement plan obligations be based on the appropriate RP-2014 Table projected generationally for calendar years after 2014 using Scale MP-2014 mortality improvement rates."

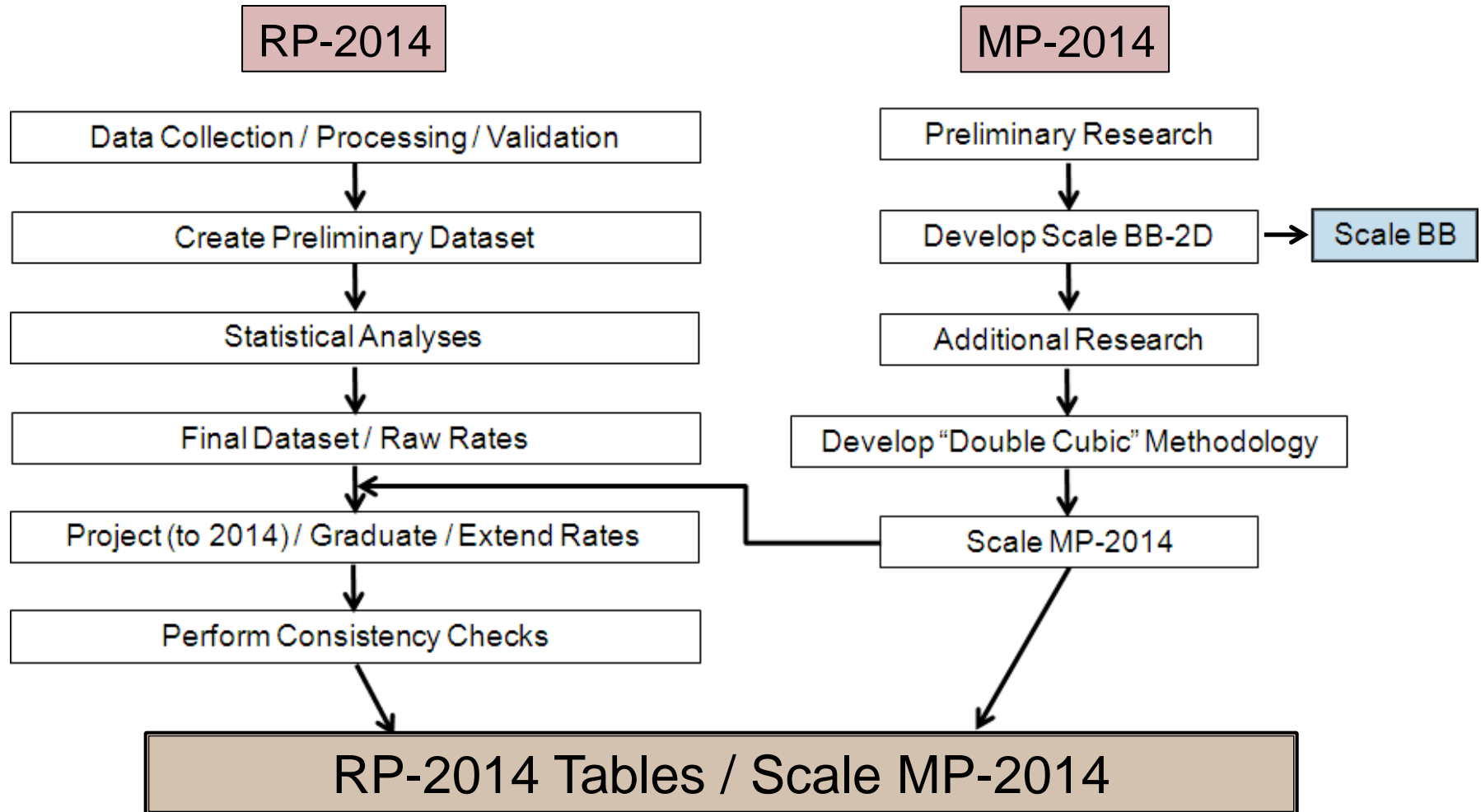
"While statistical analyses summarized in this report continue to confirm that both collar and amount quartile are statistically significant indicators of differences in base mortality rates for nondisabled lives, RPEC believes that the use of collar-based tables will generally be more practical than the use of amount-based tables."

"Users who wish to develop Combined Healthy tables are encouraged to blend appropriately selected RP-2014 Employee and Healthy Retiree tables using plan-specific retirement rate assumptions."

It's About Time...



Pension Mortality Study: Process Overview



Basics of Scale MP-2014

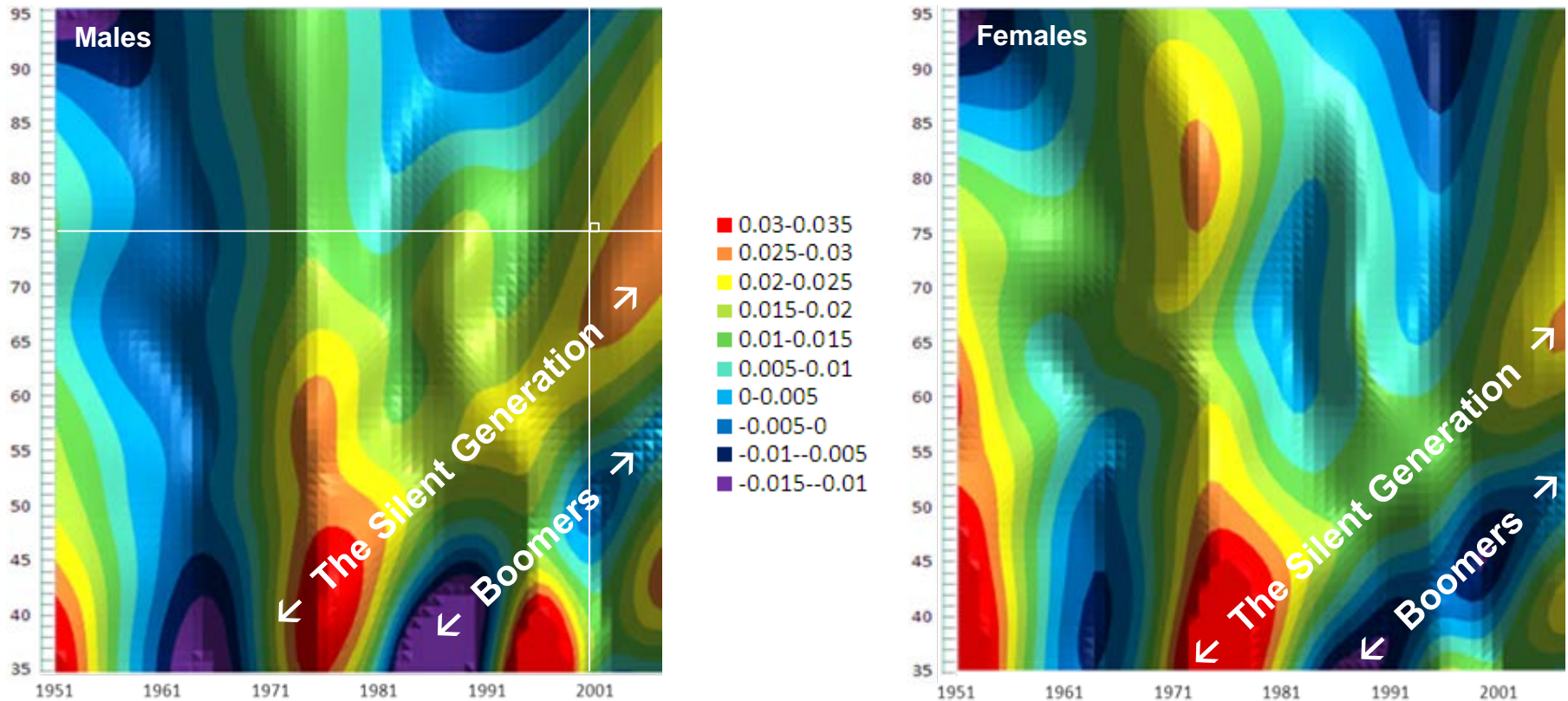
- How to measure historical mortality improvement (MI) at age x in calendar year y ?
 - Call this value $f(x,y)$
- Illustrative example; CY 2001 MI for male age 75
 - $q_{75}^{(2000)} = 0.0481$; $q_{75}^{(2001)} = 0.0472$
 - $f(75,2001) = 1 - (0.0472/0.0481) = 2.0\%$
- In general, $f(x,y) = 1 - (q_x^{(y)} / q_x^{(y-1)})$
- Eventually, use a transposed version of this same formula to project base mortality rates into the future
 - $q_x^{(y)} = q_x^{(y-1)} * [1 - f(x,y)]$

Basics of Scale MP-2014

- Three key concepts underpinning most current 2D models:
 1. Near-term MI rates should be based on recent experience;
 2. Long-term MI experience should be based on expert opinion; and
 3. Near-term MI rates should blend smoothly into the assumed long-term rates over an appropriate transition period
- First step is to develop gender-specific arrays of 2D historical MI rates

Basics of Scale MP-2014

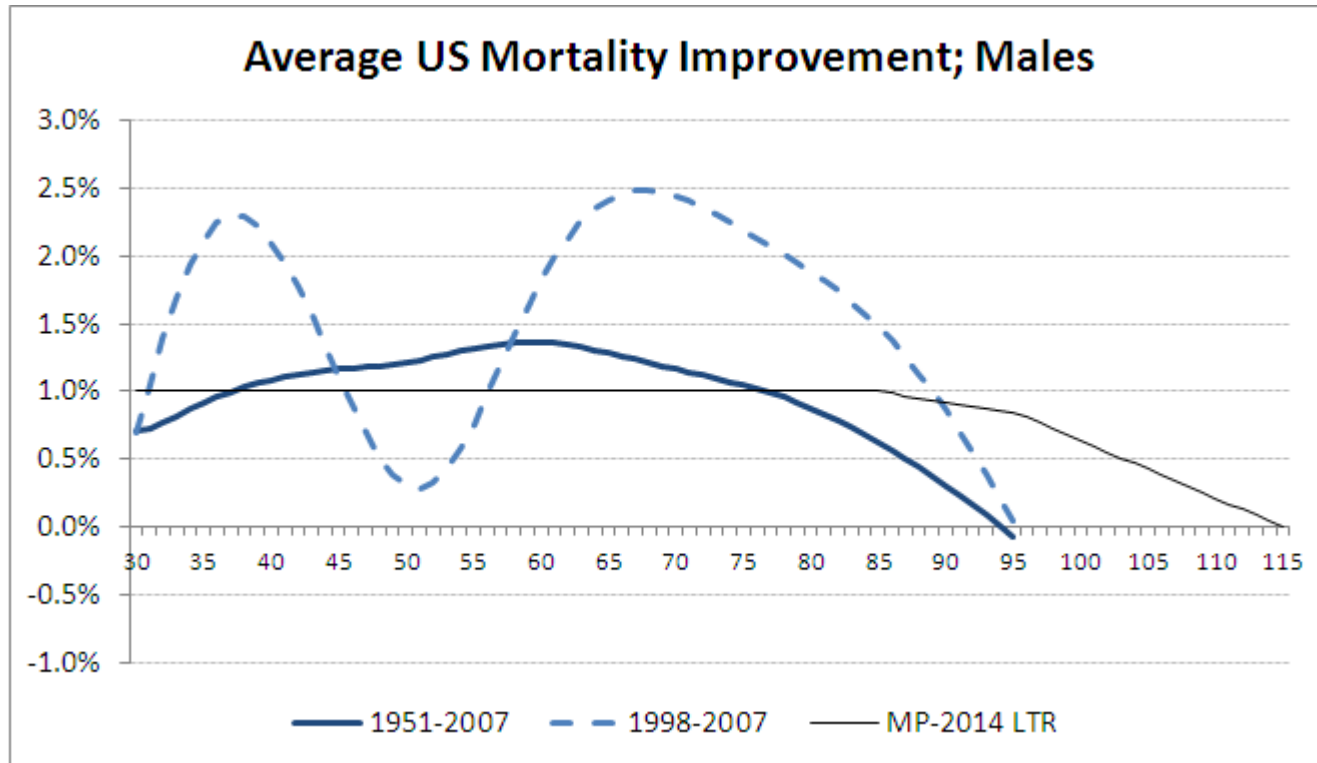
- Historical MI rates develop from SSA mortality data



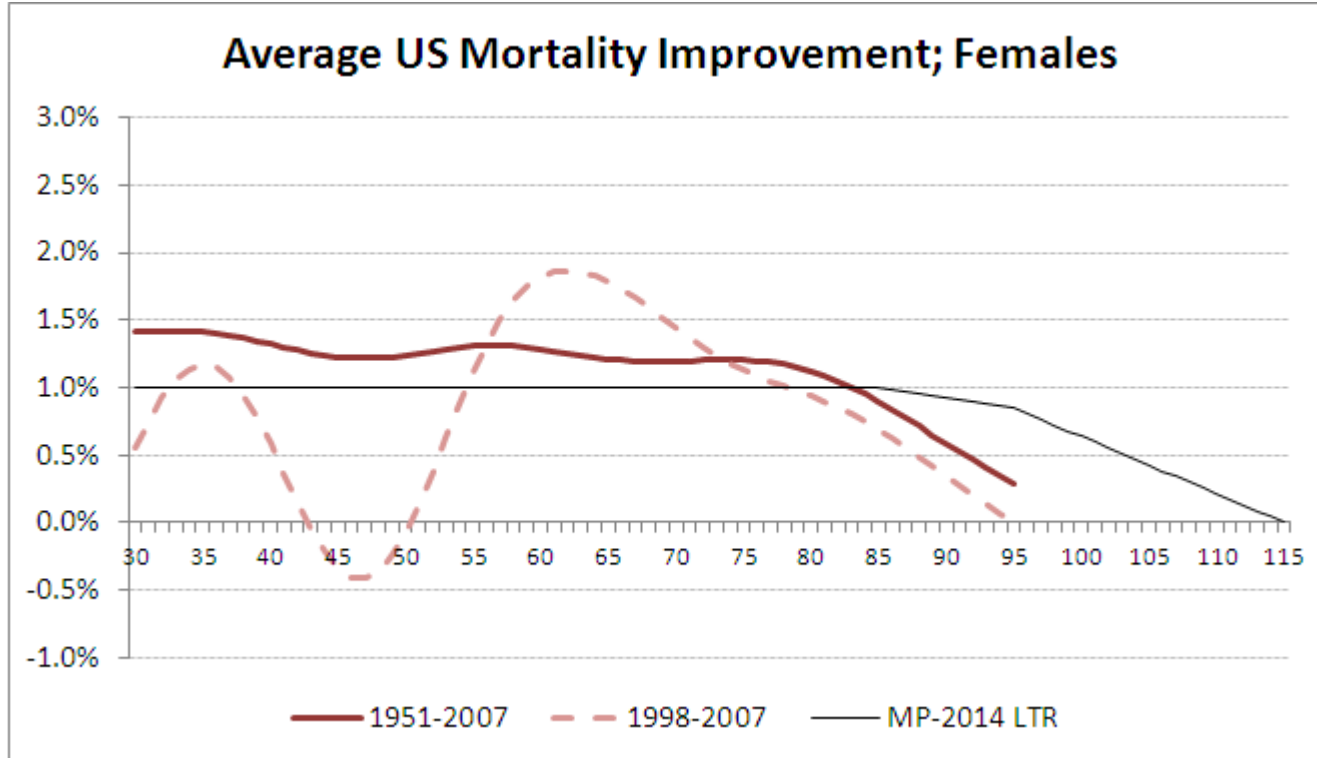
Basics of Scale MP-2014: Long-term Rates

- Between the years 1950 and 2000, the SSA's age-sex-adjusted death rate declined at an average rate of 1.06% per year
 - Considerable variation by decade and age group
- RPEC's "committee selected" long-term MI rates for Scale MP-2014 are fully phased-in by 2027:
 - All ages through 85: 1.00%
 - Ages 85 through 95: Linear decrease from 1.00% to 0.85%
 - Ages 95 through 115: Linear decrease from 0.85% to 0.00%
- New 2D methodology makes it possible for users to modify the long-term rate (LTR) structure

Graduated Historical MI Rates



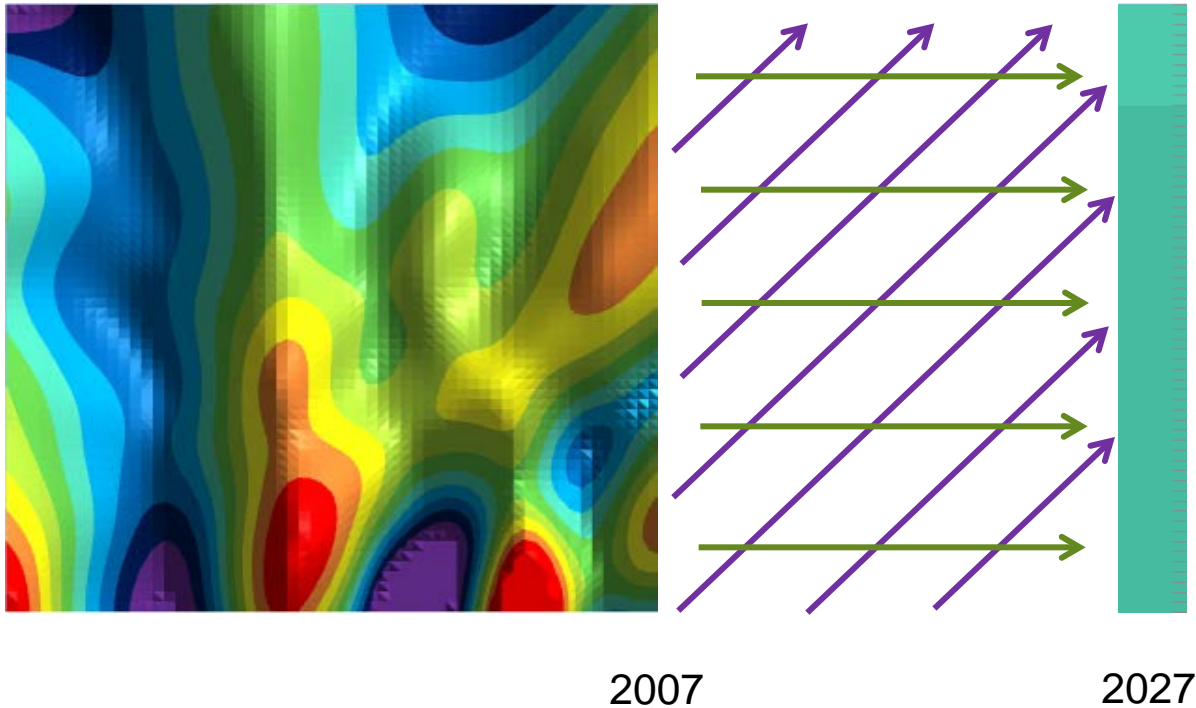
Graduated Historical MI Rates



Basics of Scale MP-2014: Interpolation

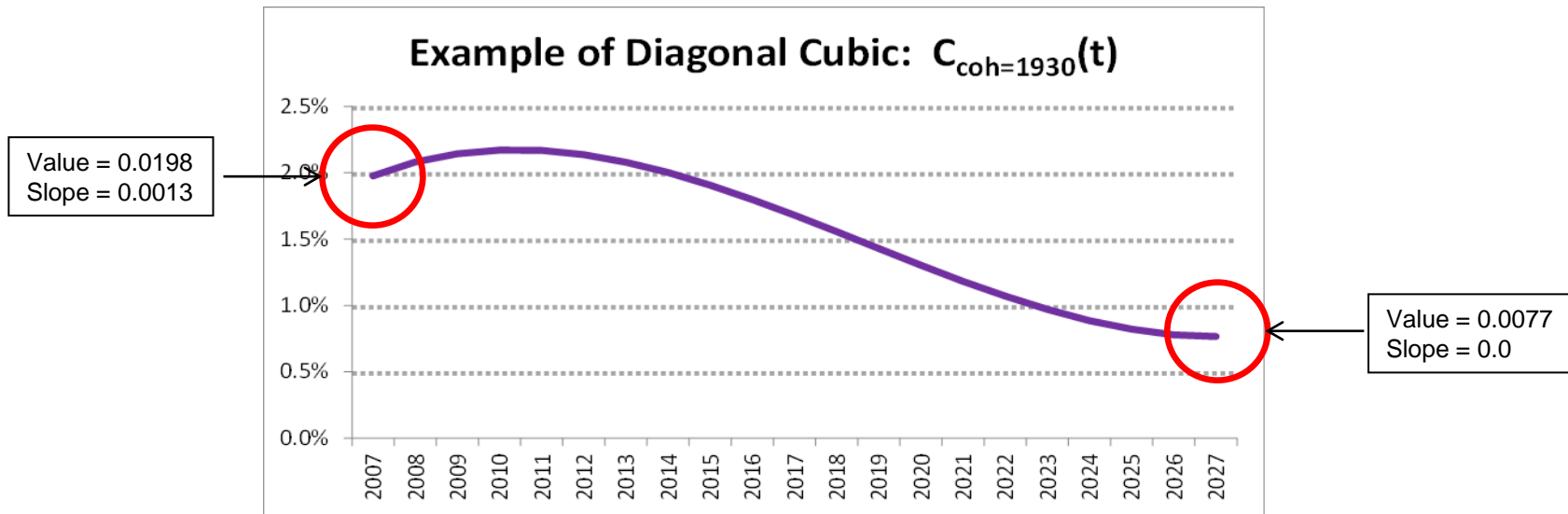
- The Scale MP-2014 transition methodology (from CY 2007 rates to 2027 long-term rates) is a simplified version of the Scale BB-2D transition methodology
- Based on a 50%/50% blend of two interpolation techniques, both of which use a certain type of cubic polynomials (next page)
 - One interpolation in the **horizontal** direction (across fixed age lines)
 - A second interpolation in the **diagonal** direction (across fixed year-of-birth cohort lines)

Basics of Scale MP-2014



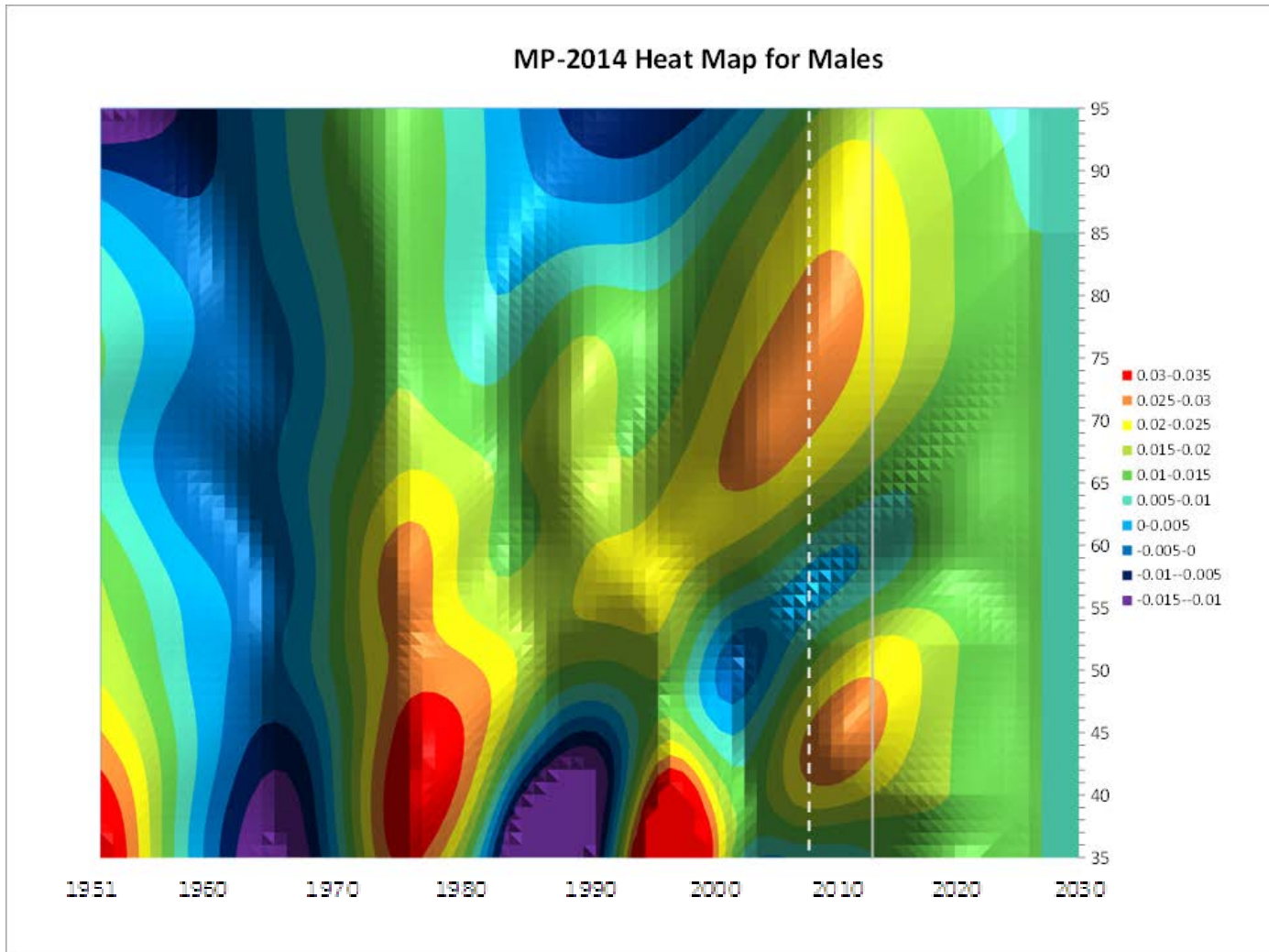
Basics of Scale MP-2014

- For transition interpolations, RPEC used a type of cubic polynomial, $C(t)$, that satisfied the following four criteria at each age x :
 - $C(2007) = f(x, 2007)$
 - $C'(2007) = \text{Change in MI between 2006 and 2007}$
 - $C(2027) = \text{Long-term rate for age } x \text{ in 2027}$
 - $C'(2027) = 0$

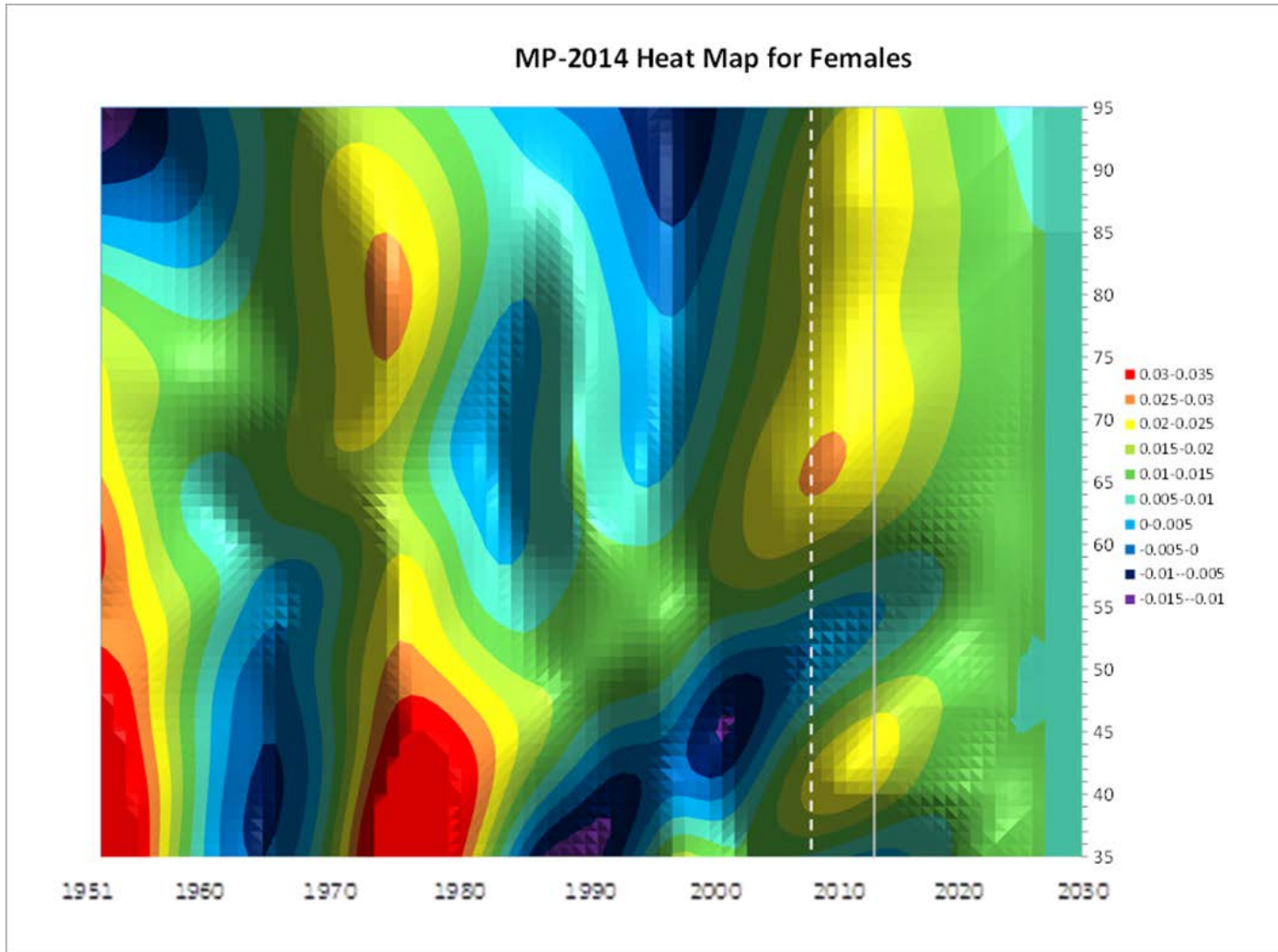


$$C_{\text{coh}=1930}(t) = 0.0198 + 0.0013(t-2007) - 0.00022075(t-2007)^2 + 0.00000628(t-2007)^3$$

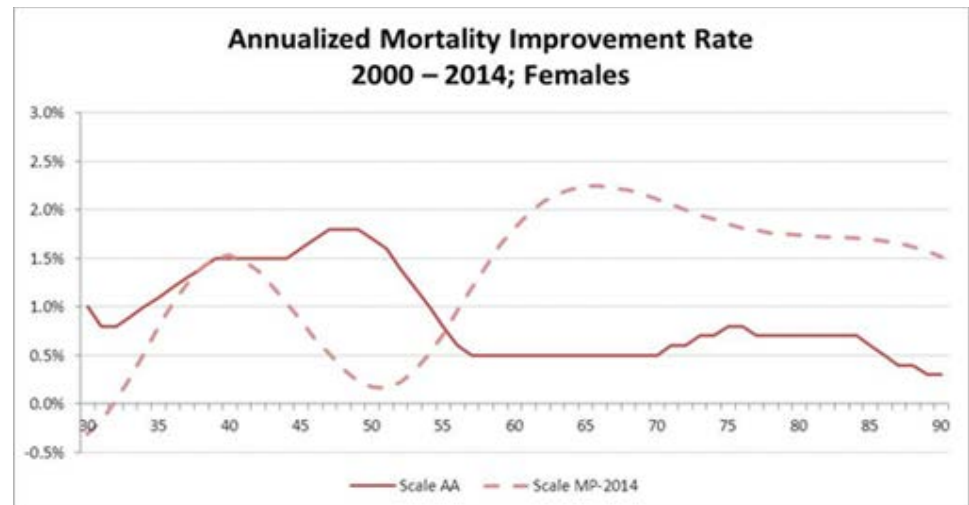
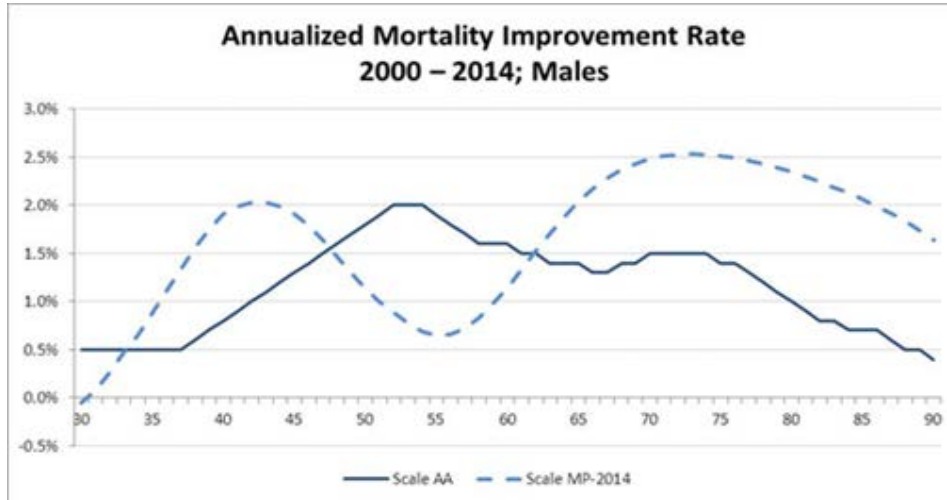
Basics of Scale MP-2014



Basics of Scale MP-2014



Basics of Scale MP-2014

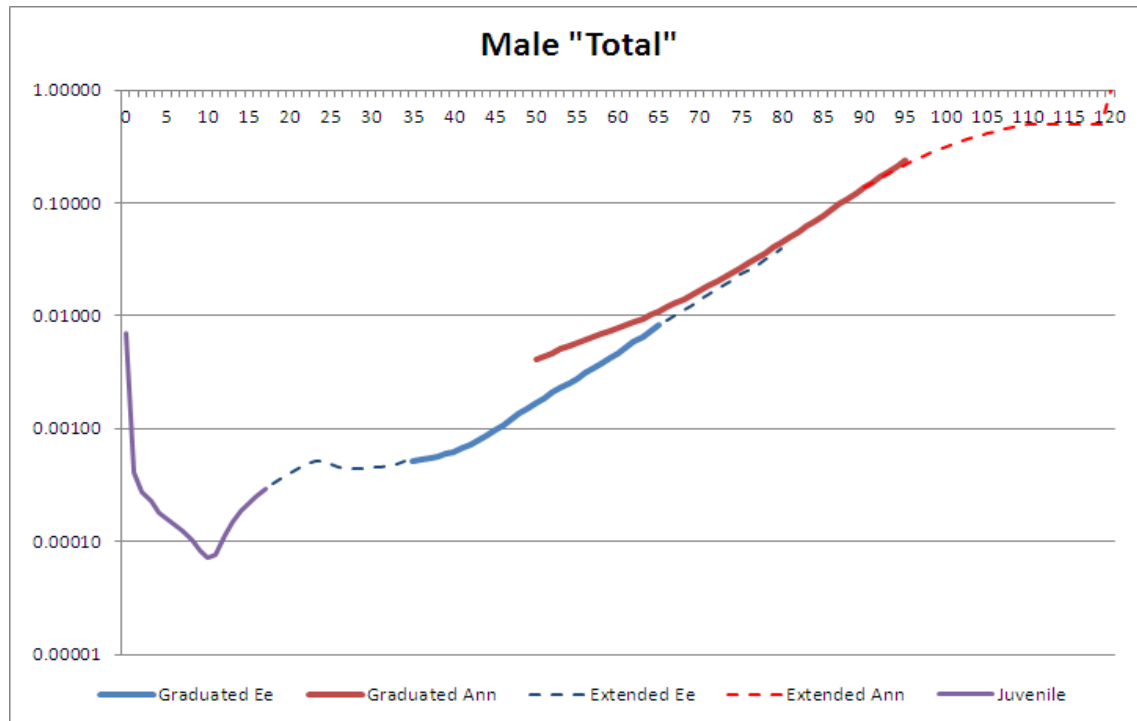


Basics of RP-2014 Base Mortality Tables

- Based on 10.5 million life-years of uninsured private plan data (> 220,000 deaths)
 - Employees: ~ 4.5 million life-years [RP-2000 included ~ 5.7 m]
 - Healthy Annuitants: ~ 5.6 million life-years [RP-2000 included ~ 4.9 m]
 - Disabled Retirees: ~ 0.4 million life-years [RP-2000 included ~ 0.4 m]
- Eleven sets of gender-specific tables produced
 - Five each for Employees and Healthy Annuitants
 - Total (non-disabled)
 - Blue Collar
 - White Collar
 - Bottom Quartile
 - Top Quartile
 - Disabled Retiree

Basics of RP-2014 : Table Extension

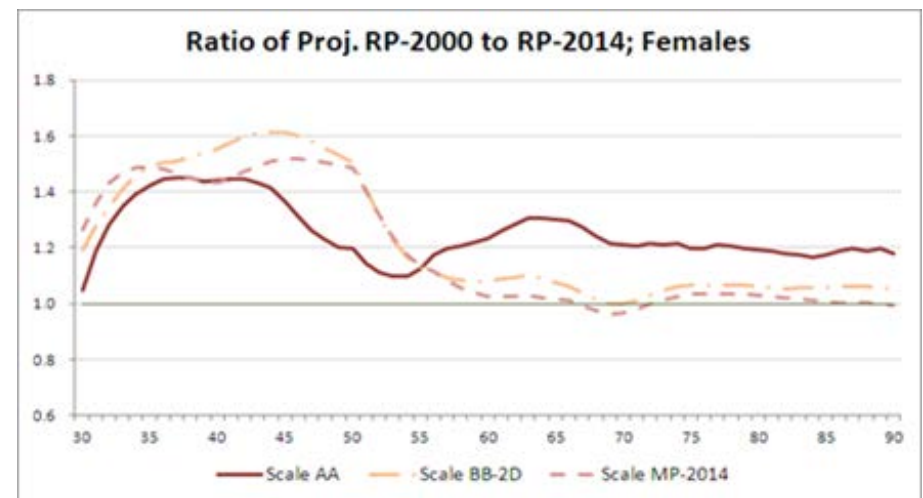
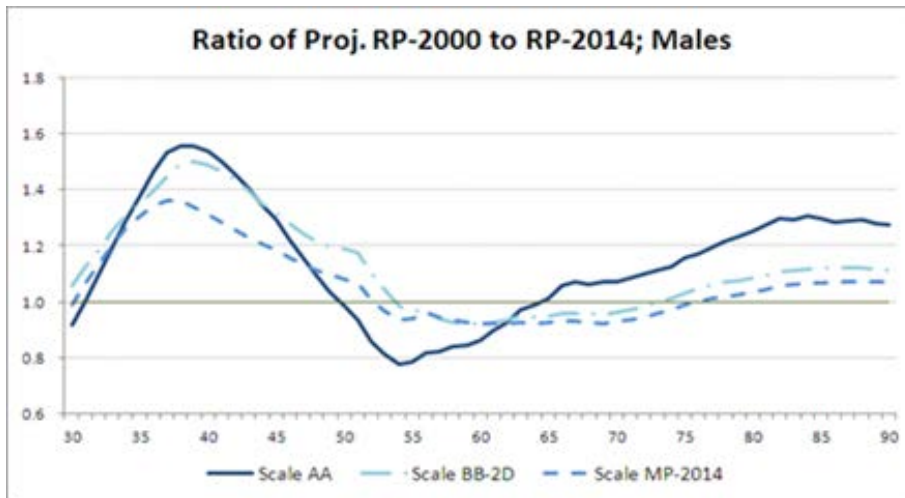
- All annuitant tables converge to a flat mortality rate of 0.5 around age 110
- Final rate (at age 120) set equal to 1.0



Comparison: Projected RP-2000 to RP-2014

- Ratio of projected RP-2000 rates to RP-2014 rates; RP-2000 rates projected to 2014 using:
 - Scale AA
 - Scale BB-2D
 - Scale MP-2014

Ratio > 1.0 \Rightarrow projected RP-2000 rate > MP-2014 rate



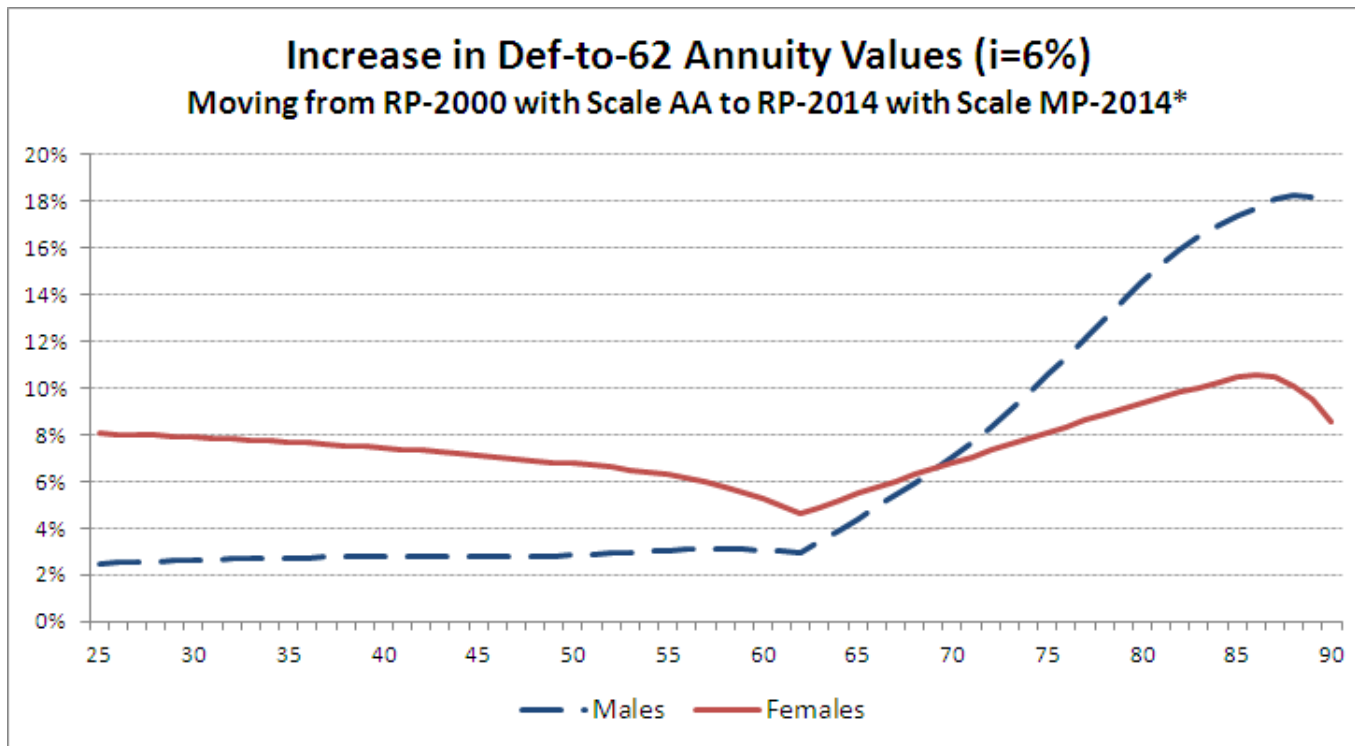
Financial Impact

- Monthly deferred-to-62 annuity values (6% interest)
 - RP-2014 basis: Employee rates to age 61; then Healthy Annuitant rates thereafter

		Monthly Deferred-to-62 Annuity Due Values; Generational @ 2014					Percentage Change of Moving to RP-2014 (with MP-2014) from:			
	Base Rates	UP-94	RP-2000	RP-2000	RP-2000	RP-2014	UP-94	RP-2000	RP-2000	RP-2000
	Proj. Scale	AA	AA	BB	BB-2D	MP-2014	AA	AA	BB	BB-2D
Age										
Males	25	1.3944	1.4029	1.4135	1.4115	1.4379	3.1%	2.5%	1.7%	1.9%
	35	2.4577	2.4688	2.4881	2.4880	2.5363	3.2%	2.7%	1.9%	1.9%
	45	4.3316	4.3569	4.3963	4.4012	4.4770	3.4%	2.8%	1.8%	1.7%
	55	7.6981	7.7400	7.8408	7.8739	7.9755	3.6%	3.0%	1.7%	1.3%
	65	11.0033	10.9891	11.2209	11.3199	11.4735	4.3%	4.4%	2.3%	1.4%
	75	8.0551	7.8708	8.2088	8.3367	8.6994	8.0%	10.5%	6.0%	4.4%
	85	4.9888	4.6687	5.0048	5.0992	5.4797	9.8%	17.4%	9.5%	7.5%
Females	25	1.4336	1.4060	1.4816	1.4904	1.5195	6.0%	8.1%	2.6%	2.0%
	35	2.5465	2.4931	2.6145	2.6299	2.6853	5.5%	7.7%	2.7%	2.1%
	45	4.5337	4.4340	4.6264	4.6534	4.7497	4.8%	7.1%	2.7%	2.1%
	55	8.1245	7.9541	8.2532	8.3155	8.4544	4.1%	6.3%	2.4%	1.7%
	65	11.7294	11.4644	11.8344	11.9486	12.0932	3.1%	5.5%	2.2%	1.2%
	75	8.9849	8.6971	9.0650	9.1654	9.3995	4.6%	8.1%	3.7%	2.6%
	85	5.7375	5.5923	5.9525	6.0148	6.1785	7.7%	10.5%	3.8%	2.7%

Financial Impact

- Monthly deferred-to-62 annuity values (6% interest)
 - Focus on RP-2000 (Scale AA) → RP-2014 (Scale MP-2014)



* RP-2014 Employee rates through age 61 and RP-2014 Healthy Annuitant rates at ages 62 and older; all mortality projection applied generationally.

Financial Impact

- Monthly deferred-to-62 annuity values (6% interest)
 - Impact of doubling the Scale MP-2014 long-term MI rates

		Monthly Deferred-to-62 Annuity Due Values; Generational @ 2014		Percentage Change of Doubling Long-Term Rates
Base Rates Proj. Scale		RP-2014*	RP-2014*	
Age		MP-2014	2 x MP-2014	
Males	25	1.4379	1.5381	7.0%
	35	2.5363	2.6980	6.4%
	45	4.4770	4.6943	4.9%
	55	7.9755	8.2241	3.1%
	65	11.4735	11.6982	2.0%
	75	8.6994	8.8497	1.7%
	85	5.4797	5.5381	1.1%
Females	25	1.5195	1.6029	5.5%
	35	2.6853	2.8273	5.3%
	45	4.7497	4.9466	4.1%
	55	8.4544	8.6904	2.8%
	65	12.0932	12.3189	1.9%
	75	9.3995	9.5606	1.7%
	85	6.1785	6.2475	1.1%

* RP-2014 Employee rates through age 61 and RP-2014 Healthy Annuitant rates at ages 62 and older; all mortality projection applied generationally.

Observations and Implementation

Chris Bone

Observations

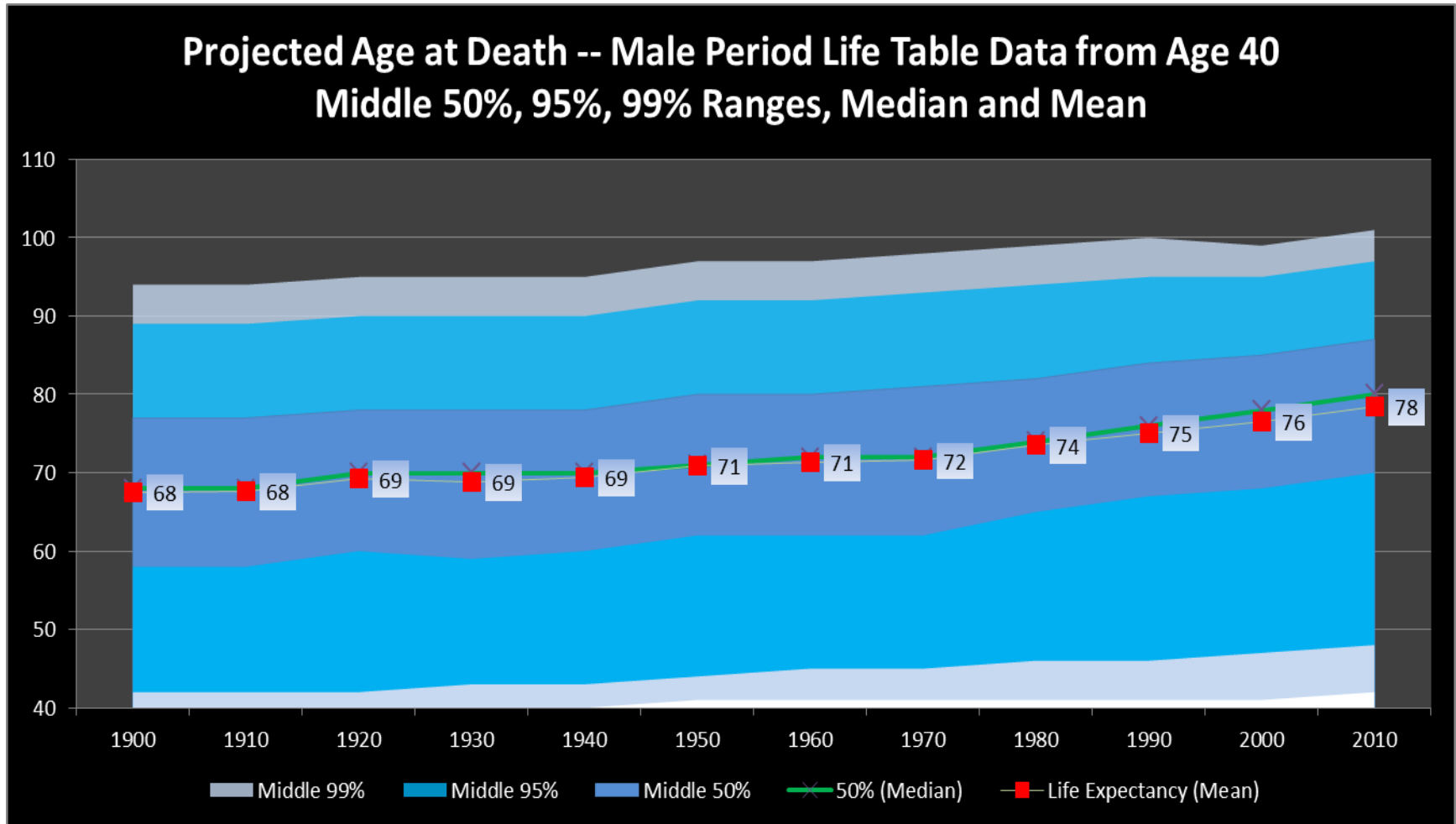
- Improvements in life chances are real and there is no reason to treat them as temporary
- How might we to present these new tables in accessible terms?
- Other consulting implications
- How important are the technical details?

Observations

Improvements in life chances are real - there is no reason to treat them as temporary

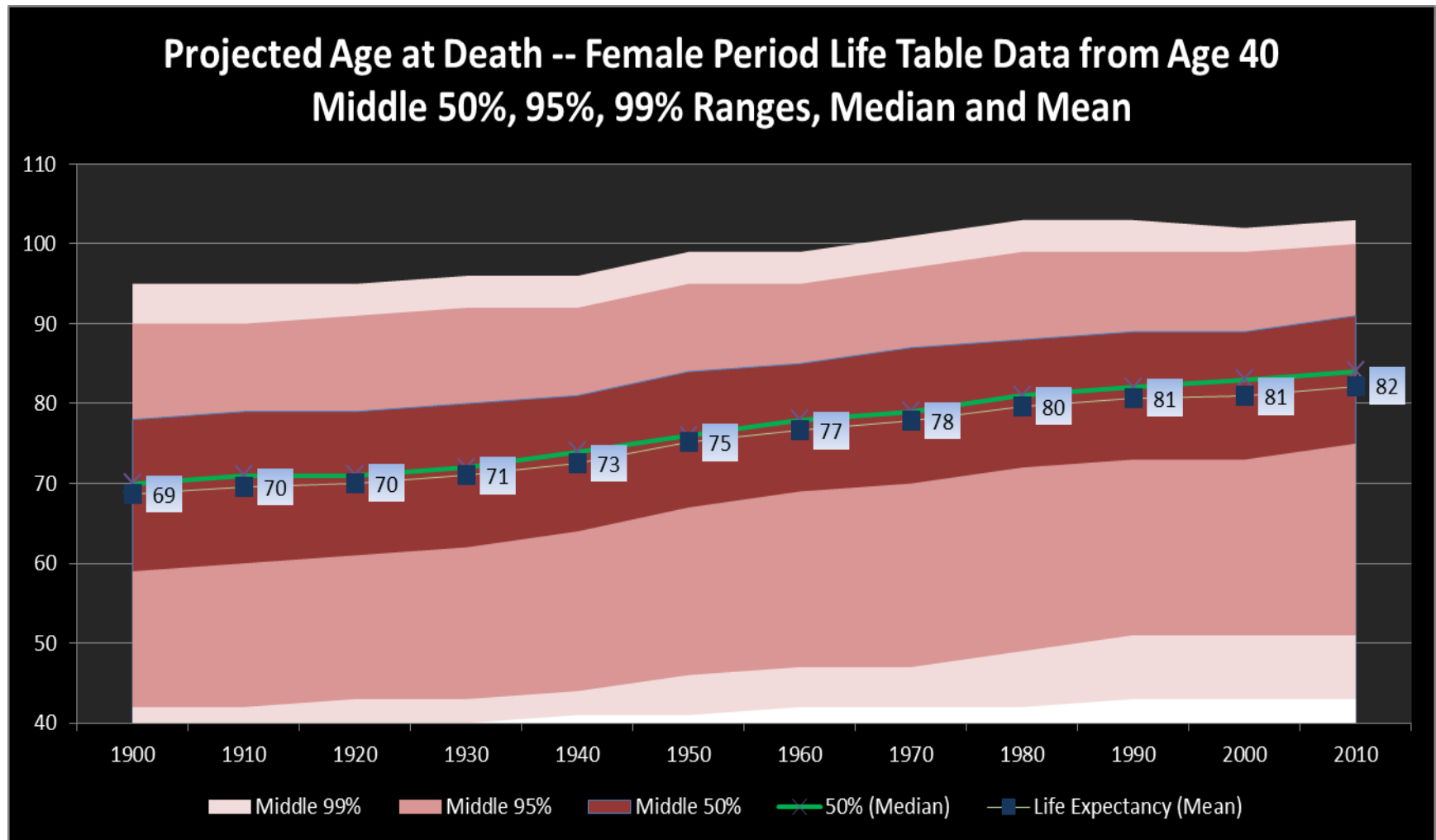
- Period life expectancy (no projection of future improvements) has risen dramatically for men and women in mid-career and at retirement ages
- The variability of outcomes has increased, particularly at retirement ages

Since 1900, life expectancy up 10 years for men at age 40



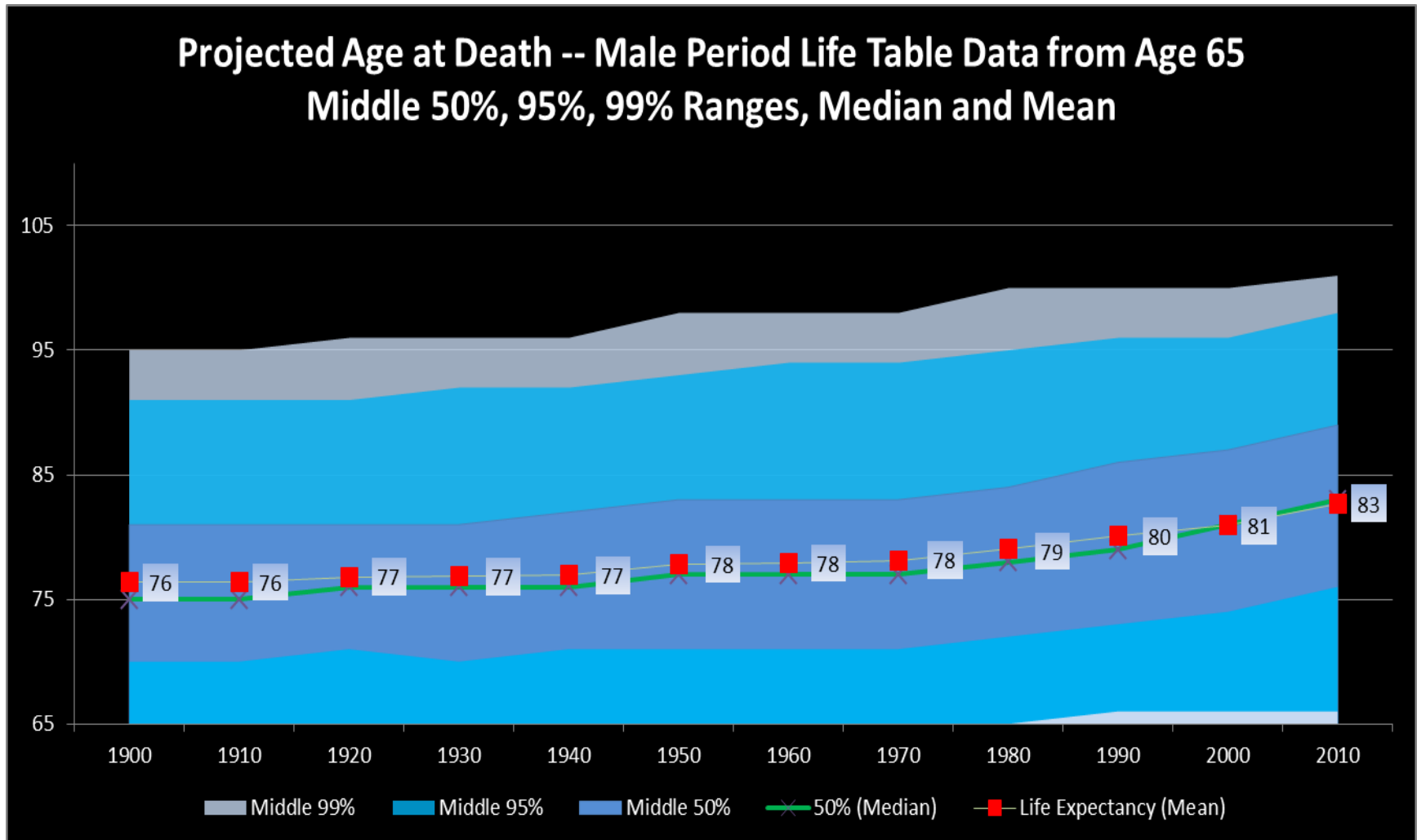
Source: SSA Period Life Tables through 2000, projected to 2010 with MP-2014 historical scale

And 13 years for women...



Source: SSA Period Life Tables through 2000, projected to 2010 with MP-2014 historical scale

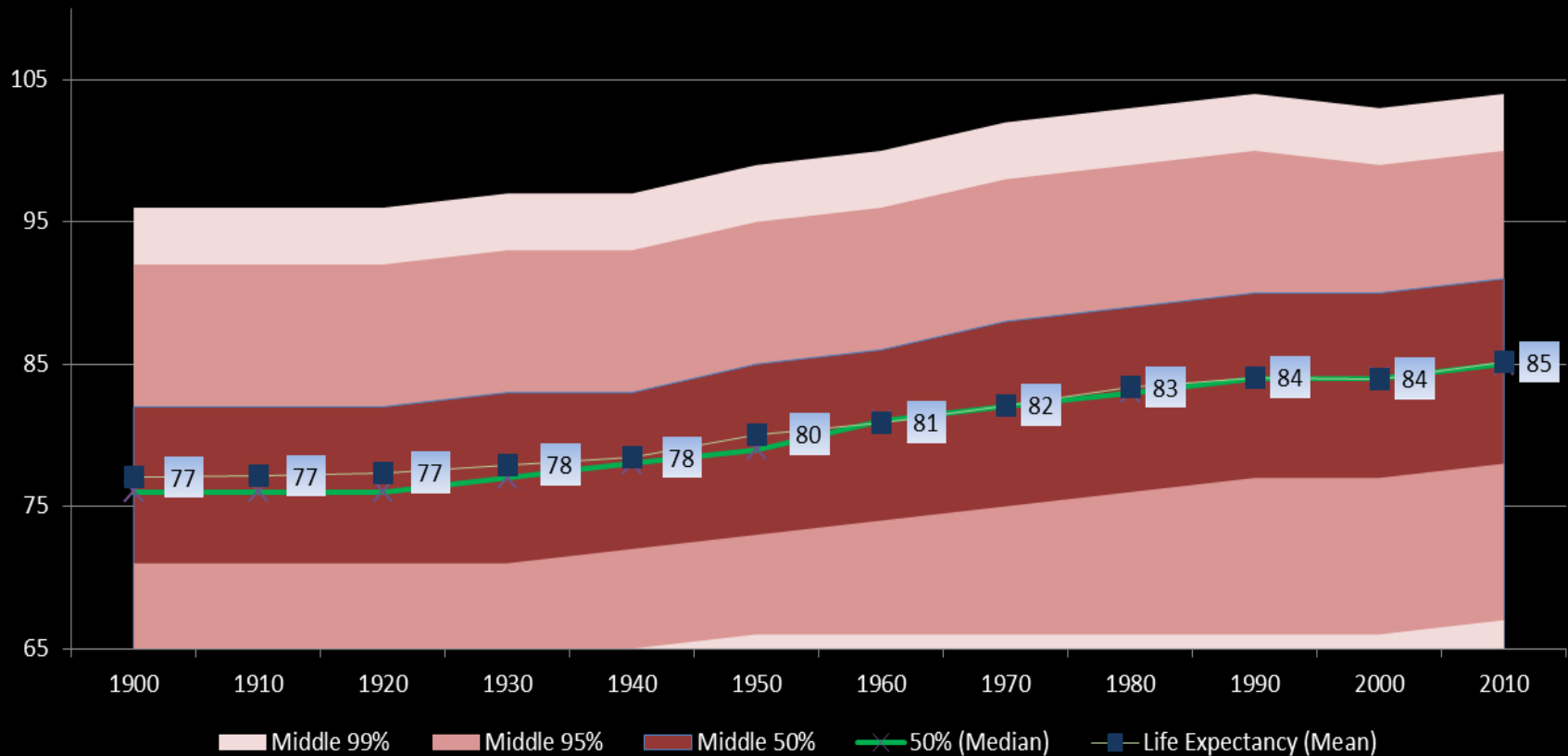
At 65 men were living 7 more years...



Source: SSA Period Life Tables through 2000, projected to 2010 with MP-2014 historical scale

And women 8 more, both with less certainty about length of life.

**Projected Age at Death -- Female Period Life Table Data from Age 65
Middle 50%, 95%, 99% Ranges, Median and Mean**

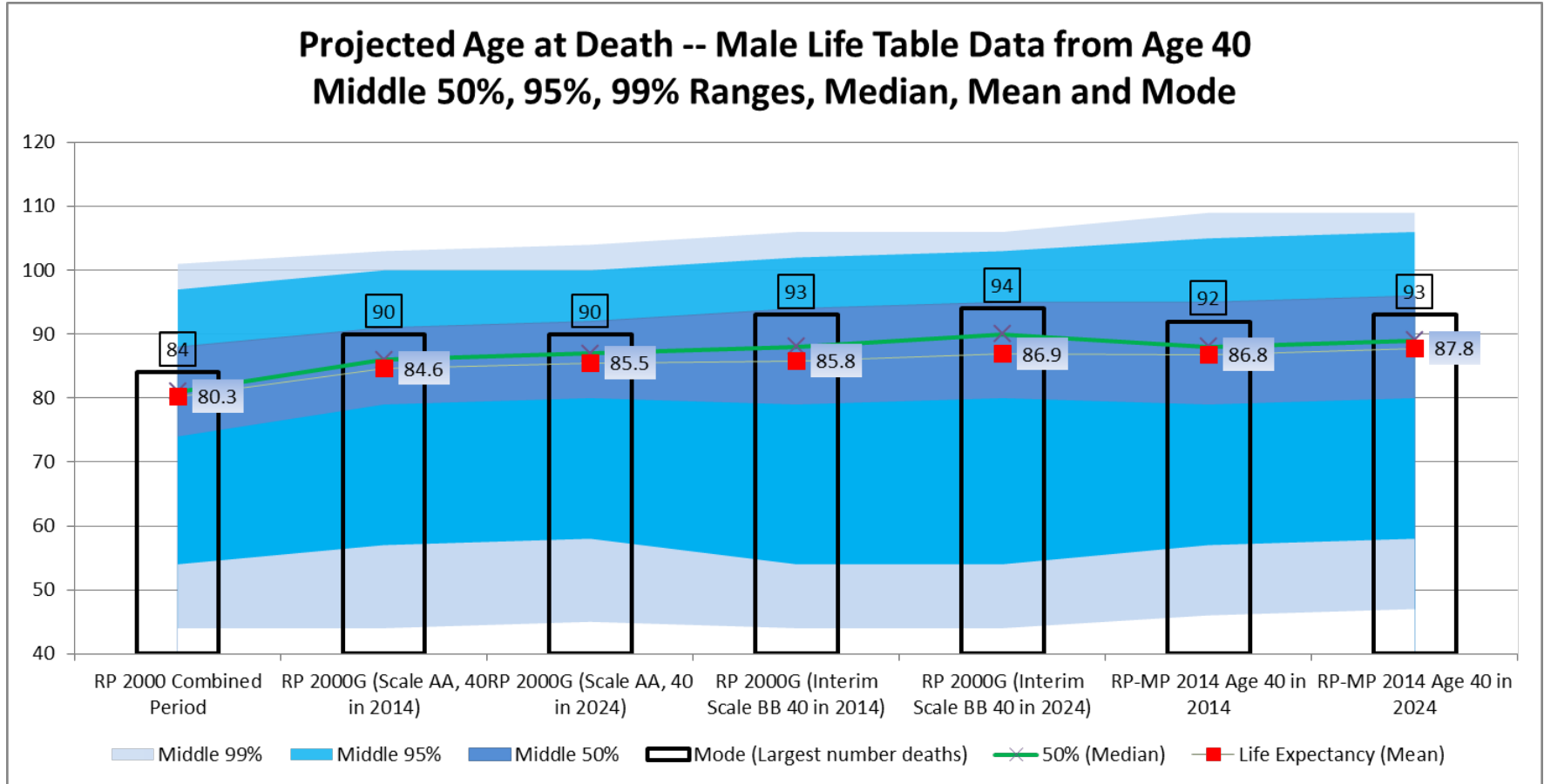


Source: SSA Period Life Tables through 2000, projected to 2010 with MP-2014 historical scale

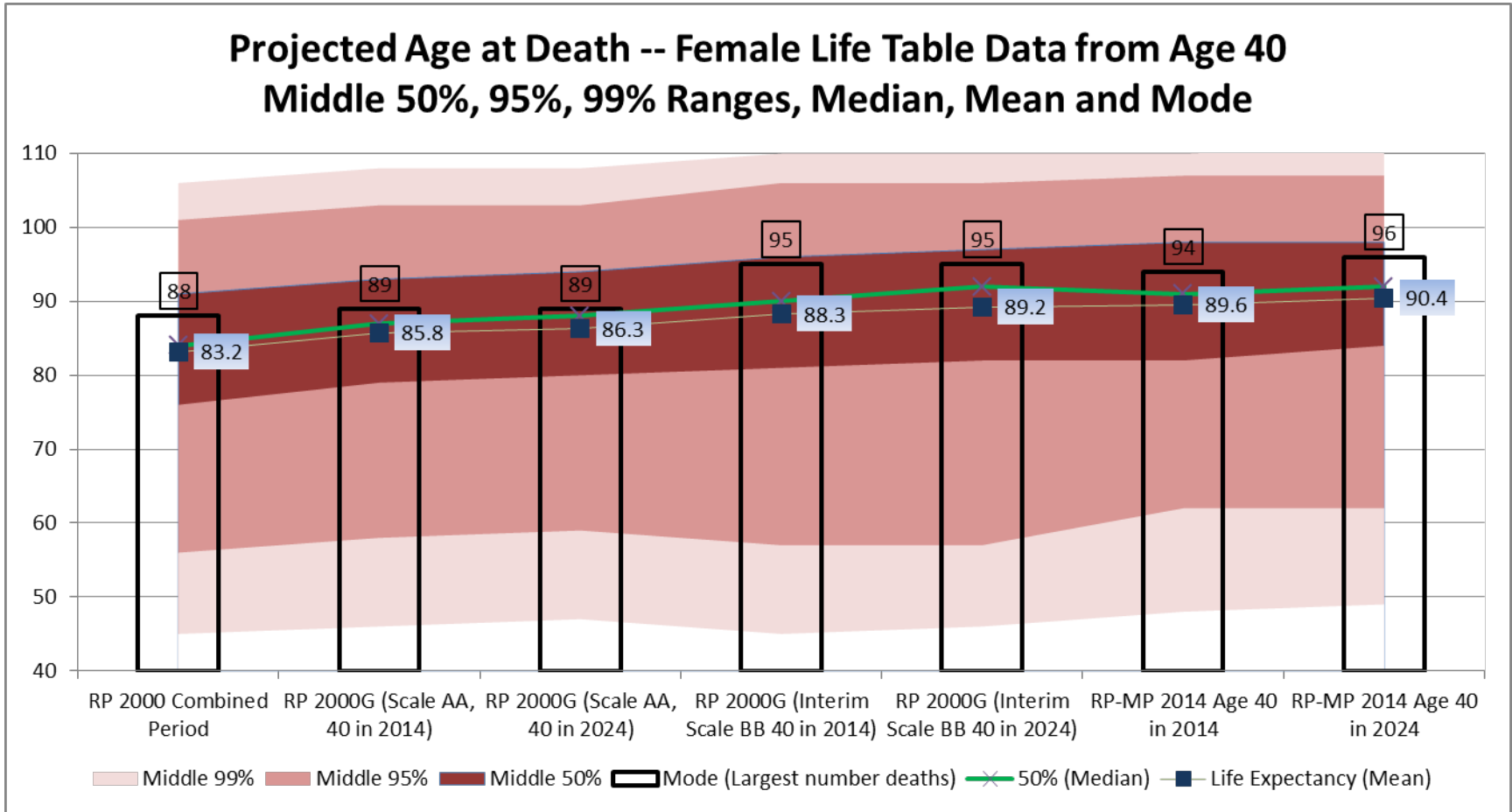
Speaking in Terms Others Use

- What do our tables say about outcomes?
- Age 40 life expectancy
 - Age 65
- Risk of outliving one's life expectancy
- How do we say outcomes *have* changed?
 - What do we *project* will change?

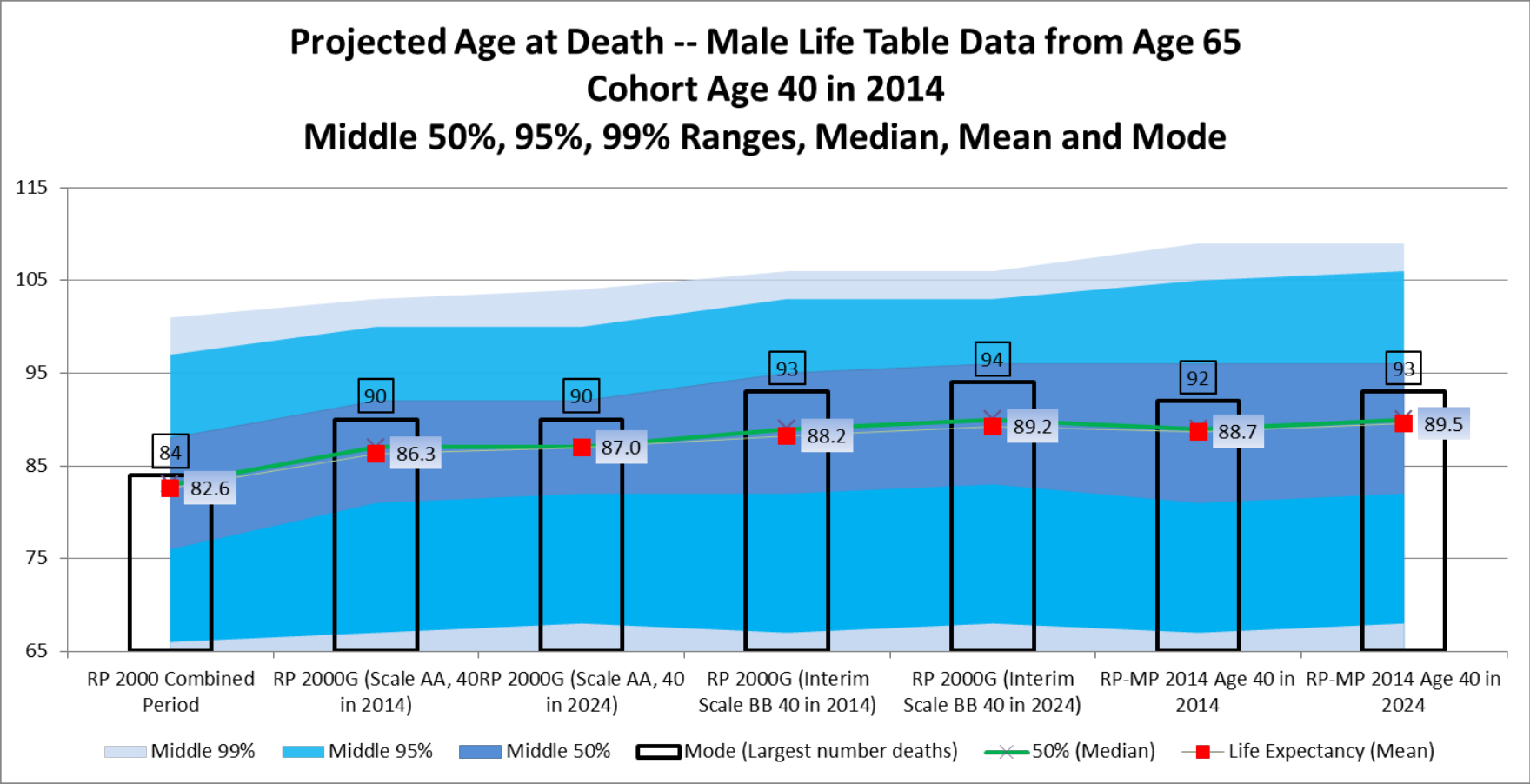
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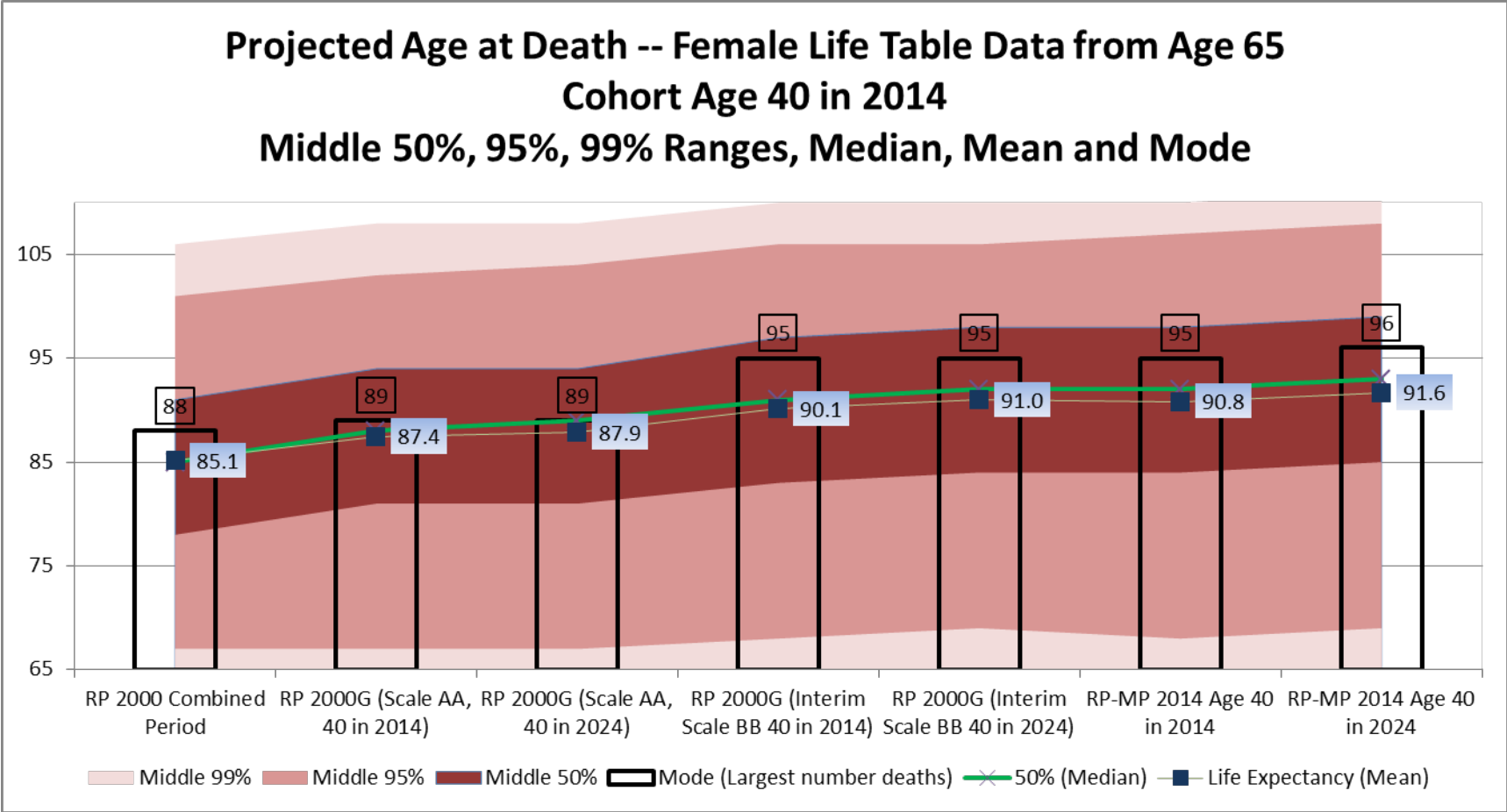
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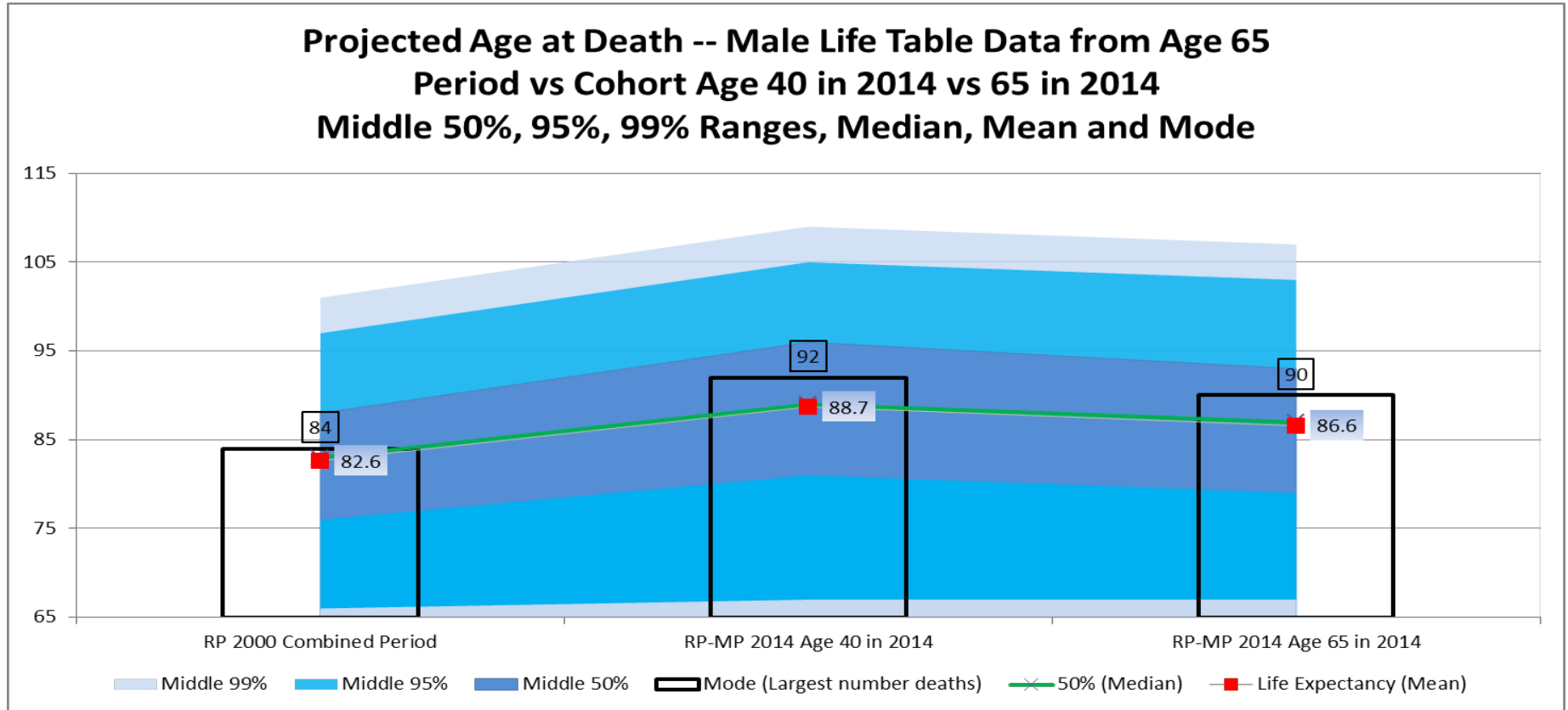
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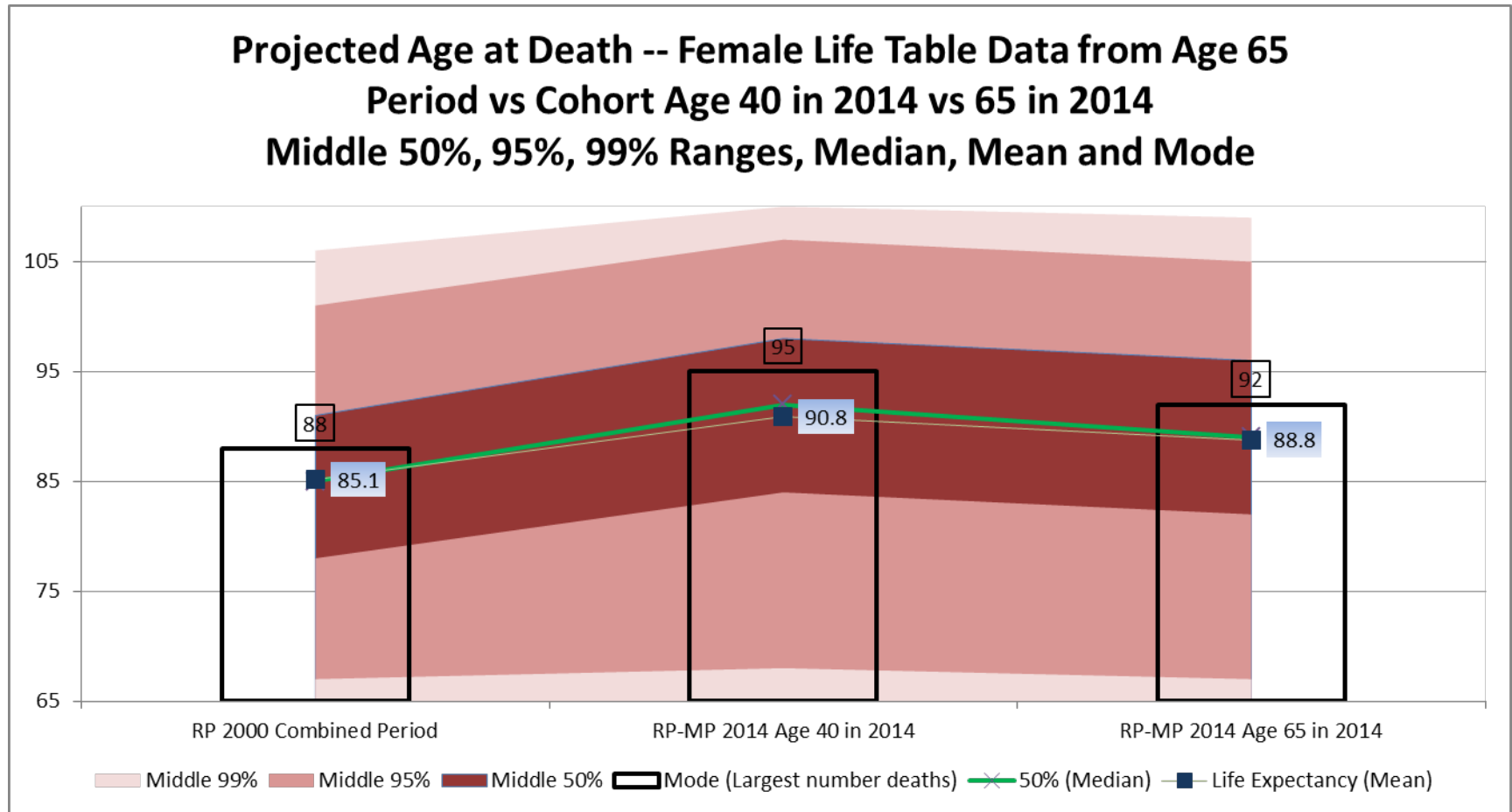
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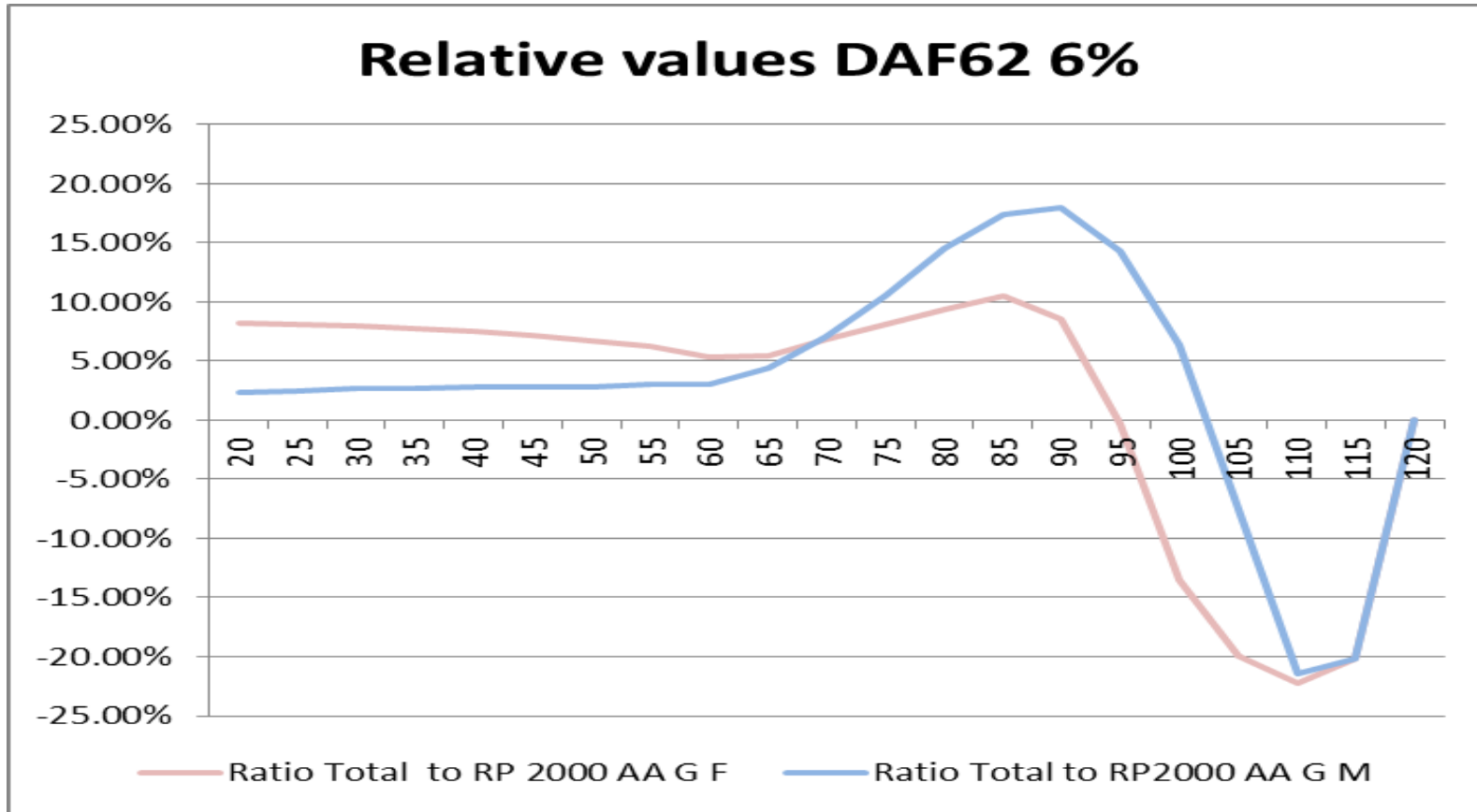
Speaking in Terms Others Use

- For a 40 year old, moving from a table based in 2000 with no projection to a table with assumed improvements in 2014 adds
 - 4 years (M) life expectancy
 - 2 years (F) life expectancy
- Moving to BB and then to RP/MP 2014 adds
 - A little over 1 year each (M)
 - 2.5 years moving to BB and then 1 year (F)
- Variability is up at retirement ages - highlights value of lifetime income

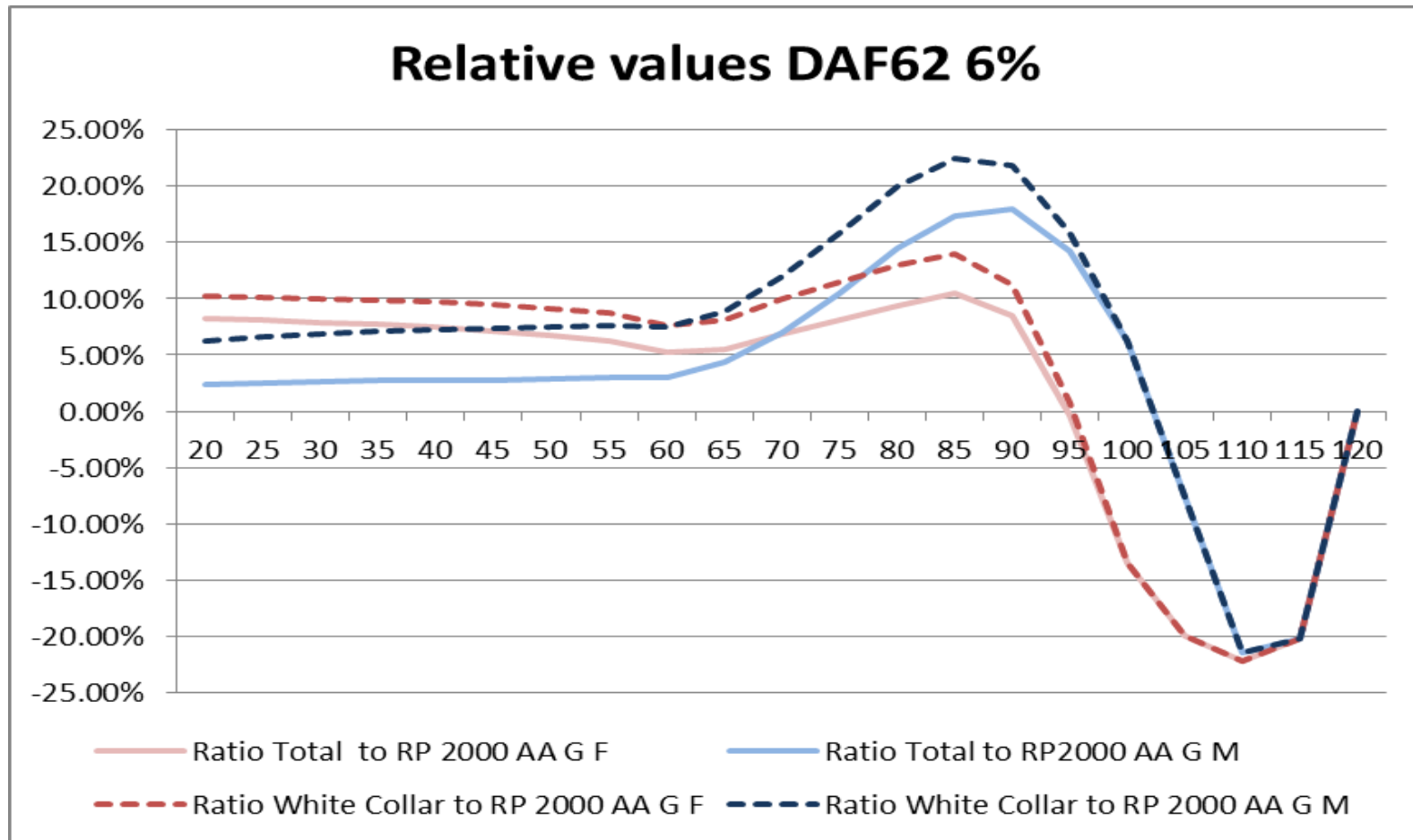
Speaking in Terms Others Use

- Life expectancy for M 40 -- 86.8 (Total table)
 - Expected to grow to 87.8 over the next decade
 - Middle 50% range is +/- 8 years (79 to 95)
- Life expectancy for F 40 -- 89.6 (Total table)
 - Expected to grow to 90.4 over the next decade
 - Middle 50% range is also +/- 8 years (82 to 98)
- M 65 life expectancy is 86.6 (+/- 7 for 50% range)
- F 65 life expectancy is 88.8 (+/- ~7 for 50% range)

But All This Good News has a price compared against fully projected scale AA



But All This Good News has a price Even higher if White Collar



Implications for Regulation

- The two RPEC reports are still in exposure draft form
 - Comments due end of May, 2014
- Accounting
 - Timing not linked to funding changes but to best estimate

Implications for Regulation

- Regulatory timetables
 - Mandated timetable for funding reconsideration
 - At least every 10 years
 - Reflect actual experience and projected trends
 - Notice 2013-49 provides continuation of current process through calendar 2015
 - Benefit determination
 - Pressures
 - Derisking (but consider vs interest rate increase)
 - Lifetime Income

Implications for Regulation

- Should replacement tables be generational?
 - Projection for the duration happened to work well with scale AA
 - Does it work well enough for scale MP?
 - Would generational with a select period work?
 - Implications for benefit determination
 - Currently static (and necessarily unisex)
 - Community ability to adopt?

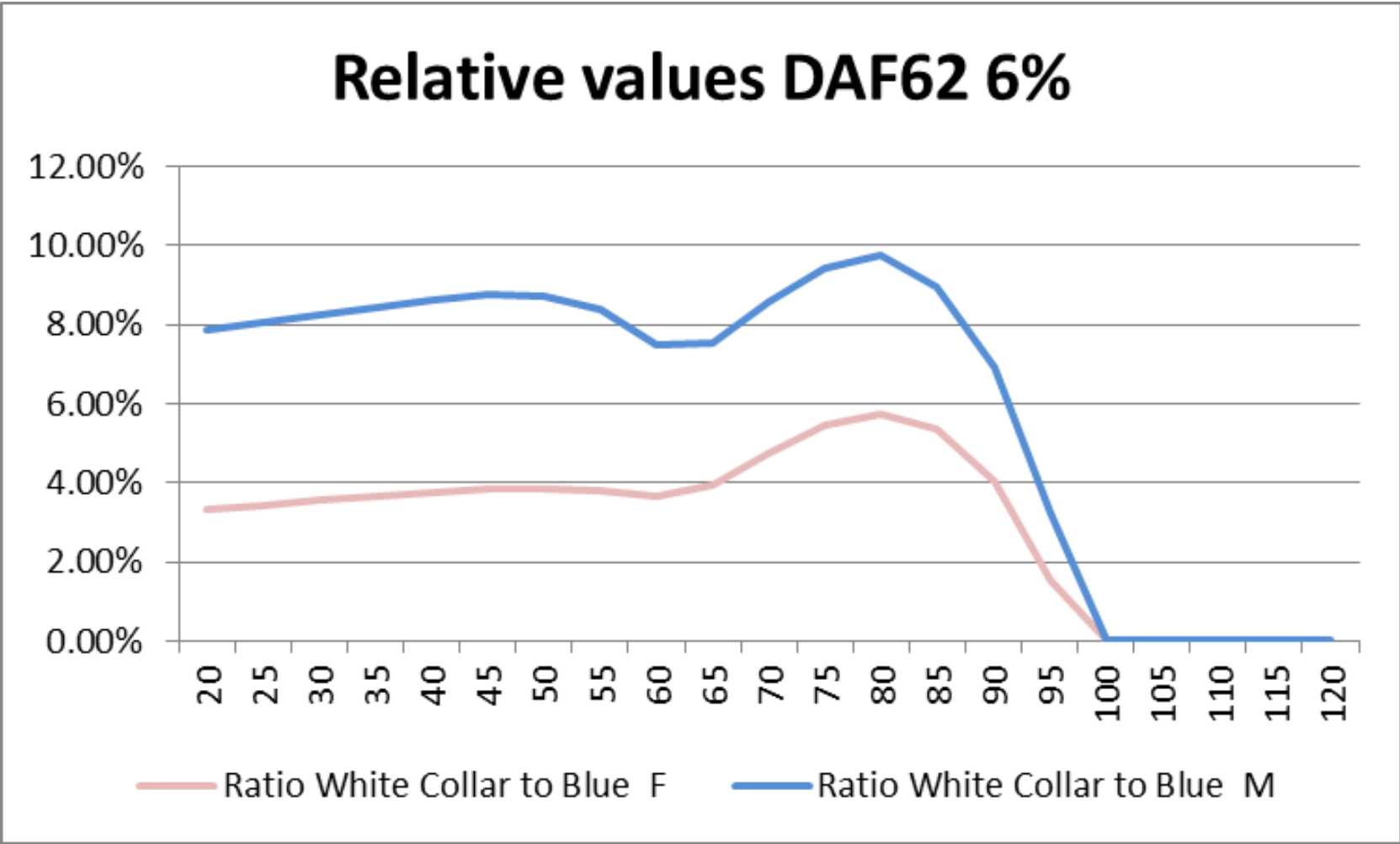
How important are the details?

- Population?
- 2D vs 1D?
- Generational vs Static Projected?

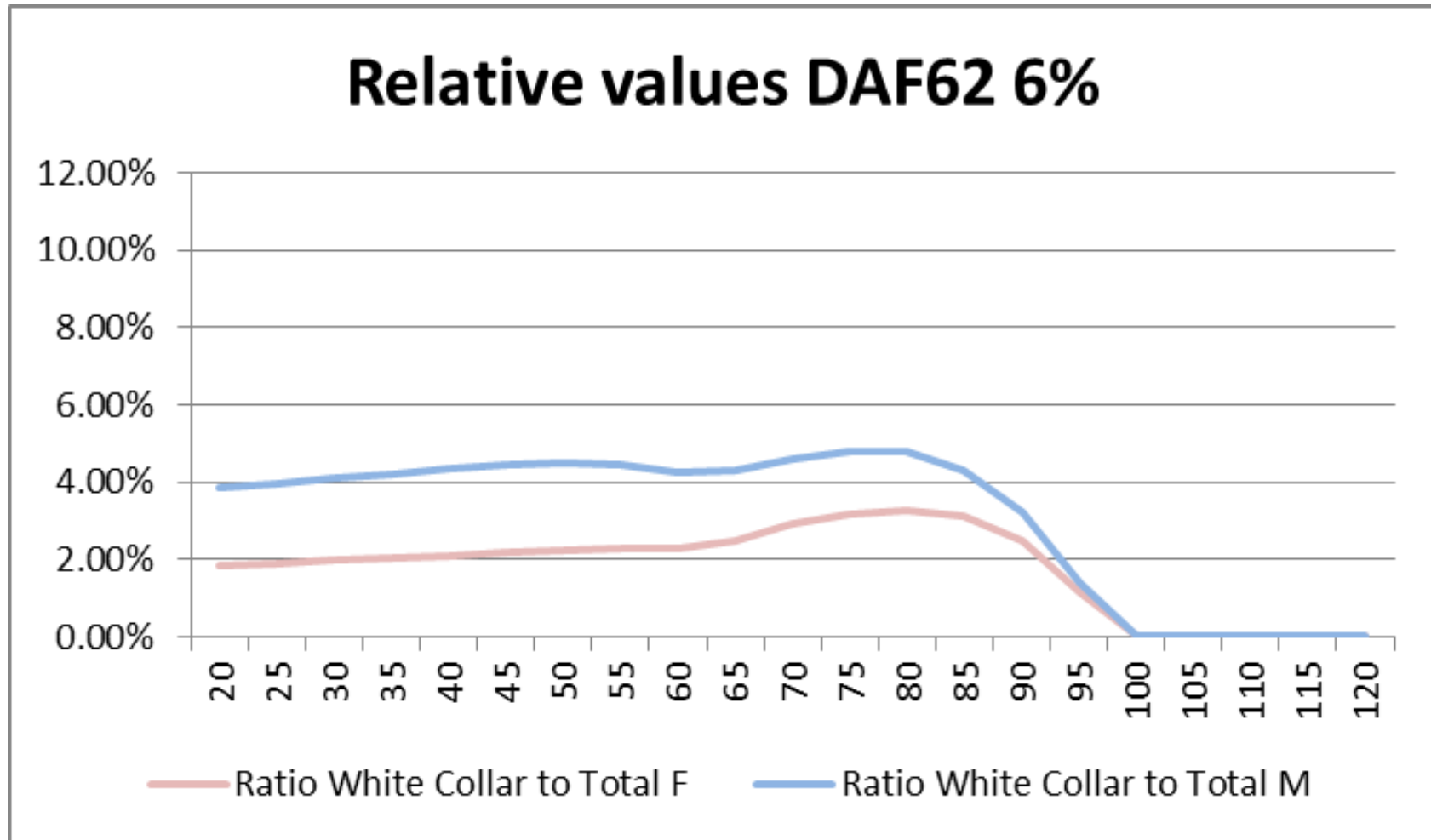
How important are the details?

Modeling the right population is one of the most important decisions

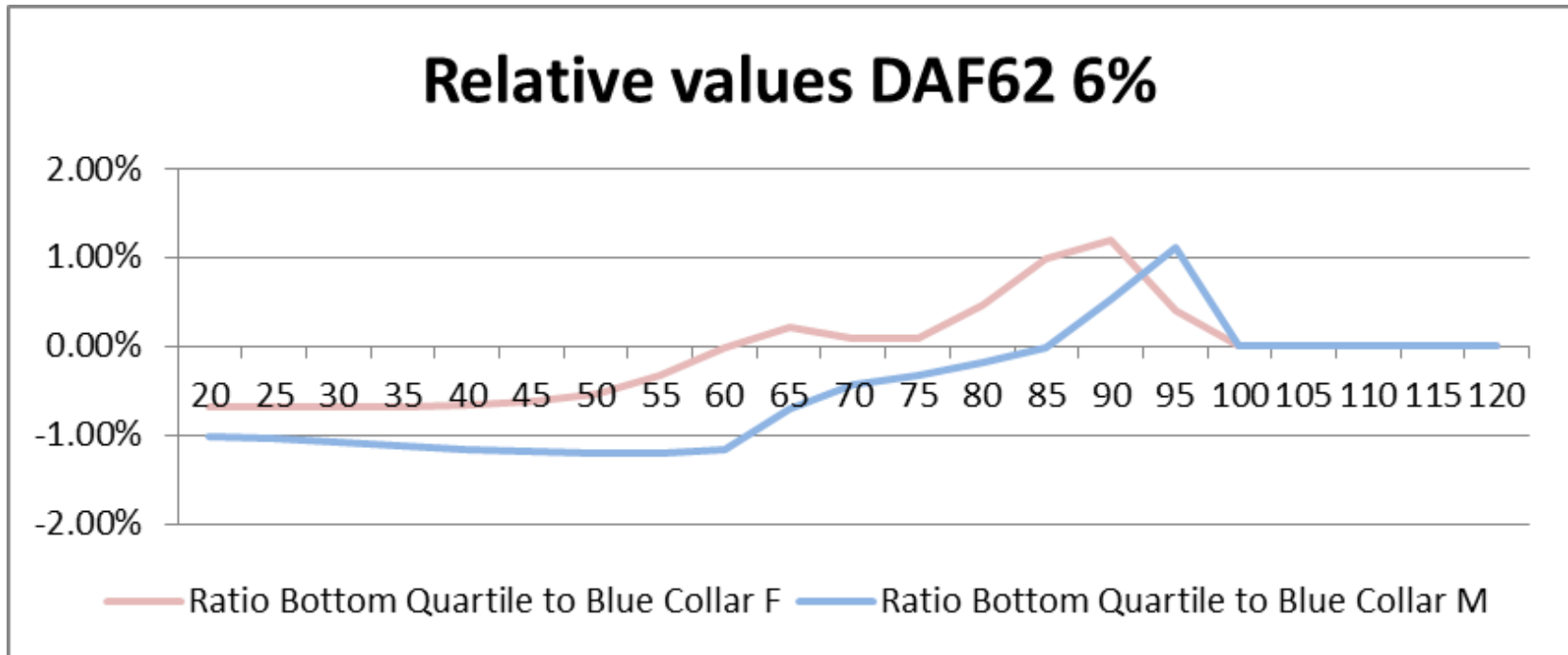
White collar populations are much more costly than Blue Collar...



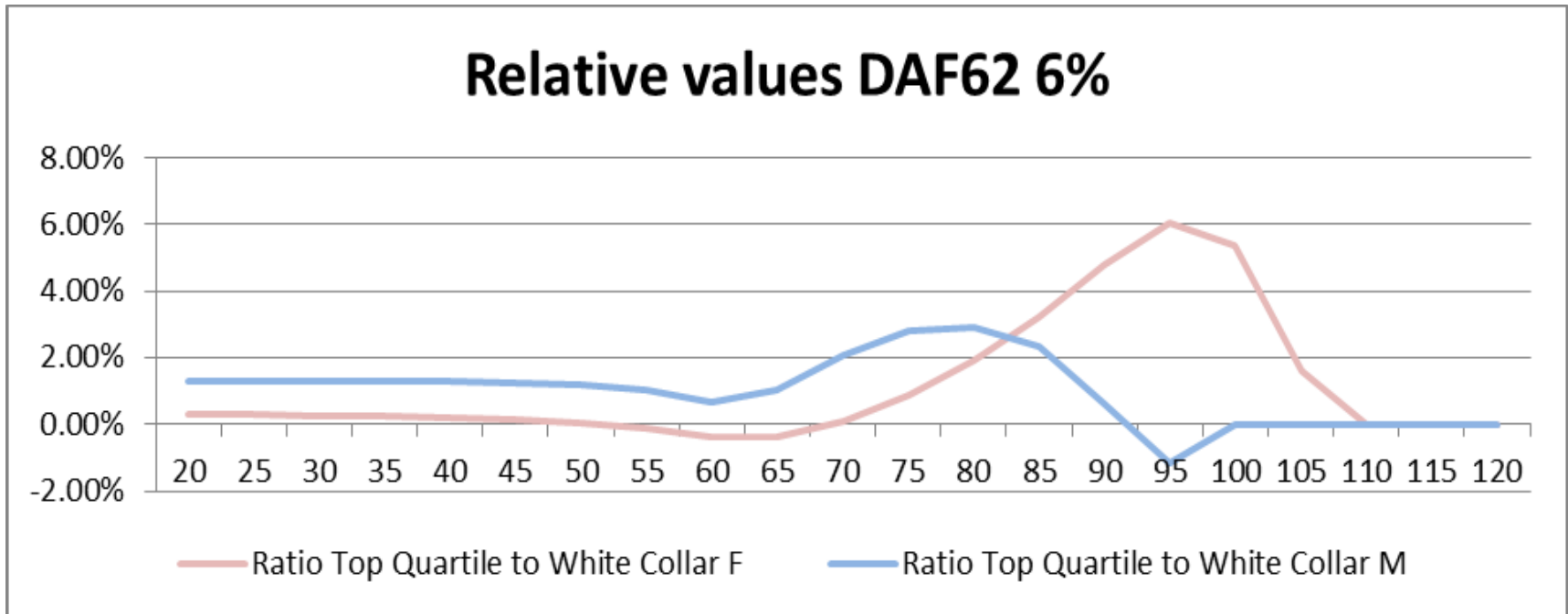
Or than the Base ("Total") table



And while Bottom Quartile Costs are fairly similar to Blue Collar ...



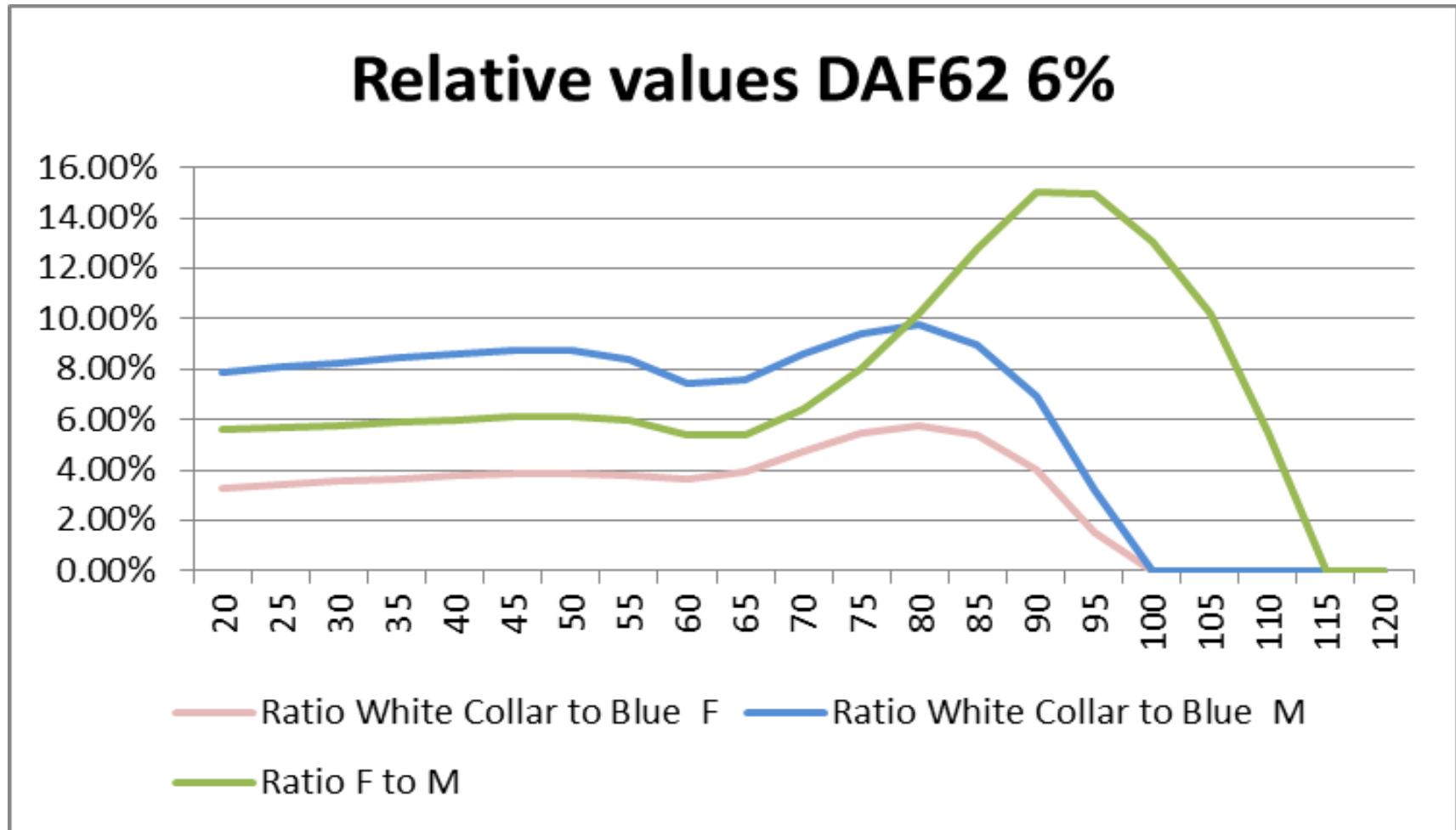
Top Quartile Costs are generally higher than White Collar



How important are the details?

*In fact, except for the oldest retirees,
the right population is ...*

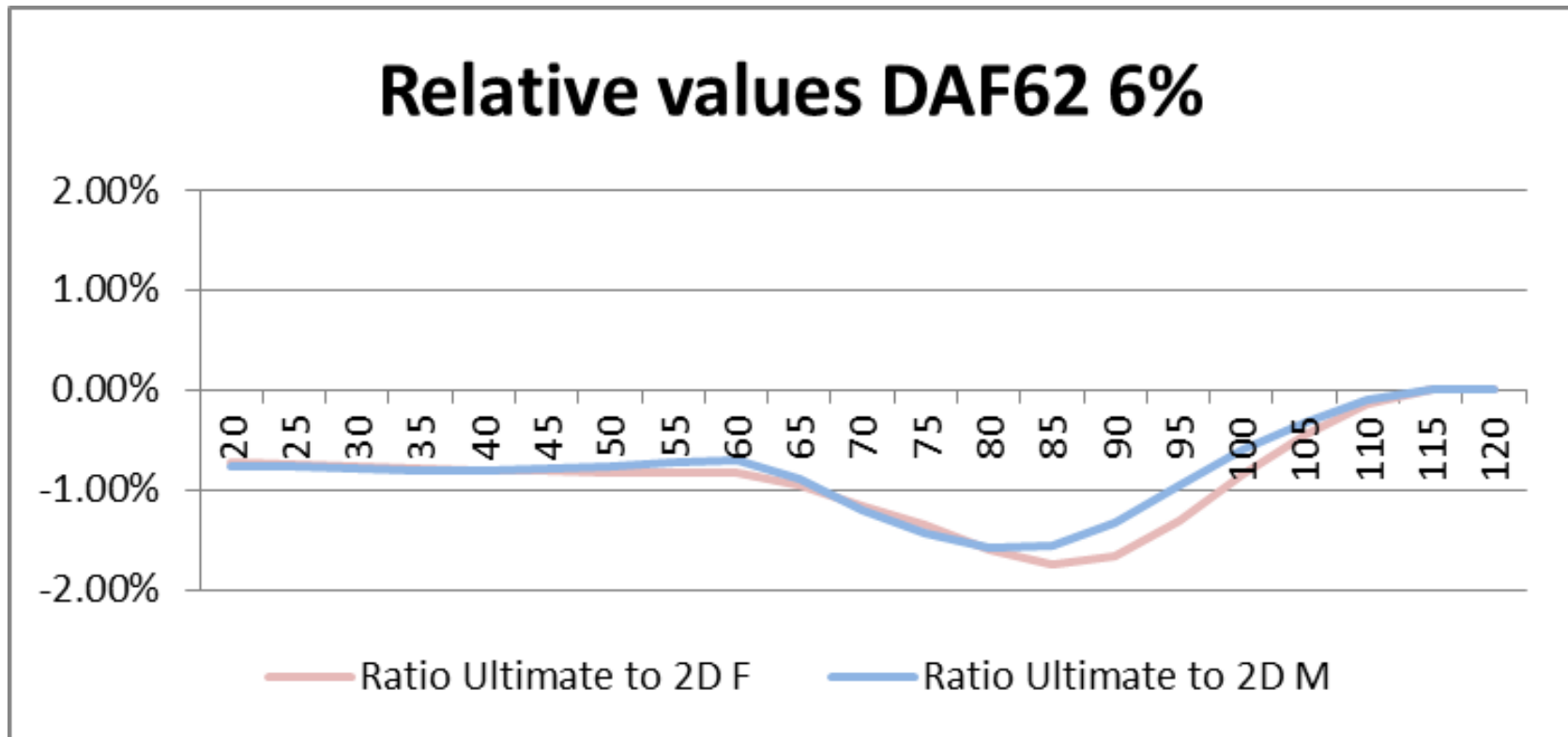
About as important as gender (until 75).



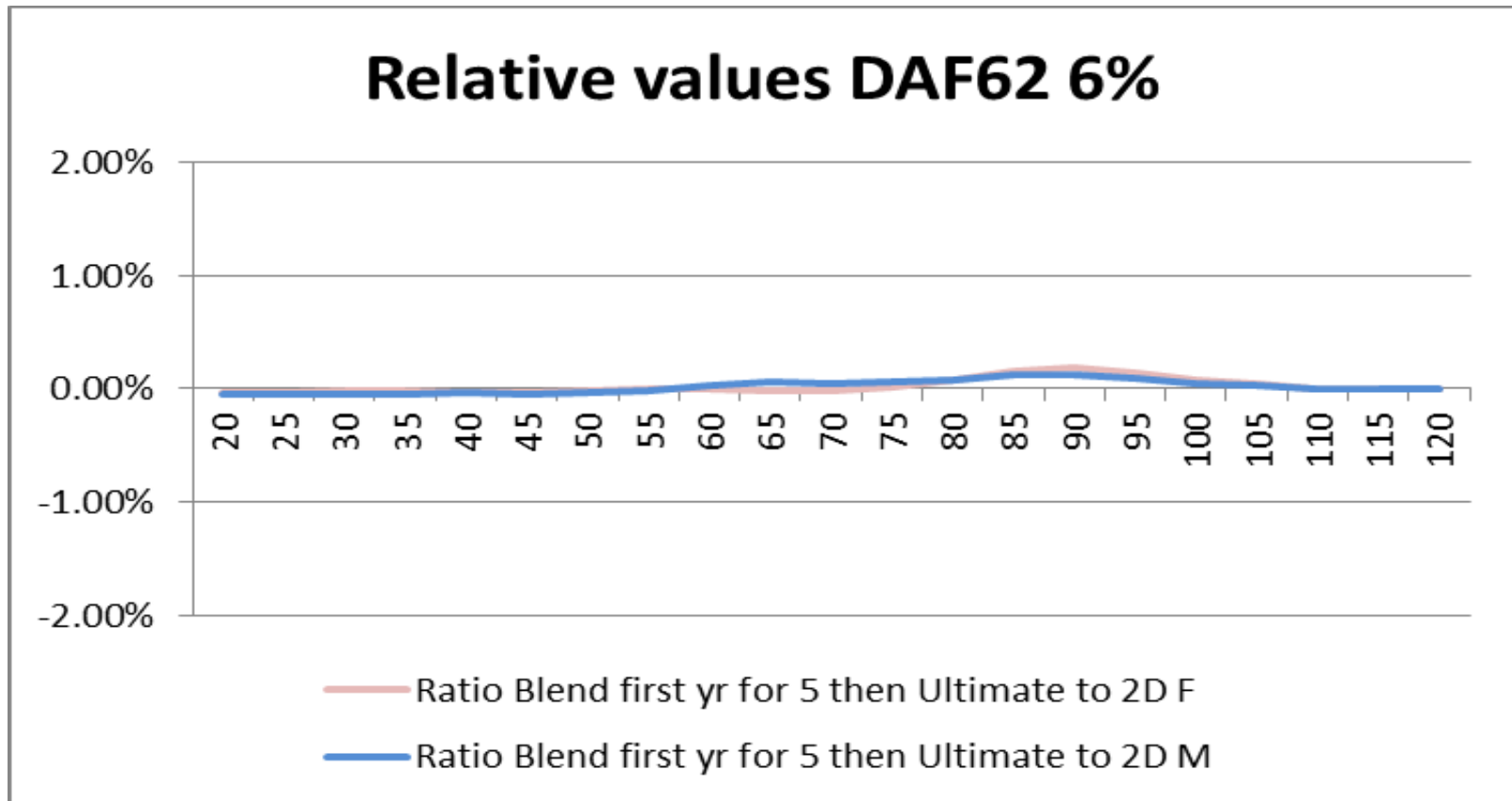
How important are the details?

While the heat maps are intuitive and beautiful, they are only a particular version of an assumption and mimicking them in table development may add more complexity than information

Ultimate Rate vs 2D Understates Costs- More for Retirees



But shifting from the Starting to the Ultimate Rate part way is very close



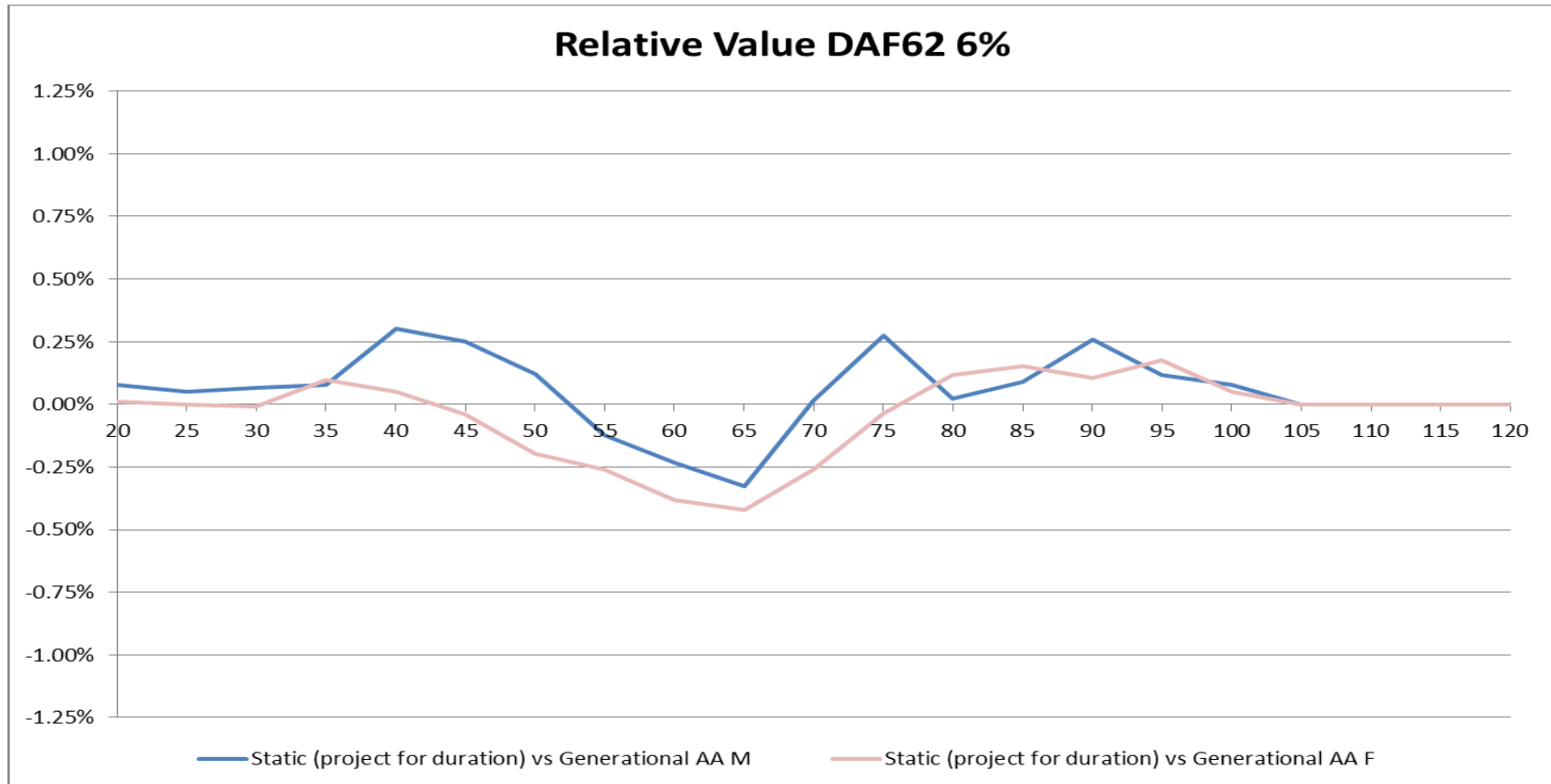
First year rate for a (5yr) select period followed by ultimate

How important are the details?

*Do we need to do generational
mortality projection?*

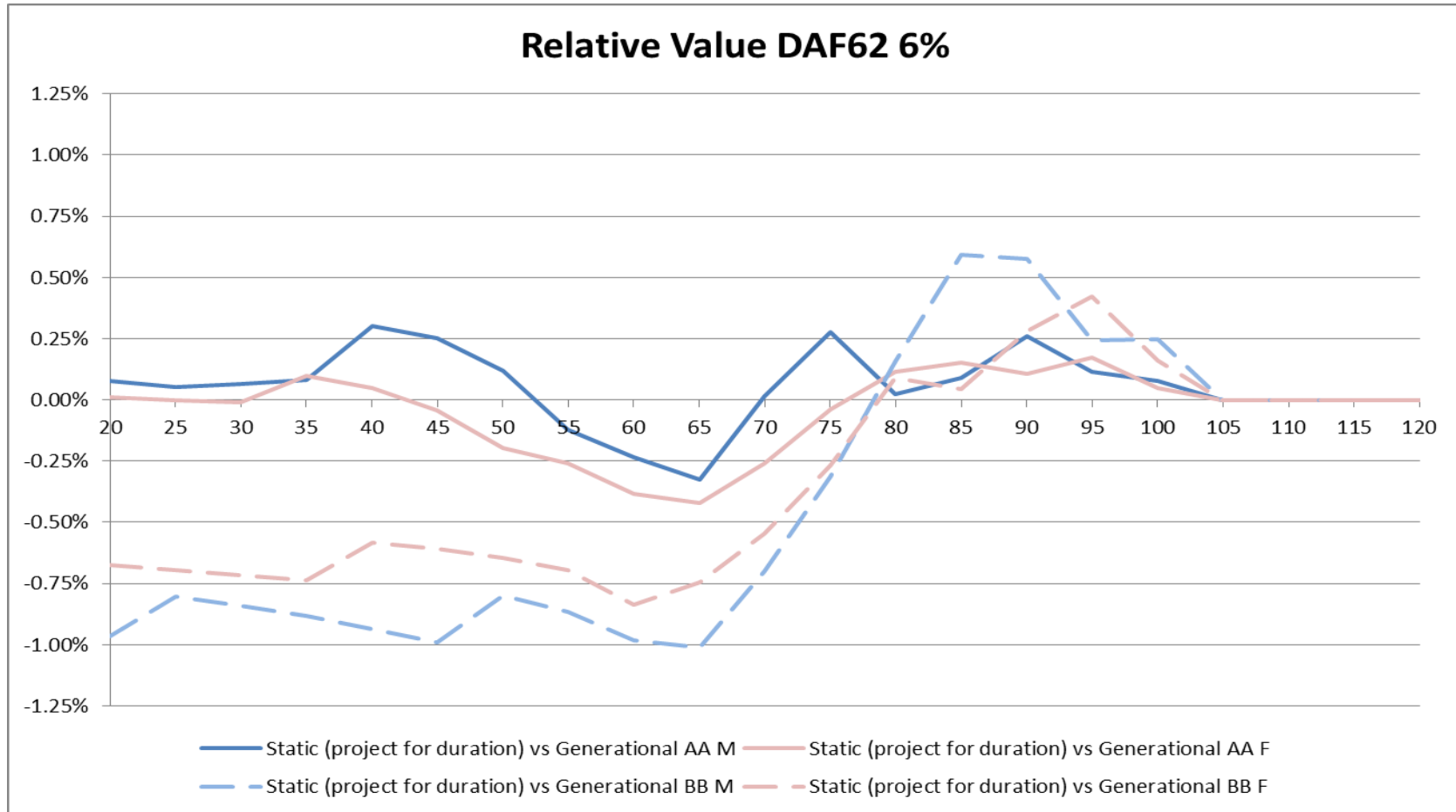
*Or is there a good static projection
alternative?*

Projecting a static table for the liability duration worked well for Scale AA ...



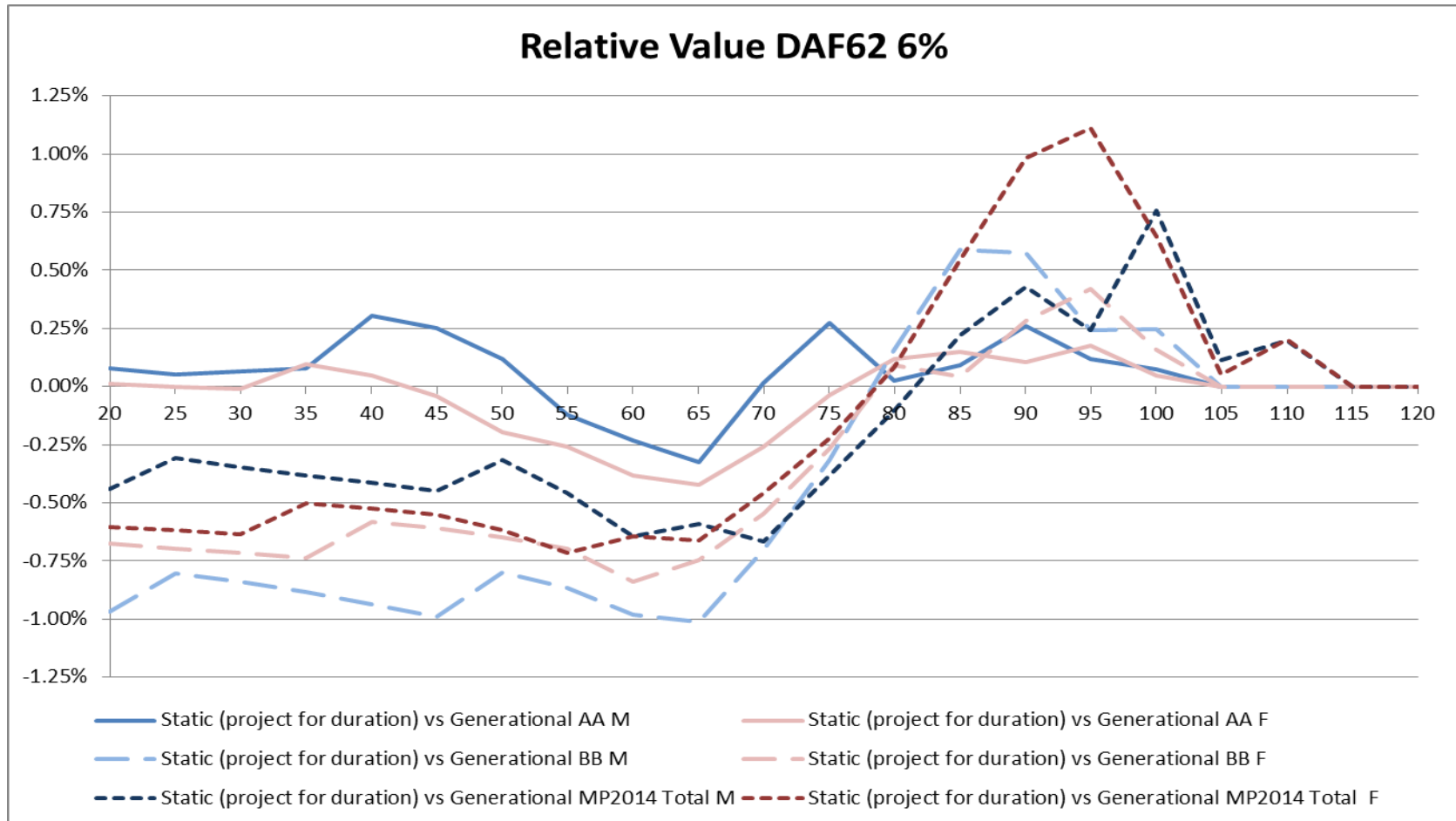
Using a liability weighted age as a proxy, values were generally within a quarter percent at most likely average ages – M/F often offset

But not so well for Scale BB.



Considerably further off for any given liability weighted age – and M/F generally do not offset

Potentially somewhat better for MP-2014 ...



Potentially closer than scale BB at most ages – but still no M/F offset and age change after 80 seems potentially troubling

How important are the details?

Population?

- Definitely important for active populations
- If most workers assumed to take joint and survivor benefits, probably MORE important than gender for the active workers

How important are the details?

2D vs 1D Generational Projection?

- Heat maps have explanatory value
- But not much impact on the numbers
- While the ultimate projection rates eventually dominate, using them alone understates costs
- 1D with a select period is very similar to 2D

How important are the details?

Generational vs Static Projected?

- Projecting a static table for the duration of the liabilities likely works better than it did for BB, but not as well as for AA
- Needs more research