Longevity Underwriting

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Presented to ACHS Meeting

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Agenda

- ✓ **Introduction**
- ✓ **Underwriting Basics**
- ✓ **Longevity Underwriting of Pensions**
- ✓ **Future of Longevity Underwriting**
- ✓ **Wrap-Up**

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Introduction

✓ **Career**
- Variable Annuities
- Corporate Borrowing
- Permanent Life Insurance
- Institutional Income
- **Pension Risk Transfer**

✓ **Personal**
- Good for Life Expectancy: Nonsmoker, Employed, & Moderate Exercise
- Bad for Life Expectancy: Red Meat, Sugar, & Sleep Deprivation
- Appointed Life Expectancy Expert for Family & Friends

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What is Underwriting?

- ✓ **Historical Example**: Lloyd's & Seafaring
- ✓ **Modern Example**: Peter Keating, "Underwriting with the Stars", ESPN The Magazine 10/19/2009

Athlete No. 3: Takeru Kobayashi, competitive eater, Age 31

Estimated yearly income: $150,000

Premium part: Stomach

Injury history: Arthritic jaw, diagnosed in June of 2007

Insurance quote: Coverage Denied

Getty Images

The insurers say:

No one will consider any part of an athlete whose job involves inhaling 57 cow brains in 15 minutes. Policies exclude "exposure to exceptional danger except in an attempt to save human life" for good reason.

Athlete No. 7: Wayne Rooney, soccer star, Age 32

Estimated yearly income: $20.4 million

Premium part: Feet

Injury history: Broken metatarsal in right foot, June of 2004 and April of 2006; Broken metatarsal in left foot, August of 2007

Getty Images

Insurance quote: $510,000

The insurers say:

He's so valuable to Manchester United that before the 2010 World Cup, the national team may end up having to insure his lower body for the club team.

Risk Identification → Risk Quantification → Premium & Terms

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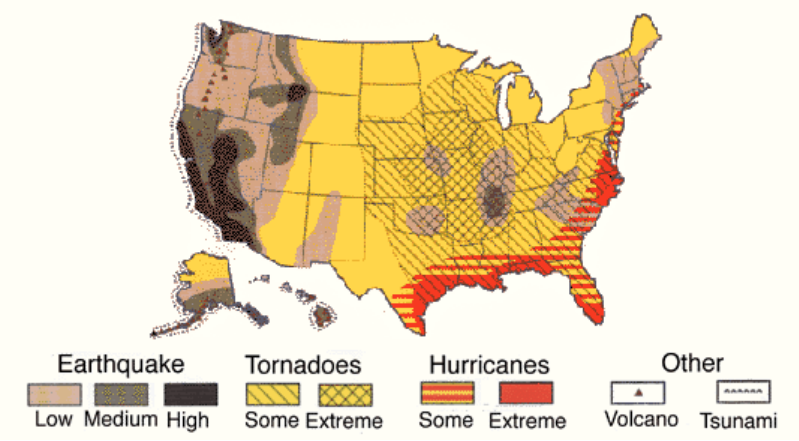
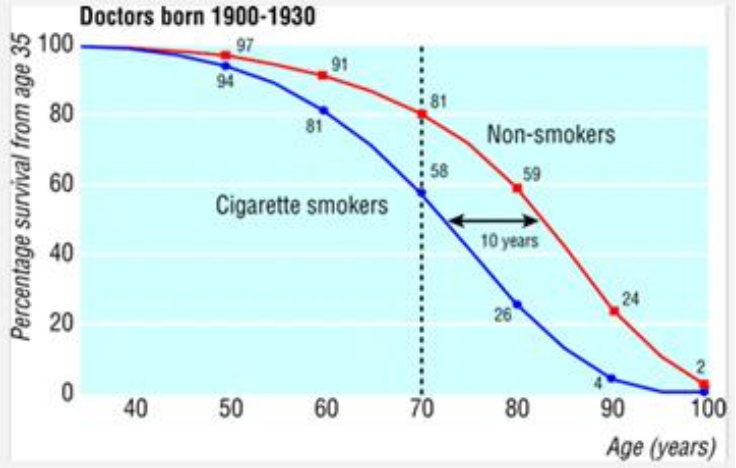
Who Uses Underwriting?

	Group/Individual Policy	Short-Term/Long-Term Contractual Premium	Primary Insurance Risk
Property & Casualty	Individual	Short-Term	Peril Occurrence
Healthcare	Group	Short-Term	Morbidity
Group Life/Disability	Group	Short-Term	Mortality/Morbidity
Individual Life	Individual	Long-Term	Mortality
Structured Settlements	Individual	Long-Term	Longevity
Group Annuities	**Group**	**Long-Term**	**Longevity**

Note: The term underwriting is used in non-insurance contexts such as personal banking (mortgages, credit cards, etc.) or investment banking (IPO's, debt issuances, etc.)





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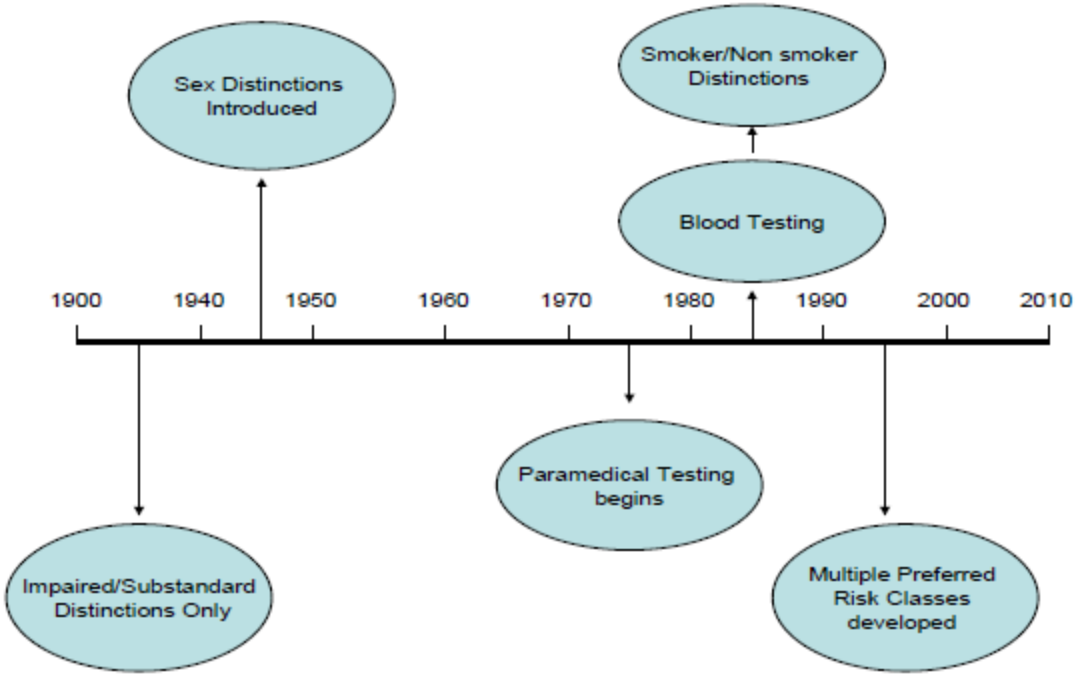
Who Uses Underwriting?

Evolution of Individual Life Underwriting

Chart 10: Development of Underwriting and Risk Classification Techniques in the US



Source: Towers Watson, "Global Mortality Improvement Experience and Projection Techniques", June 2011

Recent advancements allowed Group Annuities to move past 1970!

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Why is Underwriting Important?

Follow the Yellow Brick Road: Using underwriting techniques can lead to superior risk selection that can create top-line (market share) and bottom-line (earned margin) growth.

"First Mover" One Year Term Life Insurance Underwriting Example

No Underwriting					
	Population Percentage	*Market Share*	*True Liability*	*Charged Premium*	*Earned Margin*
Non-Smokers	75%	10%	$950	$1,010	6.3%
Smokers	25%	10%	$1,150	$1,010	-12.2%
Total	**100%**	**10%**	**$1,000**	**$1,010**	**1.0%**
With Underwriting					
	Population Percentage	*Market Share*	*True Liability*	*Charged Premium*	*Earned Margin*
Non-Smokers	75%	15%	$950	$965	1.6%
Smokers	25%	5%	$1,150	$1,162	1.0%
Total	**100%**	**13%**	**$970**	**$985**	**1.5%**

"The Wicked Witch": Subsidization

"The Good Witch": Differentiation

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Base Mortality

Before discussing the drivers of life expectancy differences, we must be at a proper life expectancy starting point as defined by our Base Mortality & Mortality Improvement assumptions.

✓ Represent Plan Population Demographics?
- Data Sources: Plan, Proprietary, Industry, or Population
- Previous Reliance on "Netting" or "Diversification" of New Business

✓ Data Quality
- Error Checking
- IBNR

✓ Credibility
- Quantitative
- **Qualitative**: Change in Company or Plan?

Percentage of Plans with Lump Sum Option

Source: Department of Labor

1991	1993	1995	1997	2000	2003	2005
14%	10%	15%	23%	43%	48%	52%

✓ **Level**

✓ **Shape**

Scenario	Year 1 qx	Year 2 qx	Year 3 qx	tpx	Immediate SLA @3%
1	4.0%	4.0%	4.0%	88.5%	2.61
2	2.5%	4.0%	5.5%	88.5%	2.63
Scen 2 / Scen 1 Liability PV					1.1%

✓ Analytic Metrics
- Mortality Ratios
- Life Expectancy
- Liability Impact

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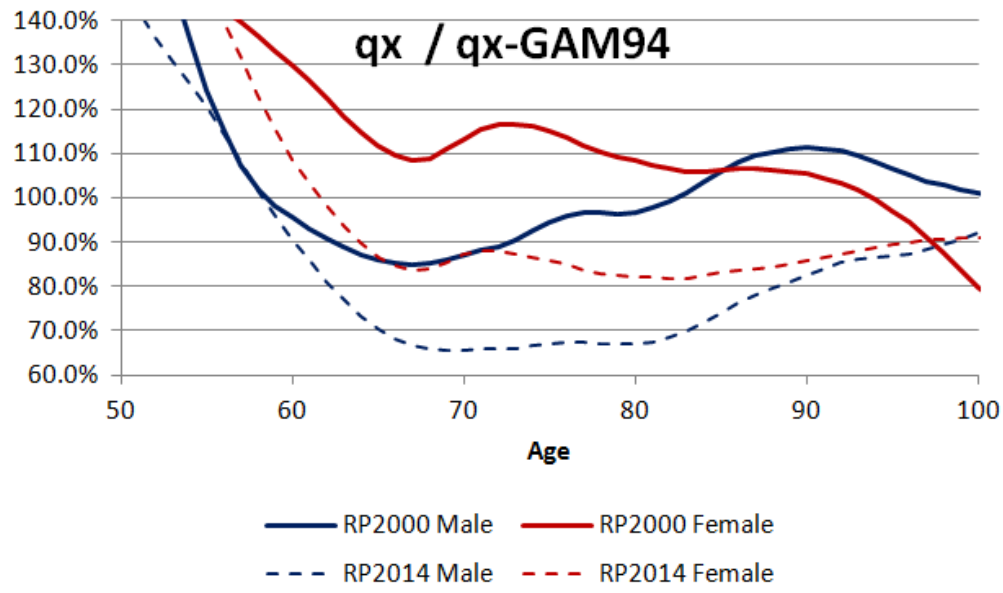
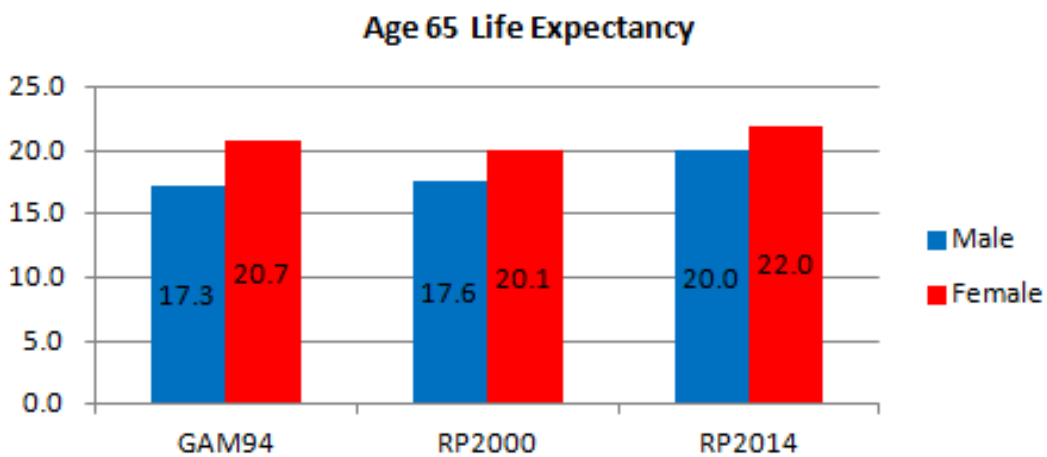
Base Mortality

Graph/Charts Inferences

- ✓ Younger & Older Ages
- ✓ Female Dataset Differences
- ✓ Mortality Improvement





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Mortality Improvement

Mortality improvements are similar to interest rates in that they are volatile, difficult to manage, assumption-driven when trying to forecast, and result in reduction factors ~ discount factors.

- ✓ Represent Plan Population Demographics?
  - Data Sources: Plan, Proprietary, Industry, or Population
  - Difficult to Evaluate

- ✓ Credibility

- ✓ One Dimensional
  - Gender
  - Age

- ✓ Two Dimensional
  - Initial Rates: Data Source, Smoothing Method, & Age-Period-Cohort Effects
  - Convergence: Length & Slope
  - Long-Term Rates

- ✓ Analytic Metrics
  - Line Graphs & Heat Maps
  - Life Expectancy
  - Liability Impact

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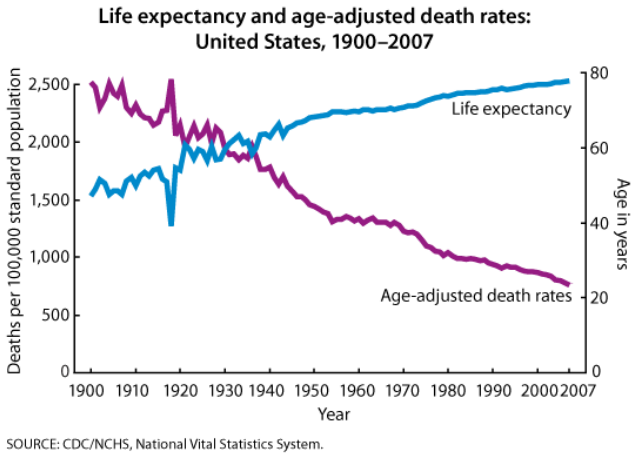
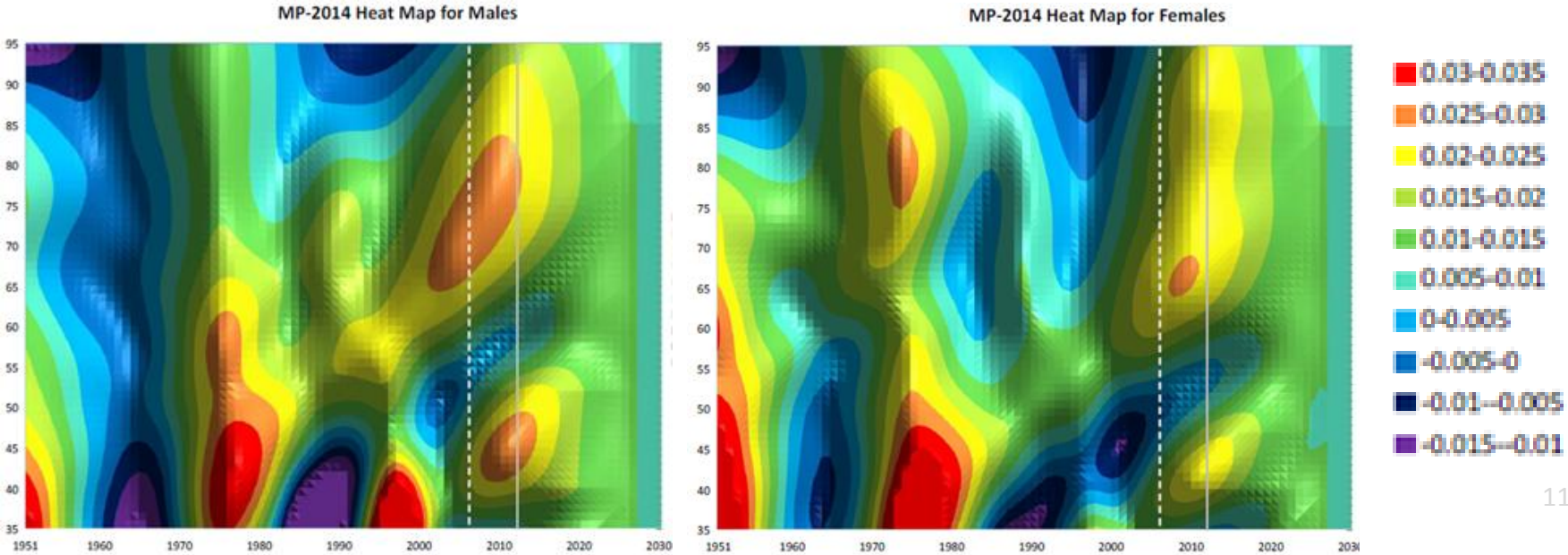
Mortality Improvement

Graph/Charts Inferences

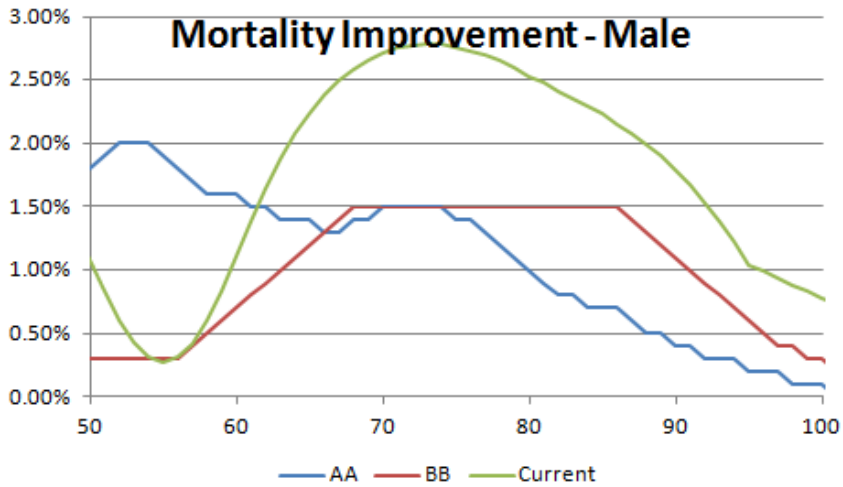
- ✓ Period Effects: Medicine, Smoking Adoption, & Medicare
- ✓ Cohort Effects: Wealth, Smoking Cessation, & Obesity
- ✓ Age Effects: Ages 85+
- ✓ Gender: Male vs. Female
- ✓ MP-2014 Projection: Improvements Increase Than Decrease & Little Age Wear Off

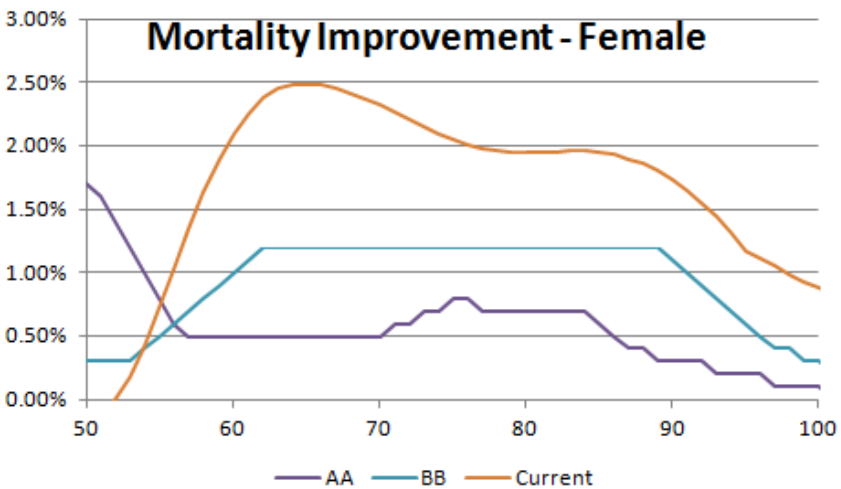


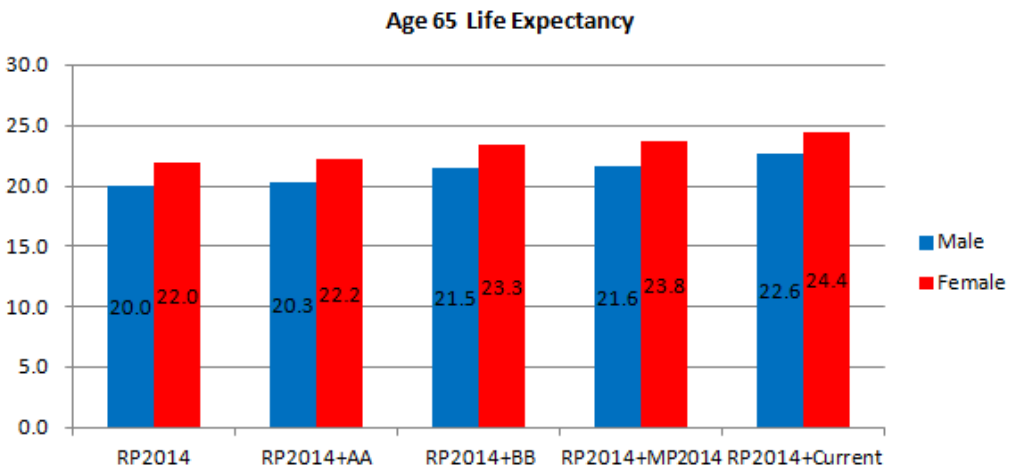


Mortality Improvement

Mortality improvements can go up, come down (RP-2014+MP-2014), or stay the same (RP2014+Current). The past three improvement scales have trended upwards.







Longevity Underwriting Drivers (LUD)

- Age
- Male / Female
- Primary / Dependent
- Retiree / Deferred
- Pension Amount
- State of Residence
- Lump Sum Option
- In-Pay / Contingent
- Industry
- Plan Type
- Hourly / Salary
- Payment Form / Retirement Age

Data Availability, Accessibility, Quality, & Credibility are Critical!

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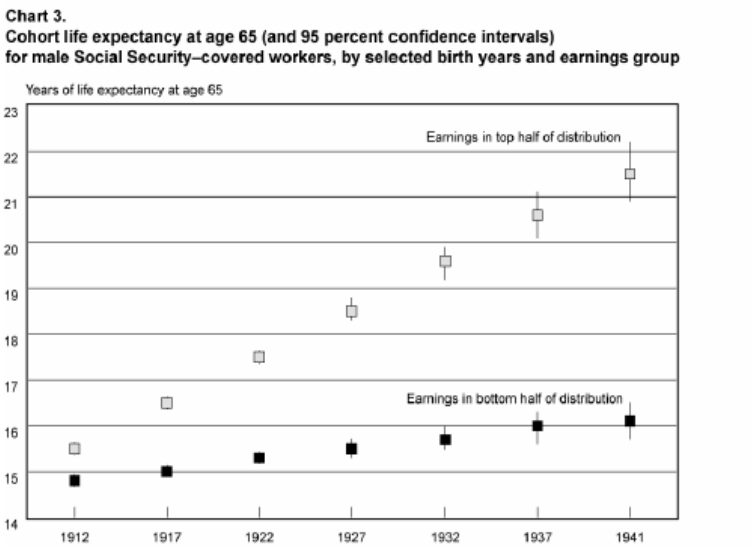
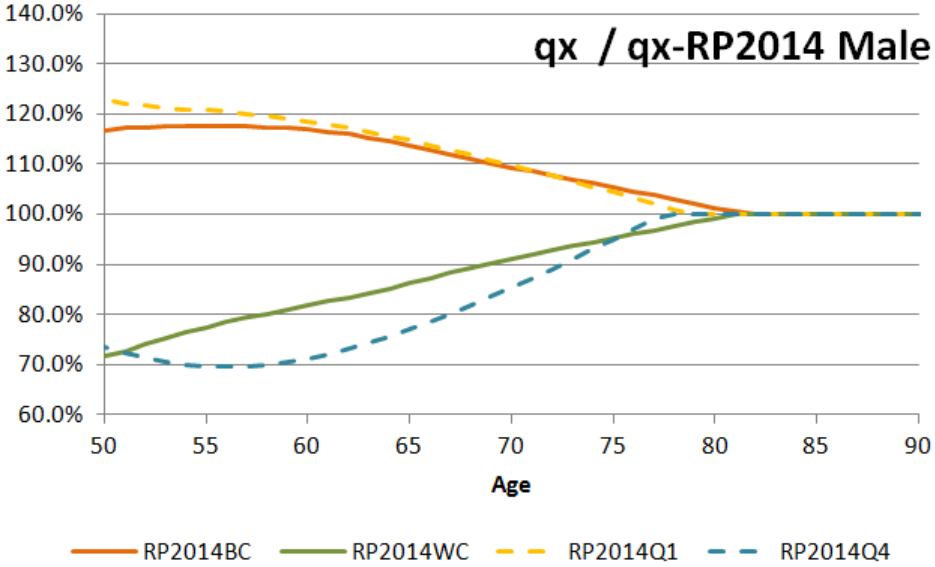
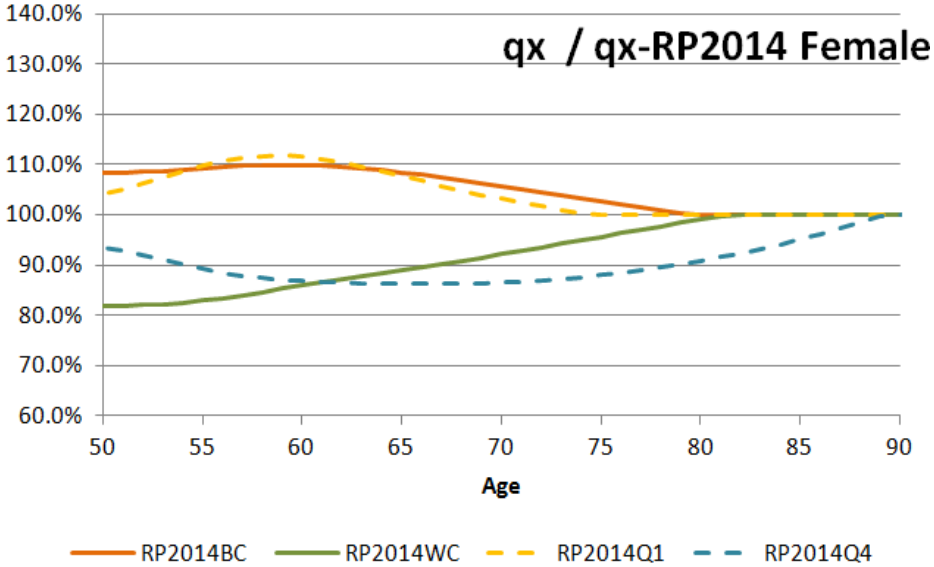
LUD: Pension Amount & Hourly(BC)/Salary(WC)

Graph/Charts Inferences

- ✓ Age Reduces Life Expectancy Inequality
- ✓ Females Less Differentiated by Wealth
- ✓ Pension Amount Imperfections
- ✓ Hourly/Salary Exceptions
- ✓ Improvement Divergence



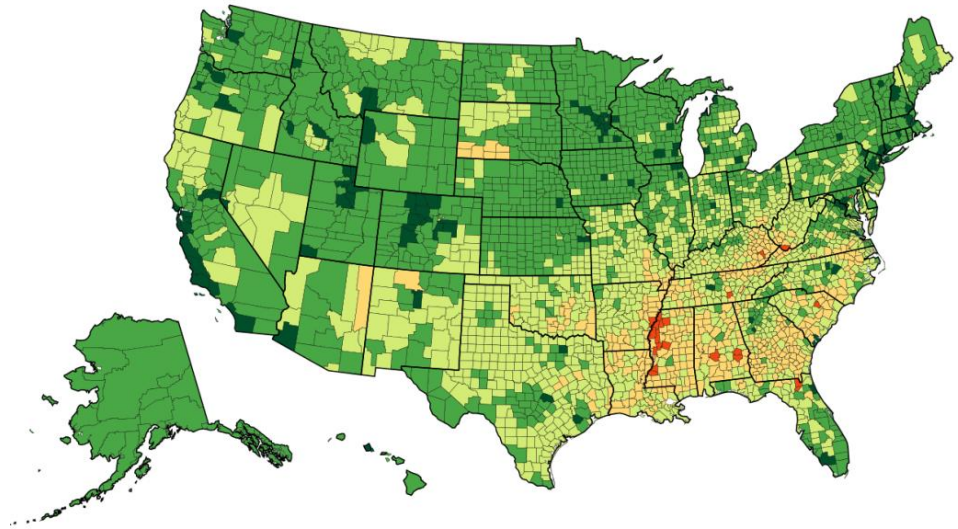




LUD: State of Residence

Causation or Correlation?

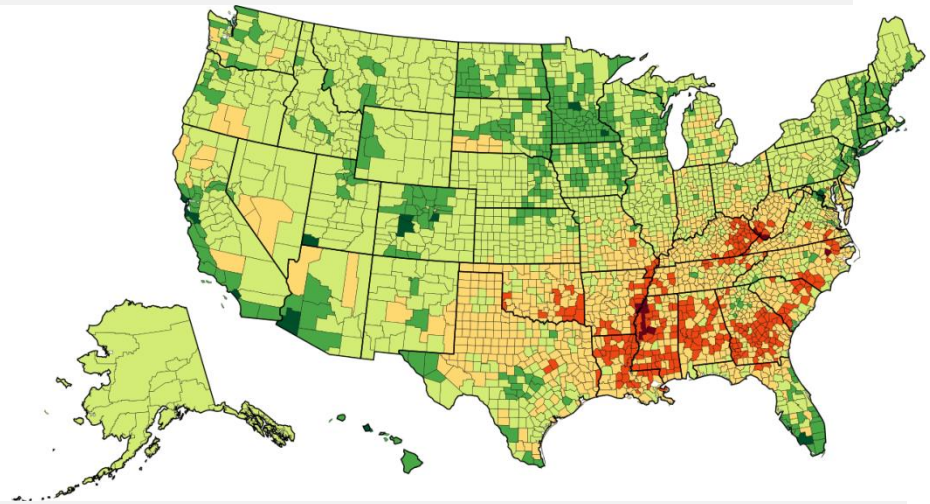
Need to Obtain Residual Impact



Male Life Expectancies 2009

Source: IHME & CDC

61.7 - 65 years | 65.1 - 68.3 years | 68.4 - 71.6 years | 71.7 - 74.9 years | 75 - 78.2 years | 78.3 - 81.6 years



Female Life Expectancies 2009

Source: IHME & CDC

73.2 - 75.3 years | 75.4 - 77.4 years | 77.5 - 79.6 years | 79.7 - 81.7 years | 81.8 - 83.8 years | 83.9 - 86 years

LUD: Industry & Retiree/Deferred

Graph/Charts Inferences

- ✓ Working is good for you…
- ✓ ….but how good depends on where you work

Table 5-4
Relative Mortality for Healthy Annuitants by Industry Code

	Age Band			
Industry – Code and Name	60-64	65-69	70-74	75-79
Male				
37 Transportation	1.140	1.091	1.022	1.041
36 Electronic Equipment	0.993	0.940	0.978	0.980
48 Communications	0.925	1.018	0.975	0.942
29 Petroleum	0.786	0.804	0.871	0.906
33 Primary Metal Industries	1.250	1.322	1.305	1.184
28 Chemicals	1.026	0.993	0.952	1.011
26 Paper	0.936	1.078	1.045	1.090
13 Oil and Gas Extraction	0.778	0.806	0.836	0.732
Female				
37 Transportation	1.174	1.010	1.025	1.105
36 Electronic Equipment	1.027	0.839	0.796	1.042
48 Communications	0.953	0.914	1.006	0.911
29 Petroleum	1.195	0.433	0.600	0.778
33 Primary Metal Industries	1.484	1.152	1.047	0.895
28 Chemicals	0.919	1.249	1.120	1.052
26 Paper	0.305	0.800	1.054	0.840
13 Oil and Gas Extraction	1.421	0.932	1.158	0.972

Figure 4-1
Comparison of RP-2000 Mortality Rates by Participant Status
Males Ages 50 - 69

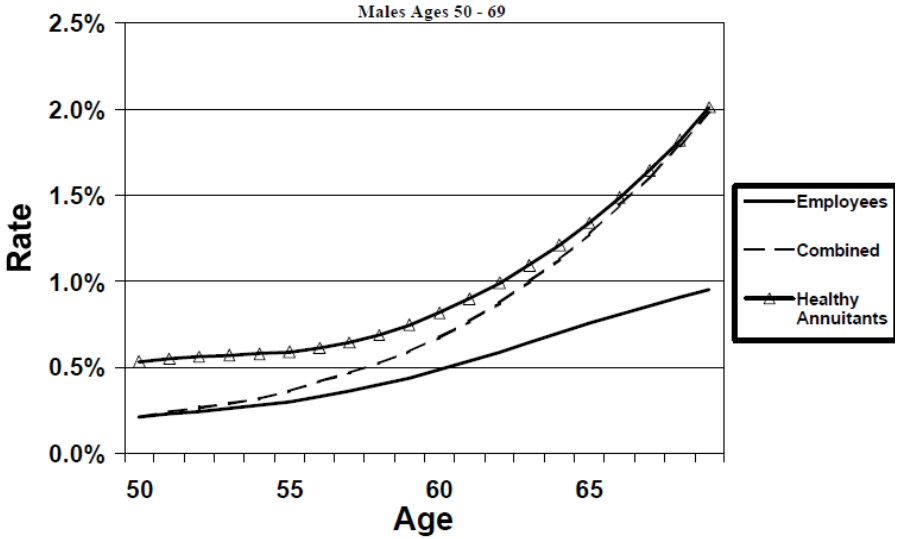
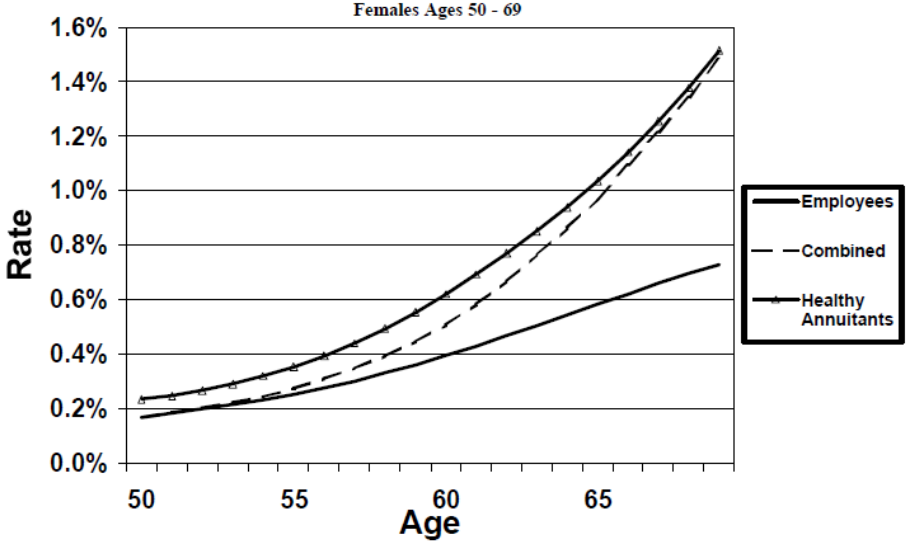


Figure 4-2
Comparison of RP-2000 Mortality Rates by Participant Status
Females Ages 50 - 69



Future Of Longevity Underwriting

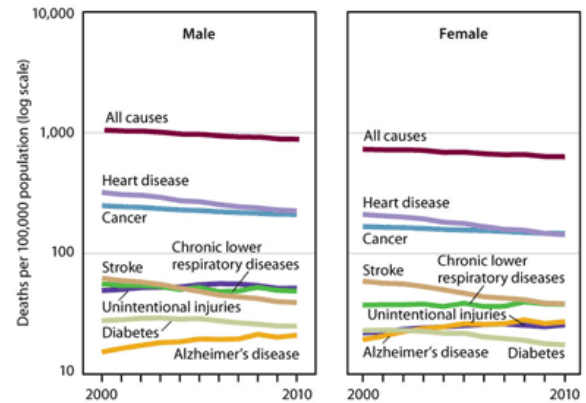
- ✓ **Modeling**
  - Mortality Table Software
  - **Cause of Death**
  - Stochastic Mortality
  - Postcode
  - Consumer Data
- ✓ **Product Development (US)**
  - Plan Sponsor Education
  - Enhanced Annuities
  - Longevity Reinsurance
  - Securitization
- ✓ **Actuarial**
  - Pricing
  - Principles-Based Reserves
  - Capital

Table 3. Average annual mortality improvement by cause of death (1979–2007)
Source: Office of the Chief Actuary (2012)

Cause of death	Male	Female
Cardiovascular disease	2.49%	2.14%
Violence (including accidents)	0.84%	0.20%
Cancer	0.64%	0.16%
Respiratory diseases	−0.06%	−2.27%
Others	−0.85%	−1.57%

Mortality: Selected Causes of Death

Figure 3. Age-adjusted death rates for selected causes of death for all ages, by sex: United States, 2000–2010



Source: CDC/NCHS, *Health, United States, 2013*, Table 20. Data from the National Vital Statistics System (NVSS).

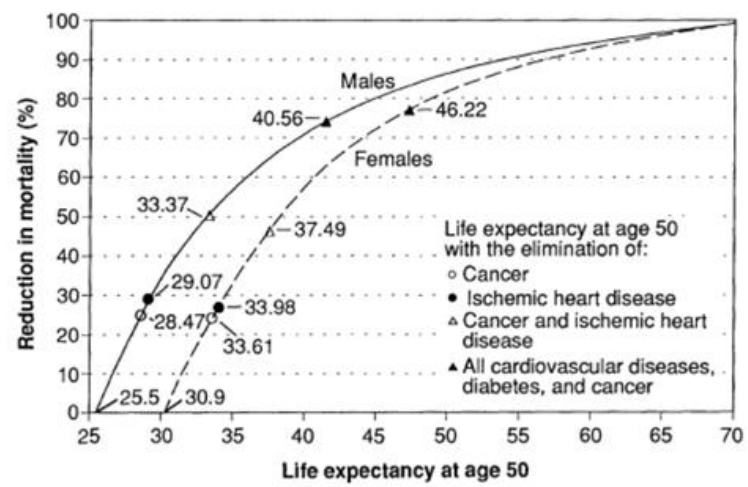


Fig. 3. Percentage of reduction in the conditional probability of death for the United States (from 1985 levels) required to produce a life expectancy at age 50 from 30 to 70 years.

Wrap-Up

- ✓ Underwriting is a critical tool for optimal risk selection & arbitrage prevention
- ✓ Prescribed industry mortality assumptions have quickly become outdated
- ✓ Longevity risk is a large and difficult risk to manage for pension plans
- ✓ Quality & quantity of data is the key for identifying longevity underwriting drivers
- ✓ Longevity underwriting is in its infancy

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