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"Dying On Time": Elderly Mortality and Pricing Implications

Vadim Marchenko, Chief Pricing Officer, Aurigen Re

June 20, 2014

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Agenda

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What is Life Expectancy?

Definition.

Life expectancy is the expected (in the statistical sense) number of years of life remaining at a given age.

Life Expectancy variations over time.

Sources used – Encyclopedia Britannica, and other sources, some with a questionable accuracy. Unless otherwise stated, it represents estimates of the life expectancies of the population as a whole. In many instances life expectancy varied considerably according to class and gender.
Life expectancy at birth takes account of infant mortality but not pre-natal mortality.

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Life Expectancy variations over time

Era	Life Expectancy at Birth (years)	Life Expectancy at Older Age
Upper Paleolithic	33	Based on the data from the recent hunter-gatherer populations, it is estimated that at age 15, life expectancy was an additional 39 years (total age 54).[10]
Neolithic[11]	20	
Bronze Age and Iron Age[12]	26	
Classical Greece[13]	28	
Classical Rome[14]	20–30	At age 10, life expectancy an additional 35 to 37 years (total age 45 to 47)
Pre-Columbian North America[15]	25–30	
Medieval Islamic Caliphate[16]	35+	
Medieval Britain[17][18]	30	At age 21, life expectancy additional 43 years (total age 64).[19]
Early Modern Britain[12]	25–40	
Early 20th Century[20][21]	31	
2010 world average[22]	67.2	

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Life expectancy increases with age as the individual survives the higher mortality rates associated with childhood. For instance, the table above listed the life expectancy at birth in Medieval Britain at 30. Having survived until the age of 21, a male member of the English aristocracy in this period could expect to live:

1200–1300: to age 64
1300–1400: to age 45 (due to the impact of the Black Death)
1400–1500: to age 69
1500–1550: to age 71

In general, the available data indicate that longer lifespans became more common recently in human evolution. This increased longevity is attributed by some writers to cultural adaptations rather than genetic evolution, although some research indicates that during the Neolithic Revolution natural selection favored increased longevity. Nevertheless, all researchers acknowledge the effect of cultural adaptations upon life expectancy.

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Life Expectancy – not a Life Span

Life expectancy is often confused with life span to the point that they are nearly synonyms; when people hear 'life expectancy was 35 years' they often interpret this as meaning that people of that time or place had short life spans.

More recently, at the height of the STOLI market, many fund managers, running STOLI portfolios, have confused the terms, often assuming everyone is expected to not survive past their life expectancy.

Statistically, at the advanced ages STOLI market targeted, a little more than 50% of the population is expected to survive past their life expectancy.

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Factors affecting Life Expectancy

From the modern actuarial prospective,

The following factors would impact life expectancy for a given individual:

The obvious factors are:

- Current age.
- Gender.
- Undewriting category (preferred, standard, table rating).

More technical factors:

- What is the underlying base mortality table ?
- Does base mortality grade toward general population and how fast?
- Expected levels of mortality improvement and for how long it applies?
- Does the mortality rating grade toward standard and how fast?

Numeric Example of Standard vs Table B

Face Amount	1,000,000	1,000,000
Gender	Male	Male
Issue Age	75	75
Use Factor Grading	YES	NO
Expected UW Class	Standard	Standard
Life Expectancy	15.2	14.4
Expected Age at Death	90.2	89.4
Expected PV of Premium	702,261	716,349
Expected PV of Claims	632,035	644,714
Expected PV of Profit	70,226	71,635
Expected Profit Margin	10.0%	10.0%
Actual Mortality Factor	Table B	Table B
Actual Life Expectancy	14.3	12.2
Actual exp. Age at Death	89.3	87.2
Actual PV of Premium	643,831	495,686
Actual PV of Claims	650,406	685,952
Actual PV of Profit	(6,575)	(190,266)
Actual Profit Margin	-1.0%	-38.4%
Monthly Premium at EAD	4,023	4,082
Ratio of M-ly Prem to 1% Profit	61%	82%

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Pricing YRT Reinsurance on Term versus Perm

Pricing YRT Reinsurance on a Term Product:
- Average age is fairly young.
- The total amount of premium collected per insured over the product lifetime is fairly stable.
- Number of deaths over the product horizon is fairly volatile and is they key determining factor of product profitability.
- The exact duration of death claims does not have significant impact on overall results.

Pricing YRT Reinsurance on a Perm Product, Elderly Ages:
- The total amount of Death Benefits paid per insured is fairly stable, many purchase insurance to be held to maturity.
- While the exact timing of death does not have significant impact on the Present Value of Claim payouts, it does make very material impact on the amount of premium collected.
- Even if the death occurs during the expected calendar year, a few months differential in the timing of death could have very material impact on profitability.

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Impact of Mortality Improvement

Face Amount	1,000,000	1,000,000	1,000,000	1,000,000
Gender	Male	Male	Male	Male
Issue Age	75	75	75	75
Use Factor Grading	YES	YES	YES	YES
Expected UW Class	Standard	Standard	Standard	Standard
Mortality Improvement Adj.	100%	100%	0%	100%
Life Expectancy	15.2	15.2	14.1	15.2
Expected Age at Death	90.2	90.2	89.1	90.2
Expected PV of Premium	702,261	702,261	724,414	702,261
Expected PV of Claims	632,035	632,035	651,972	632,035
Expected PV of Profit	70,226	70,226	72,441	70,226
Expected Profit Margin	10.0%	10.0%	10.0%	10.0%
Actual Mortality Factor	Standard	Table C	Table B	Table B
Mortality Improvement Adj.	0%	100%	0%	100%
Actual Life Expectancy	14.1	13.8	13.1	14.3
Actual exp. Age at Death	89.1	88.8	88.1	89.3
Actual PV of Premium	599,524	616,516	653,973	643,831
Actual PV of Claims	651,972	659,093	671,667	650,406
Actual PV of Profit	(52,448)	(42,577)	(17,694)	(6,575)
Actual Profit Margin	-8.7%	-6.9%	-2.7%	-1.0%

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Measuring Mortality Improvement in Population

Mortality Study 1			Death Rate
	Exposure	Deaths	Per 1,000
Attained Age 55	1,000,000	4,000	4
Attained Age 56	1,000,000	4,000	4
Total	2,000,000	8,000	4
Mortality Study 2			Death Rate
	Exposure	Deaths	Per 1,000
Attained Age 55	1,000,000	3,000	3
Attained Age 56	1,000,000	5,000	5
Total	2,000,000	8,000	4
Does Mortality study 2 indicate:			
A) Deterioration in population mortality			
B) Improvement in population mortality			
C) No change in population mortality			

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Questions?

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Aurigen USA Holdings Inc - Team

Michael Pado - Chief Executive Officer

- Email: Michael.Pado@AurigenRe.com
- Office: 732.212.6861 Mobile: 732.788.1933

Vadim Marchenko - Chief Pricing Officer

- Email: Vadim.Marchenko@AurigenRe.com
- Office: 203.282.2304 Mobile: 203.945.6852

Cristina Downey - Chief Underwriting Officer

- Email: Cristina.Downey@AurigenRe.com
- Office: 732.212.6892 Mobile: 203.428.5596

Hiram Gonzalez - Account Executive (not in attendance)

- Email: Hiram.Gonzalez@AurigenRe.com
- Office: 732.212.6874 Mobile: 972.345.4381

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