SOCIETY OF ACTUARIES

Mortality Improvement:
Trends and Implications for Pension Plans

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How To Use This PPT Deck

- This deck of slides is intended to be used as a *starting point* for an educational presentation that you may want to use for your clients and/or your actuarial staff. Given your audience and your time constraints, you will most likely want to pick and choose the specific slides (or even the specific data series on a graph) that you want to include. For your clients, you may also want to add financial impact slides that are specific to the client.
- The slides are organized in four general sections (identified by red section-divider slides):
  - The first section is a "core" group of slides that are most likely to be the basis for a higher-level presentation, followed by
  - Two appendices with more detailed and/or technical information (the 2nd appendix includes more technical/detailed than the 1st), and then
  - A bibliography of sources
- Speakers notes are included throughout and can be helpful in a variety of ways. As you prepare your presentation, please be sure to read them. Sometimes they provide background and context for the slide or provide suggestions for how to talk about a slide. Sometimes they provide key data points shown in the graph in case you are asked a question. Sometimes they include suggestions for how to coordinate a slide's animation and your comments.

Agenda

- Brief history of mortality
- Trends and observations
- Related factors
- Observed mortality improvement
- New assumptions

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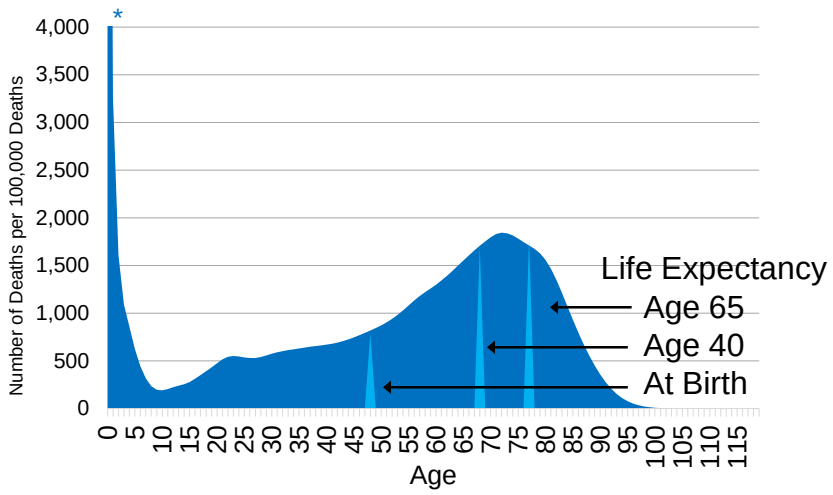
Mortality in the United States, 1900-2000

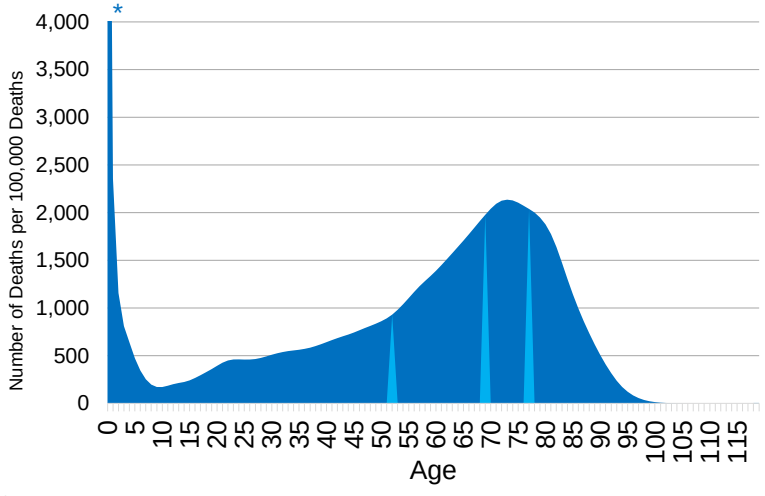
Age at Death in 1900



*13,283

Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

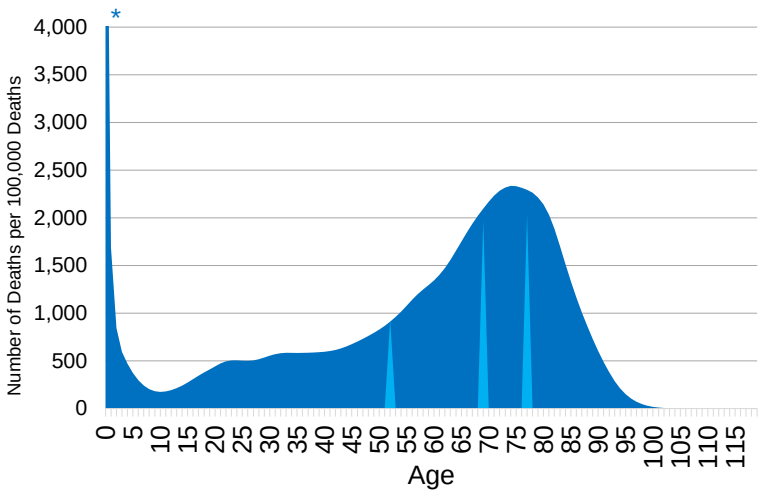
Age at Death in 1910



*10,916

Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

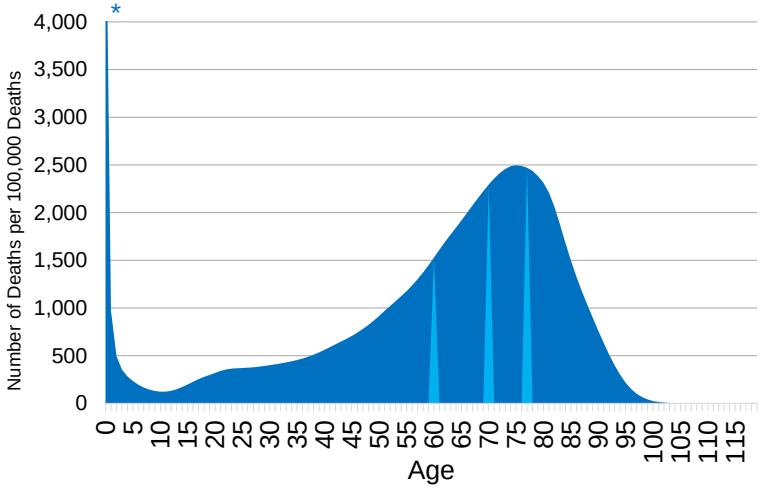
Age at Death in 1920



*7,684

Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

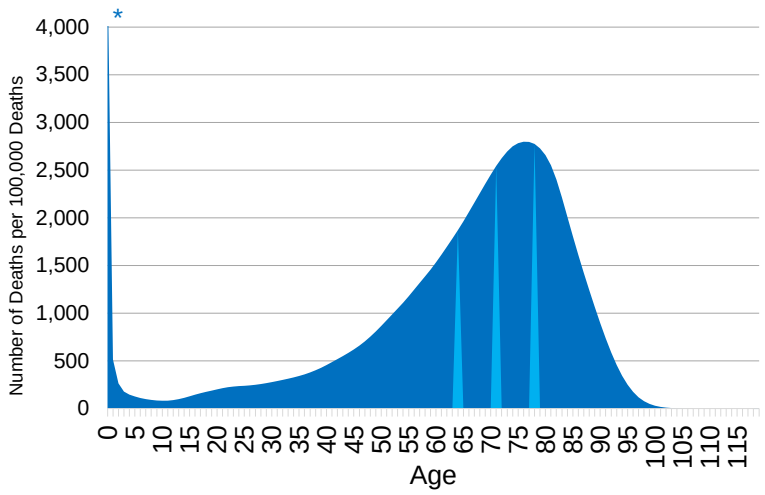
Age at Death in 1930



*7,684

Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

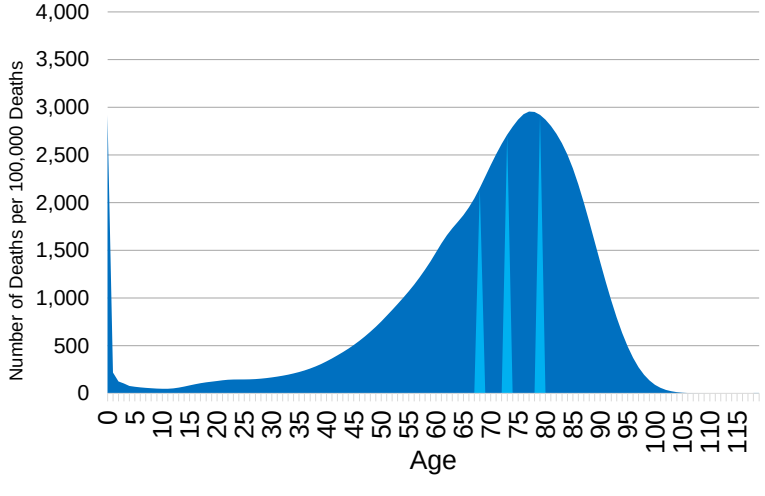
Age at Death in 1940



*4,725

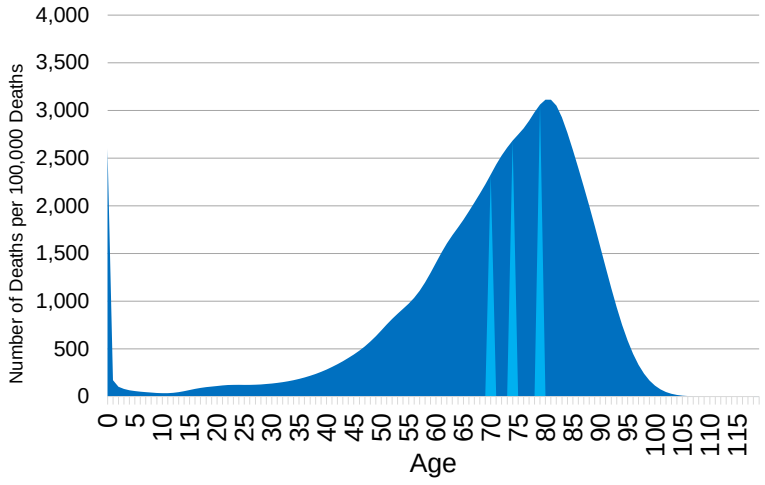
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 1950



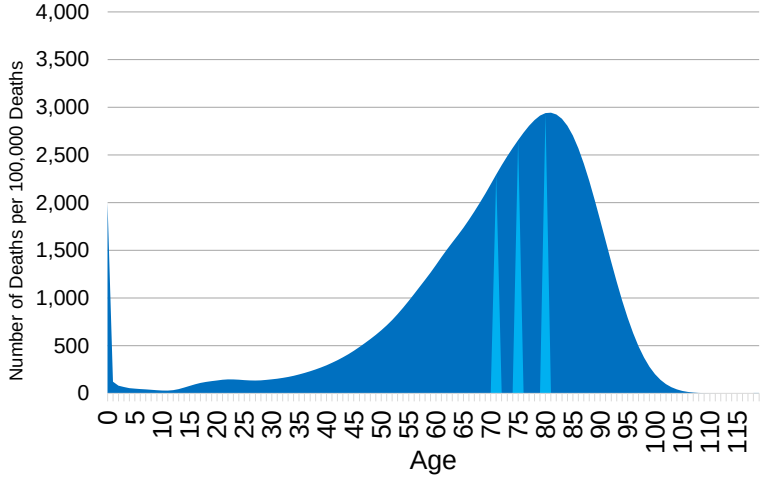
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 1960



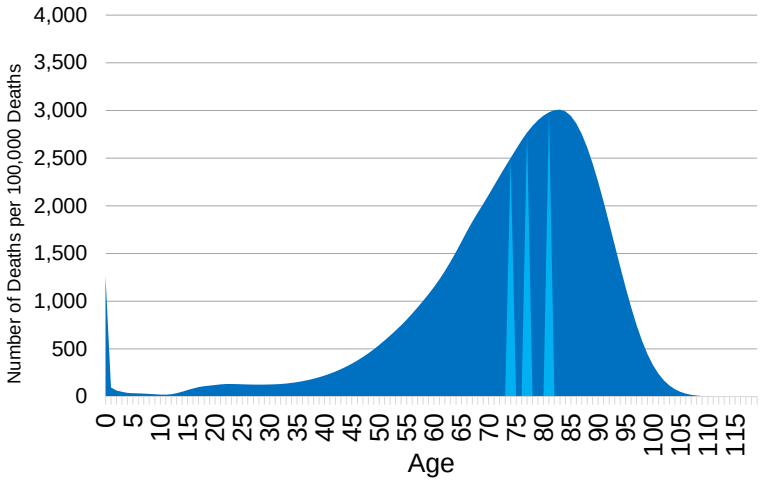
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 1970



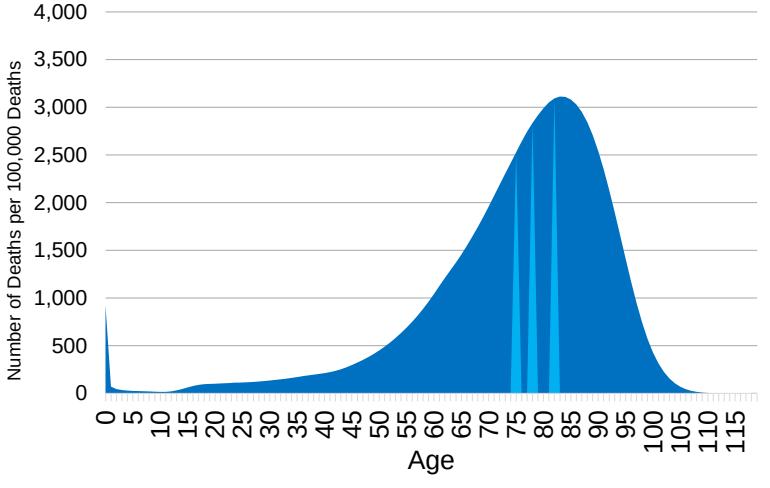
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 1980



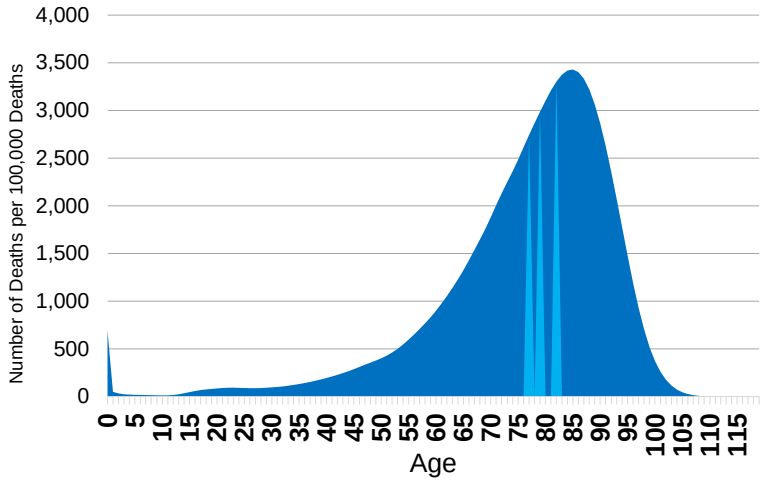
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 1990



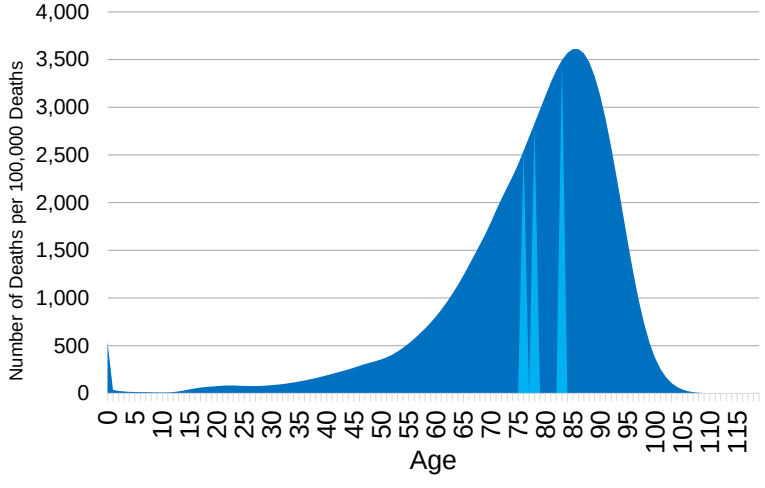
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 2000



Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 2010 (Projected)



Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

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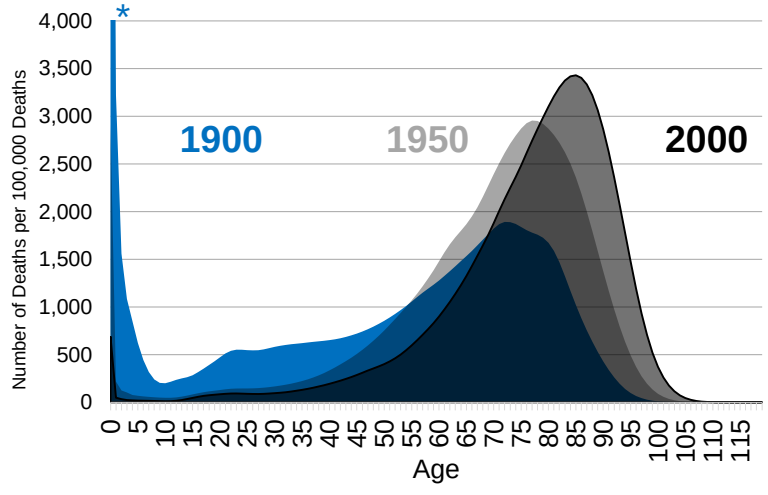
Trends and Observations

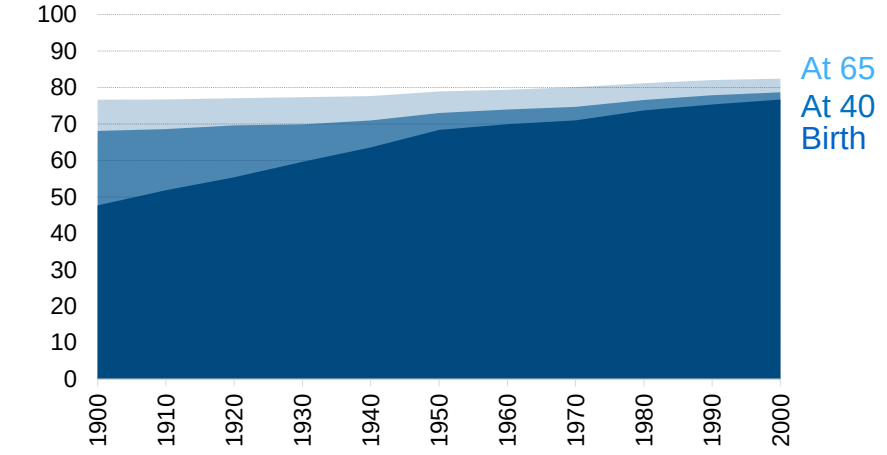
Changes Over the Century



*13,283

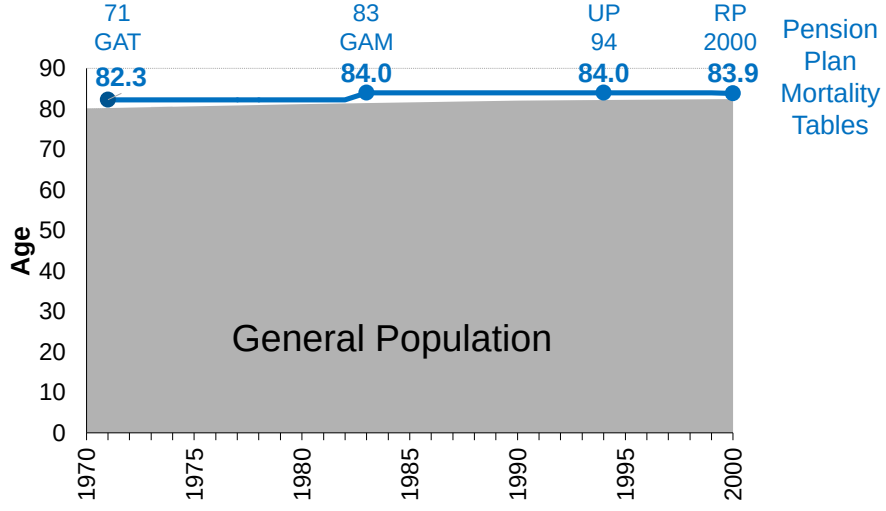
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

20th Century Life Expectancy Improvements



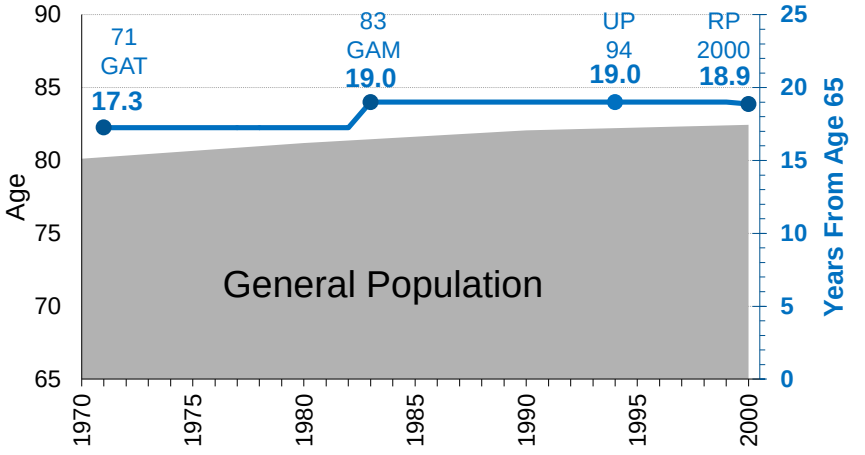
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Life Expectancy At 65



Population Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female, non-decade years interpolated

Remaining Life Exp. At 65



Population Data: SSA Actuarial Study 120 – Periods 1900-2000, non-decade years interpolated. Mortality Tables: 71GAT, 83GAM, UP-94,RP-2000 unprojected, RP-2000 (AA generational), RP-2014 (MP-2014 generational). All 50% male, 50% female.

20th Century Mortality Observations

- Life expectancy continually increased
  - At birth: dramatic increases, especially pre-1950
  - At "middle age": slower, steadier increases
- Most current forecasts assume slower life expectancy increases in the future, including at older ages*
- Undervaluing future mortality improvement understates pension liabilities

* IMF Global Financial Stability Report, 2012

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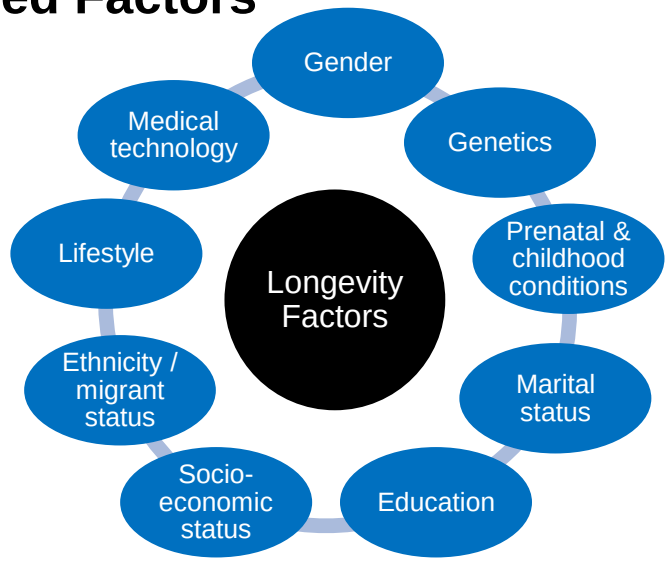
Related Factors

Associated Factors

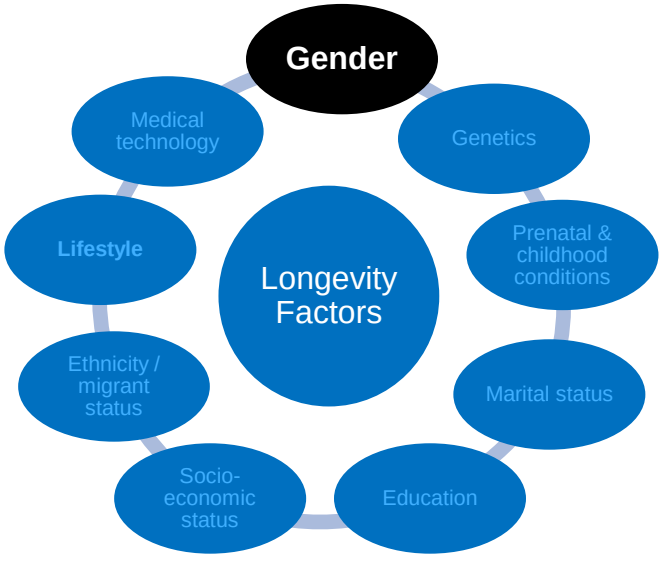
Various factors influence mortality. Some may be reflected to some extent in pension plan valuations.



Source: Variation in Longevity, Longevity Bulletin, IFA, May 2012

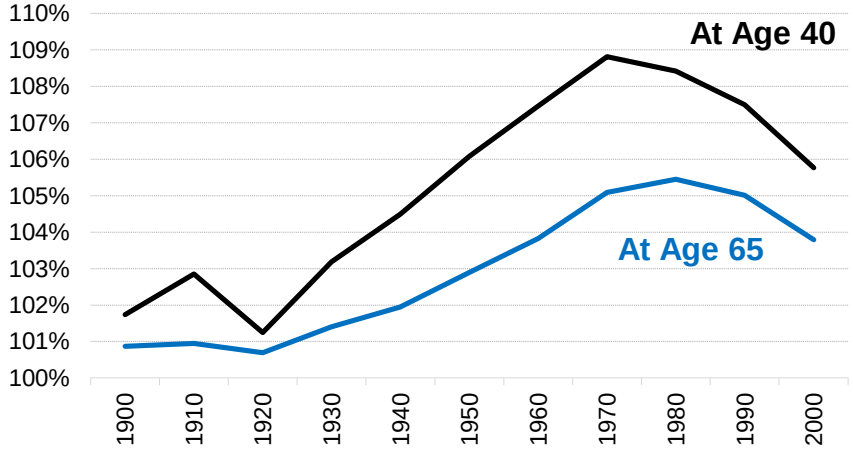
Gender

Different mortality by gender has long been reflected in pension plan valuations.



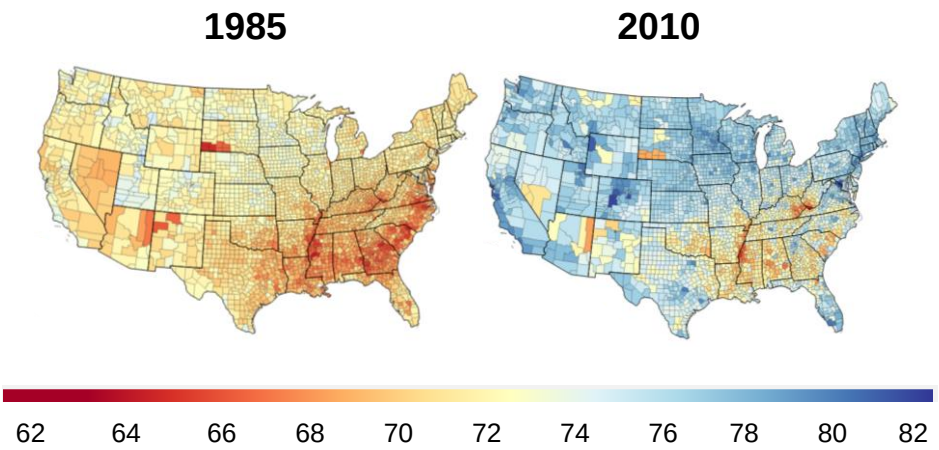
Source: Variation in Longevity, Longevity Bulletin, IFA, May 2012

Female Compared to Male Life Expectancy Over the 20th Century in the U.S.



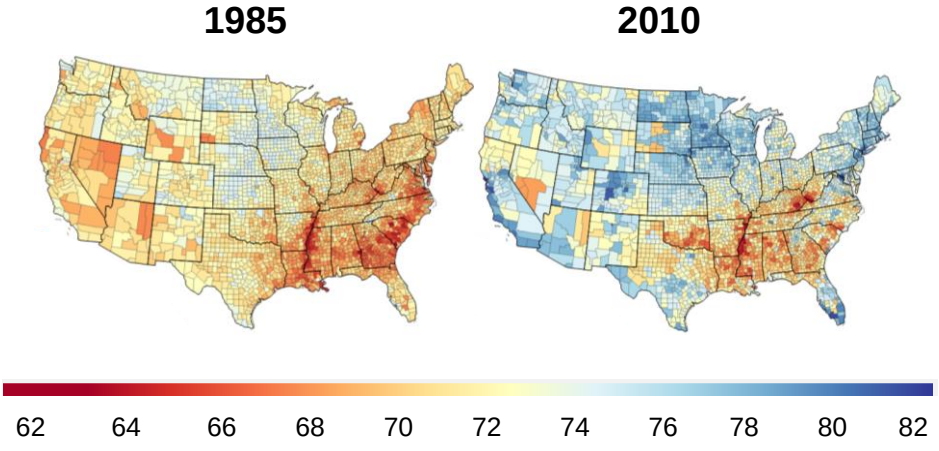
Data: SSA Actuarial Study 120 – Periods 1900-2000

Life Expectancy by County: Males



Source: Institute for Health Metrics and Evaluation, 2013

Life Expectancy by County: Females



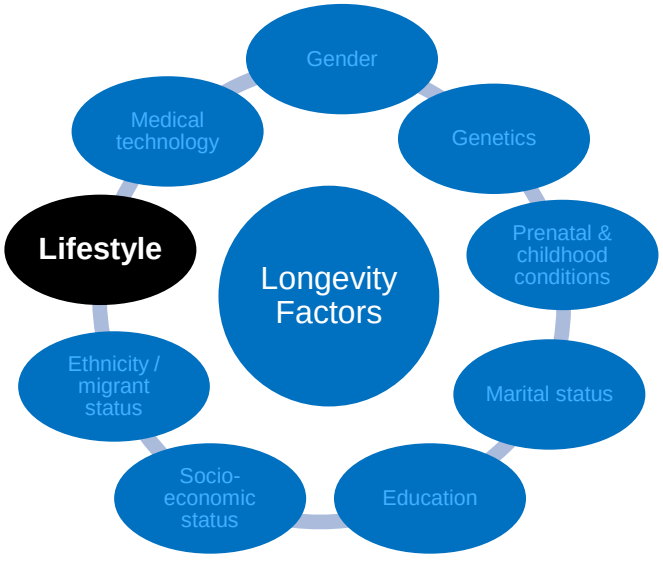
Source: Institute for Health Metrics and Evaluation, 2013

Lifestyle

Historical examples:

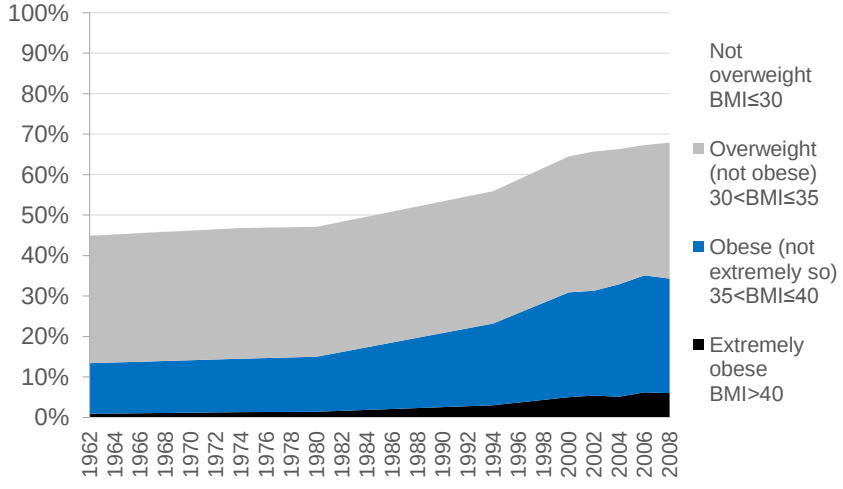
- Tobacco use
- Food safety
- Work place safety
- Motor vehicle safety

Obesity is one current issue



Source: Variation in Longevity, Longevity Bulletin, IFA, May 2012

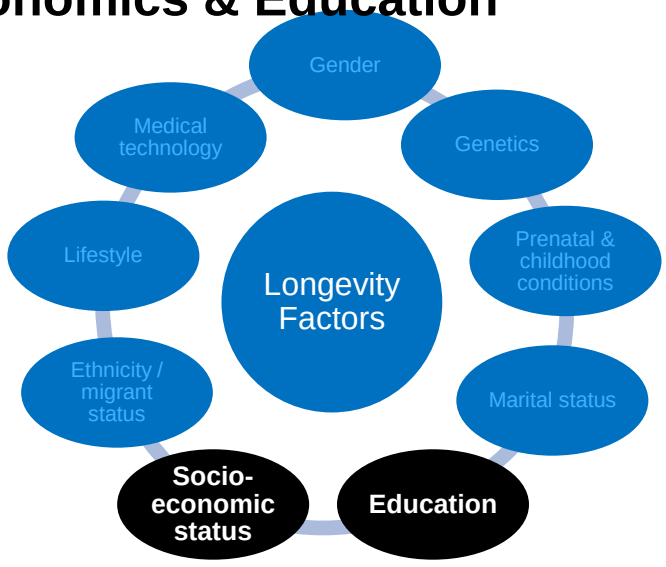
U.S. Adult Obesity 1962-2008



Source: NHANES, Flegal et al (2012); results prior to 2000 have been smoothed

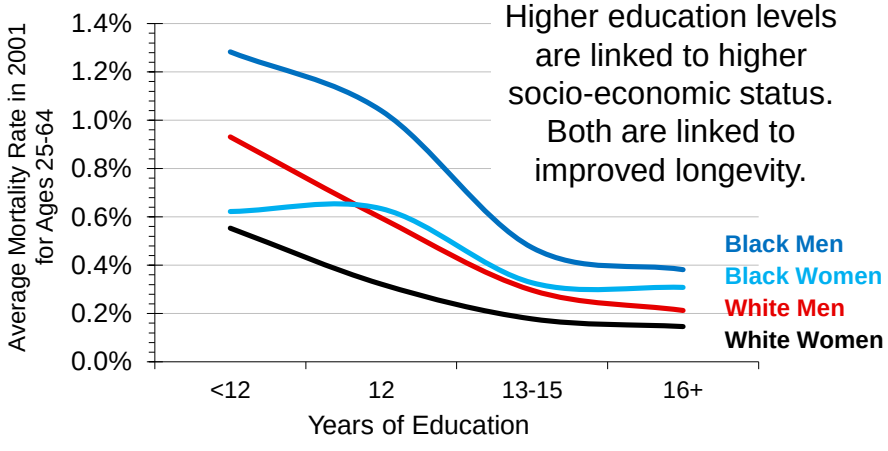
Socioeconomics & Education

Mortality differences for blue vs. white collar workers can also be reflected in a pension plan valuation.



Source: Variation in Longevity, Longevity Bulletin, IFA, May 2012

U.S. Mortality Varies by Education



Higher education levels are linked to higher socio-economic status. Both are linked to improved longevity.

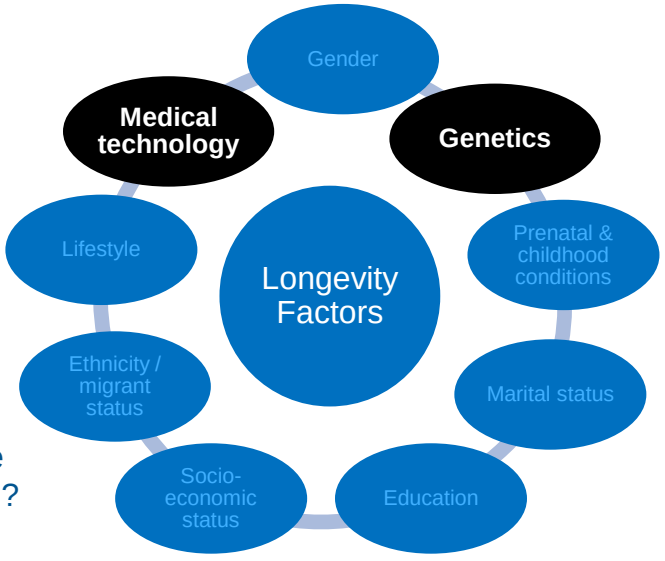
Source: Jemal A, Ward E, Anderson RN, Murray T, et al. (2008) Widening of Socioeconomic Inequalities in U.S. Death Rates, 1993–2001. PLoS ONE 3(5): e2181. doi:10.1371/journal.pone.0002181

Medicine

Historical examples:

- Antibiotics, immunization, vaccination
- Imaging (X-ray, CT scan, MRI)
- Cardiac care and surgery
- Organ transplants

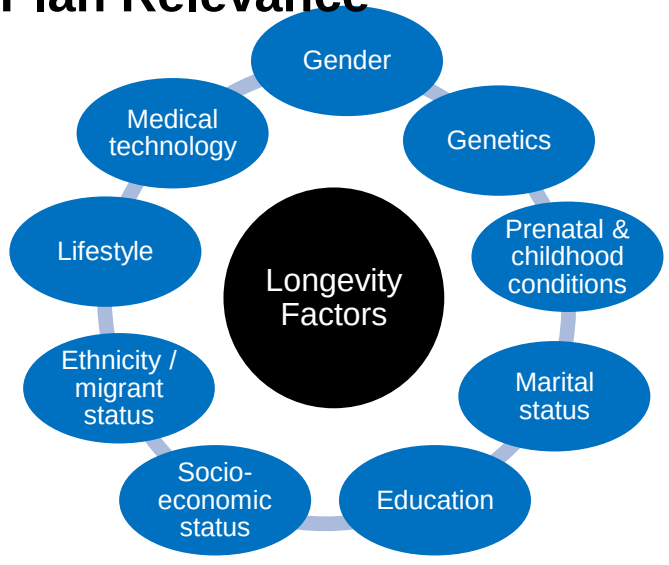
What will future advances bring?



Source: Variation in Longevity, Longevity Bulletin, IFA, May 2012

Pension Plan Relevance

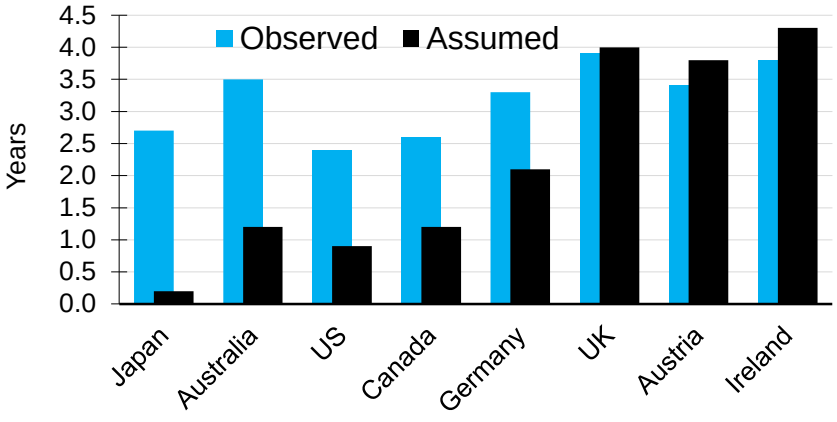
Some of these factors might be evident (or likely) in pension plan's population and can be reflected in the valuation of liabilities.



Source: Variation in Longevity, Longevity Bulletin, IFA, May 2012

Pension Valuations Around the Globe

Assumed Mortality Improvement in 2010 vs.
Observed Mortality Improvement Since 1990



Source: IMF Global Financial Stability Report, 2012

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Current Best Practice

Assume mortality will continue to improve.

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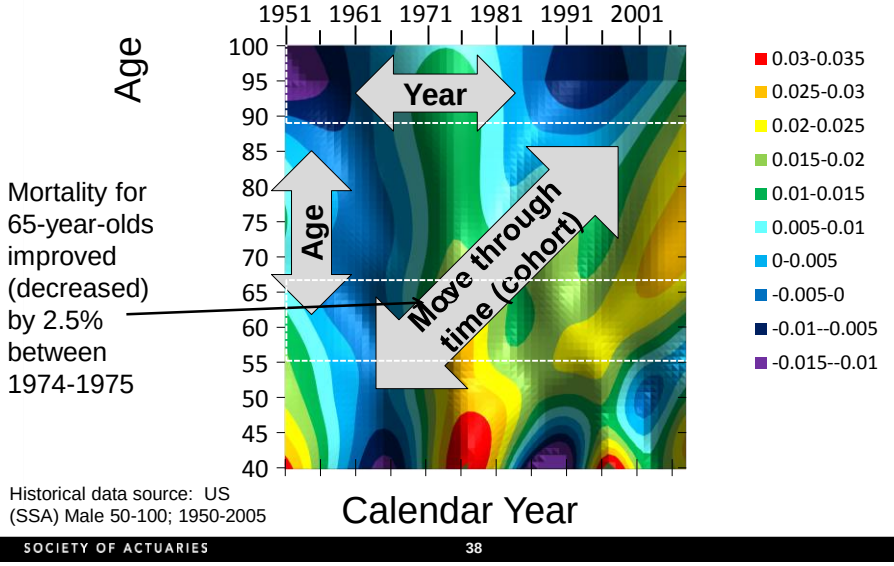
Observed Mortality Improvement and Previous Assumptions

Mortality Improvement Rates



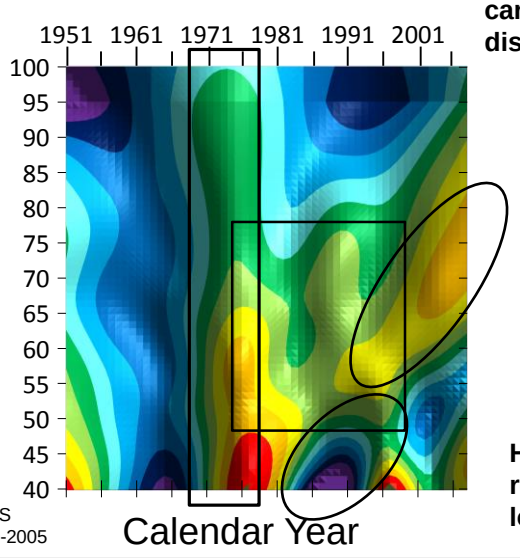
Mortality for 65-year-olds improved (decreased) by 2.5% between 1974-1975

Historical data source: US (SSA) Male 50-100; 1950-2005

Males: MI Rates

Medicare began in 1966; mortality improved for all ages.

Lagged effect of 1960's anti-smoking campaigns



Statin drugs reduced cardiovascular disease

- 0.03-0.035
- 0.025-0.03
- 0.02-0.025
- 0.015-0.02
- 0.01-0.015
- 0.005-0.01
- 0-0.005
- -0.005-0
- -0.01--0.005
- -0.015--0.01

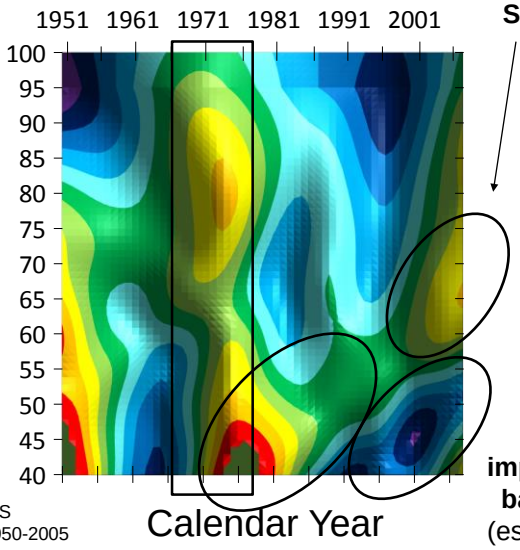
HIV/AIDS reduced longevity

Historical data source: US (SSA) Male 50-100; 1950-2005

Females: MI Rates

Medicare "Mountain Range"

"Silent generation" enjoyed relatively high improvement rates



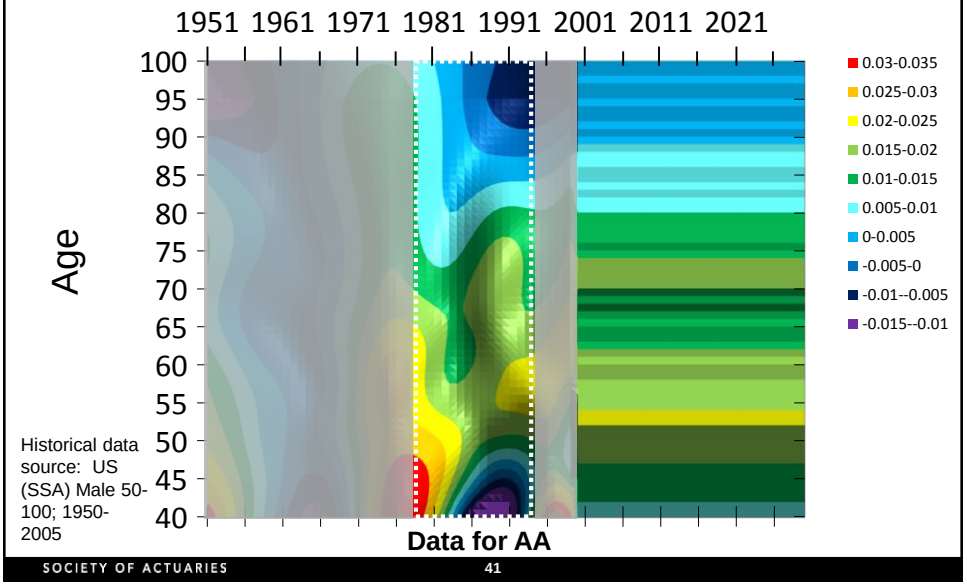
Statins

- 0.03-0.035
- 0.025-0.03
- 0.02-0.025
- 0.015-0.02
- 0.01-0.015
- 0.005-0.01
- 0-0.005
- -0.005-0
- -0.01--0.005
- -0.015--0.01

Less improvement for baby boomers (esp. born ~1955)

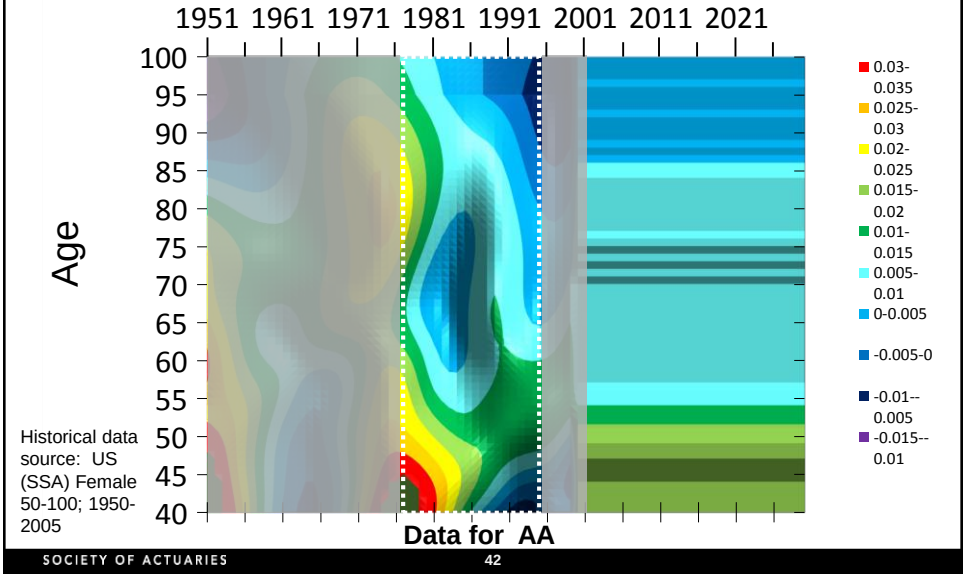
Historical data source: US (SSA) Female 50-100; 1950-2005

Males: Observed MI and AA



Historical data source: US (SSA) Male 50-100; 1950-2005

Females: Observed MI and AA



Historical data source: US (SSA) Female 50-100; 1950-2005

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New Mortality and Mortality Improvement Assumptions

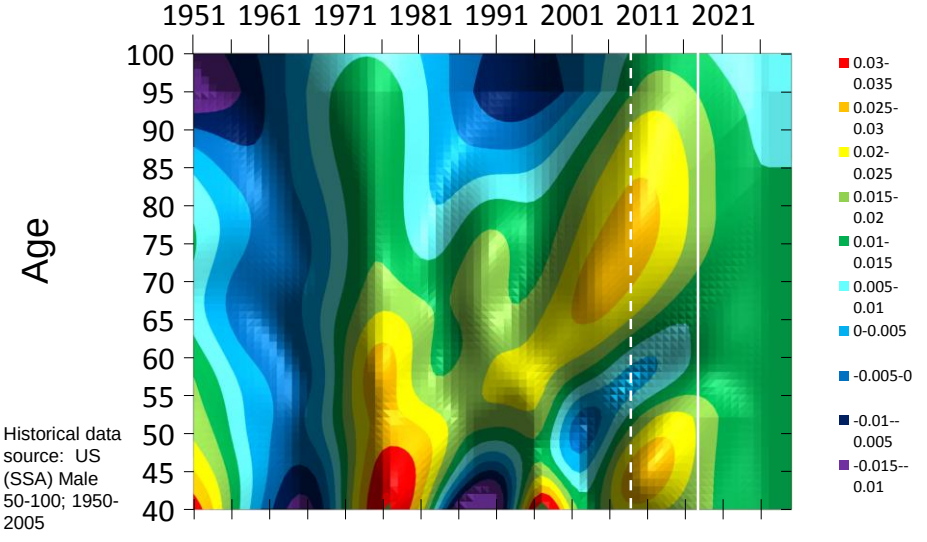
New Mortality Table for Pension Plans

- Base table RP-2014 replaces RP-2000
  - Private pension plan experience over 2004 – 2008 totaling 10.2 million life-years
  - Rates adjusted to 2014 using the new MP-2014 projection scale
- Variations for blue/white collar employees and annuitants, by benefit amount and disabled persons
- Intended for use with pension plans; may not be appropriate for insured products

New Mortality Improvement Scale for Pension Plans

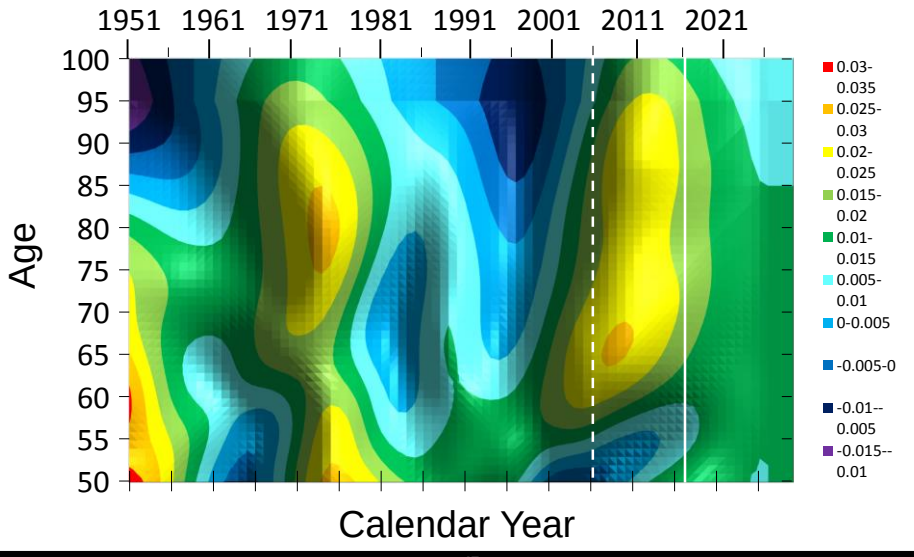
- Scale MP-2014 replaces Scales AA and BB
- Two dimensions for each gender reflect cohort variations in mortality improvement:
  - Age
  - Calendar year
- Intended for use with pension plans; may not be appropriate for insured products

Males: Observed MI and MP-2014

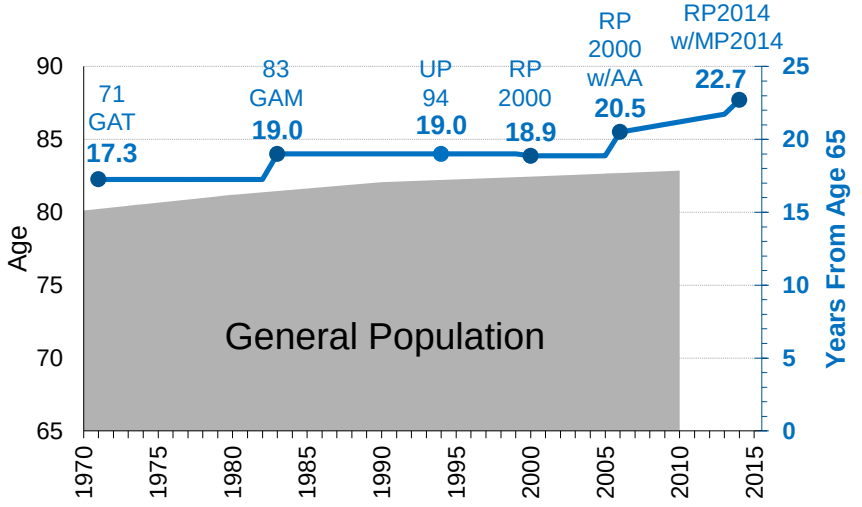


Historical data source: US (SSA) Male 50-100; 1950-2005

Females: Observed and MP-2014

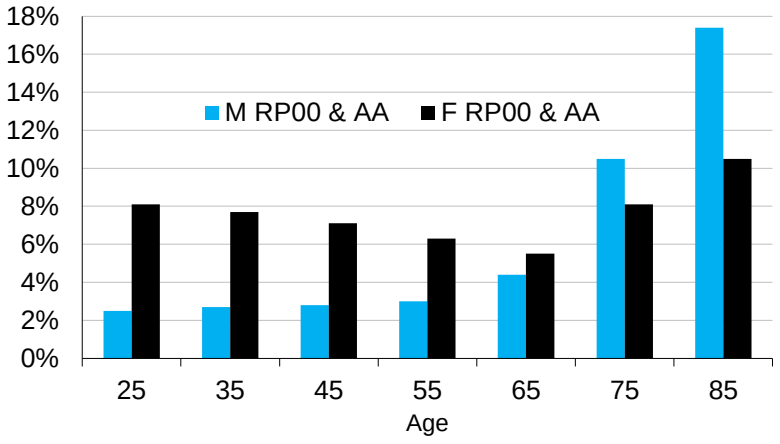


Remaining Life Exp. At 65



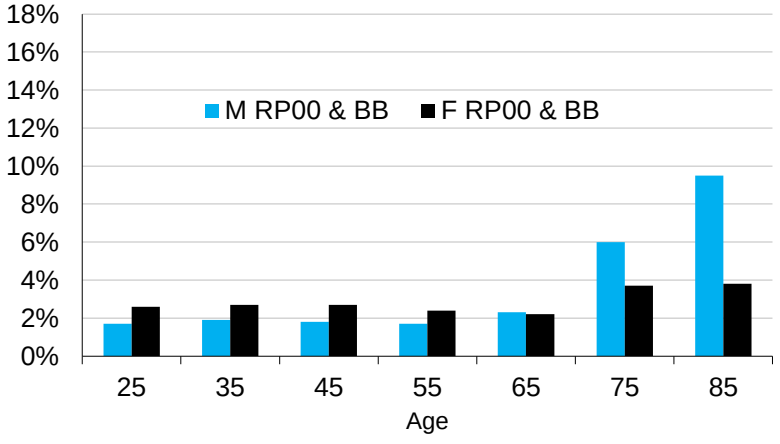
Population Data: SSA Actuarial Study 120 – Periods 1900-2000, non-decade years interpolated. Mortality Tables: 71GAT, 83GAM, UP-94,RP-2000 unprojected, RP-2000 (AA generational), RP-2014 (MP-2014 generational). All 50% male, 50% female.

Financial Impact of New Tables From RP2000 (AA) Percentage Increase in Liability*



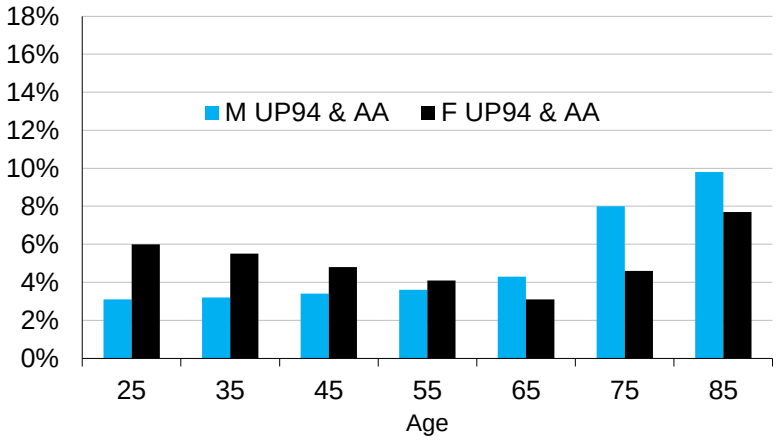
* Monthly deferred-to-62 annuity due values at 6.0% interest; for RP-2014, Total Employee Rates through age 61 and Healthy Annuitant Rates for ages 65 and above; RP-2000 combined rates with generational projection

Financial Impact of New Tables From RP2000 (BB) Percentage Increase in Liability*



* Monthly deferred-to-62 annuity due values at 6.0% interest; for RP-2014, Total Employee Rates through age 61 and Healthy Annuitant Rates for ages 65 and above; RP-2000 combined rates with generational projection

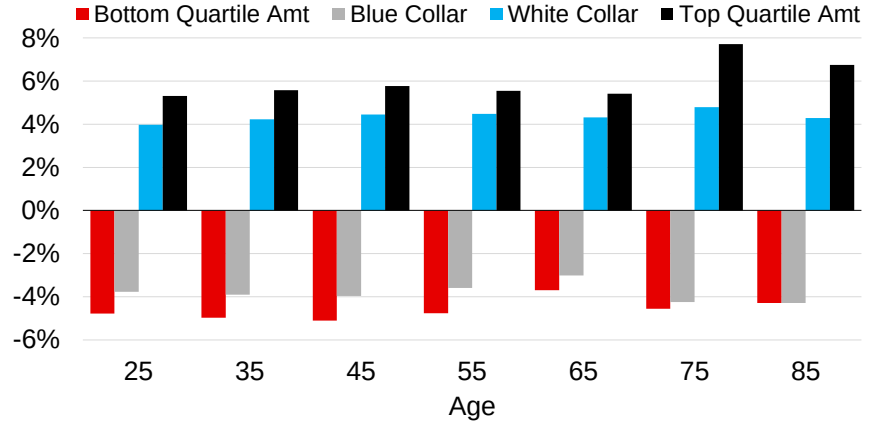
Financial Impact of New Tables From UP94 (AA) Percentage Increase in Liability*



* Monthly deferred-to-62 annuity due values at 6.0% interest; for RP-2014, Total Employee Rates through age 61 and Healthy Annuitant Rates for ages 65 and above; RP-2000 combined rates with generational projection

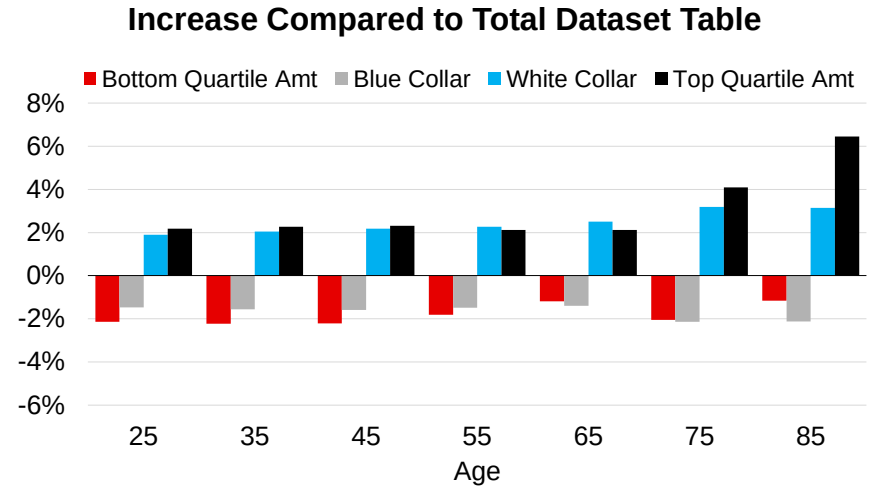
Liability* Comparison of RP-2014 Specialized Tables: Male

Increase Compared to Total Dataset Table



*Monthly deferred-to-62 annuity due values using RP-2014 with MP-2014 generational projection and 6%

Liability* Comparison of RP-2014 Specialized Tables: Female



*Monthly deferred-to-62 annuity due values using RP-2014 with MP-2014 generational projection and 6%

Summary

- Updated assumptions better reflect the way that longevity has been improving
- New tables enable more effective valuation and modeling
- Specialized tables enable reflection of certain specific characteristics that may be present in a pension plan population