Evaluating Life Expectancy Estimates

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Agenda

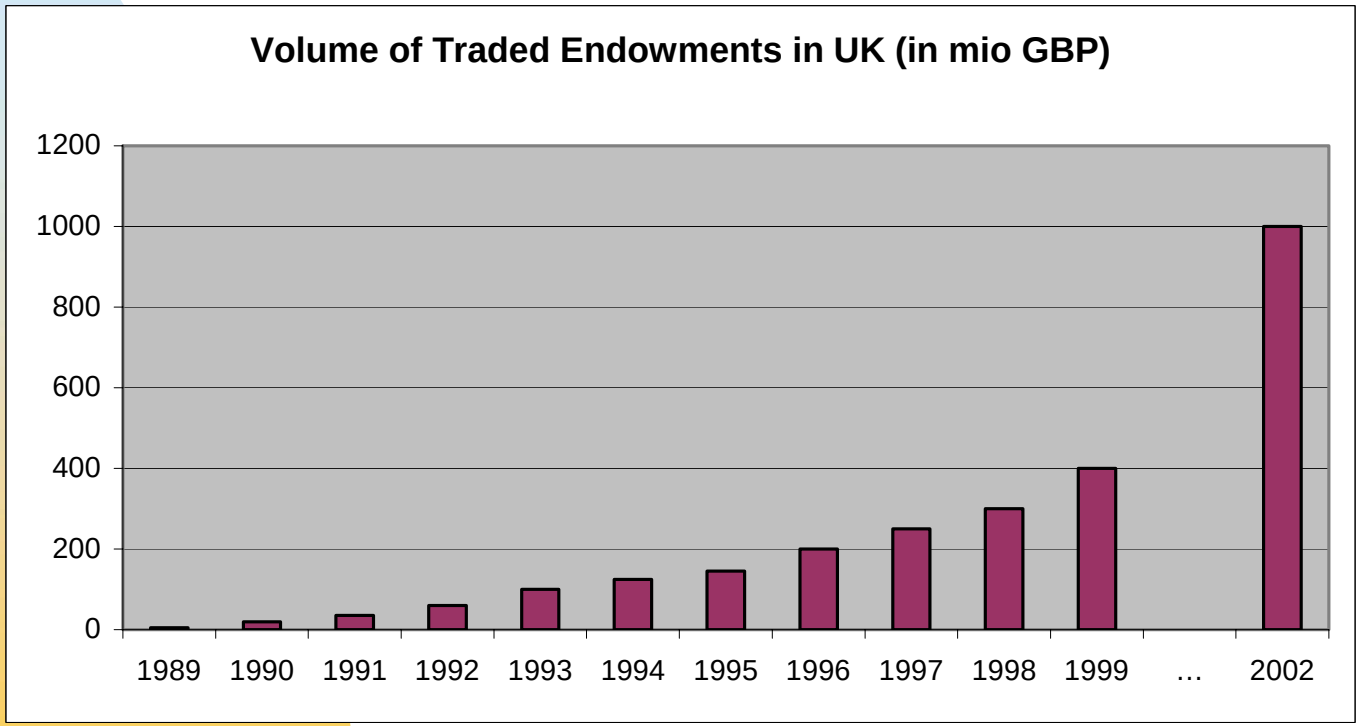
- Traded Life Insurance – Europe vs. the US
- **The importance of Life Expectancy Estimates for Life Settlements**
- **Actuarial Issues of Life Expectancy Estimates**
- **How to evaluate Life Expectancy Estimates**
  - Detour: How not to
  - Actual to expected
  - Actual to distribution
  - Analyses of the shape of the mortality curve
- **Summary**

Traded Life Insurance: Europe vs. the US

- **In many large European markets (in particular UK, Germany) there is a history of traded life insurance**
- **History in the UK**
  - 1854: court ruling
    - The “Life Insurance Act“ of 1774 (requiring insurable interest) is relevant only at the time the contract is taken out
    - → Trading of insurance contracts possible
  - significant market developed in the 1980s (brokers, auctioneers)
  - 1989: first market maker
  - 1992: Association of Policy Market Makers founded
    - Lobby work resulted in law:
      When insured wants to cancel a policy, insurer has to inform her about the secondary market
  - also 1992: First TEP-fund (TEP = Traded Endowment Policy)

Traded Life Insurance: Europe vs. the US

- **Volume in UK**



Traded Life Insurance: Europe vs. the US

- **History and Volume in Germany**
  - Development started in 1999 (cash.life – still market leader)
  - Current volume: unknown but large potential for growth
    - Market leader buys about €300m in surrender values p.a.
    - Insurers pay over €12bn in surrender values p.a.
  - Recently: Many so-called closed funds with high fee structure
    - Unclear if return of the policies can make up for these fees
    - Leverage within these funds vs. marketing story as low-risk investments

Traded Life Insurance: Europe vs. the US

- **Policies in UK and Germany**
  - Type of policies: Endowment or Unitized With Profits
    - Usually regular (not flexible) premium
    - Fixed death benefit
    - Maturity usually at age 50-70 of insured
      - Traded policies: 2-15 years remaining to maturity
    - Maturity benefit (if insured still alive):
      - guaranteed maturity benefit + non guaranteed bonus
      - bonus depends on return insurer's assets
  - Details about guarantees and surplus distribution differ in different markets

Traded Life Insurance: Europe vs. the US

- **Policies in UK and Germany**
  - Why does it make sense to buy such policies?
    - Policies have high up-front charges
    - Part of the bonus not included in surrender value
    - Consequences:
      - Return in the last years is higher than in the first years
      - Attractive return if policy is bought close to maturity
        - even if purchase price exceeds surrender value
  - But: Turbulent capital markets may lead to reduction of surplus and thus lower returns
    - → Correlation with capital markets!

Traded Life Insurance: Europe vs. the US

- **Differences between TEPs and life settlements**

TEPs	life settlements
"Arbitrage" between market interest rates and insurers' bonus rates	"Arbitrage" between individual mortality probabilities and insurers' mortality tables
You know when you get the benefit but you do not know the amount	You know the amount of the benefit but not when you get it (and how many premiums you have to pay)
Return is highly correlated with capital markets	Return is (almost) uncorrelated to capital markets
Different policies are correlated since all insurers invest in the same capital markets	Different policies are (almost) uncorrelated
Worst case: Guaranteed maturity benefit	Worst case: ???

Traded Life Insurance: Europe vs. the US

- **The life settlement market is entirely different to the TEP market**

- **There are many TEPs but almost no life settlements in Europe**
  - Only very few seniors have policies with high death benefit
  - → Market similar to US (senior) life settlements can not exist
  - Thus, Europeans invest either in European TEPs or in US life settlements

- **→ That's why Europeans who are interested in life settlement investments buy US policies**

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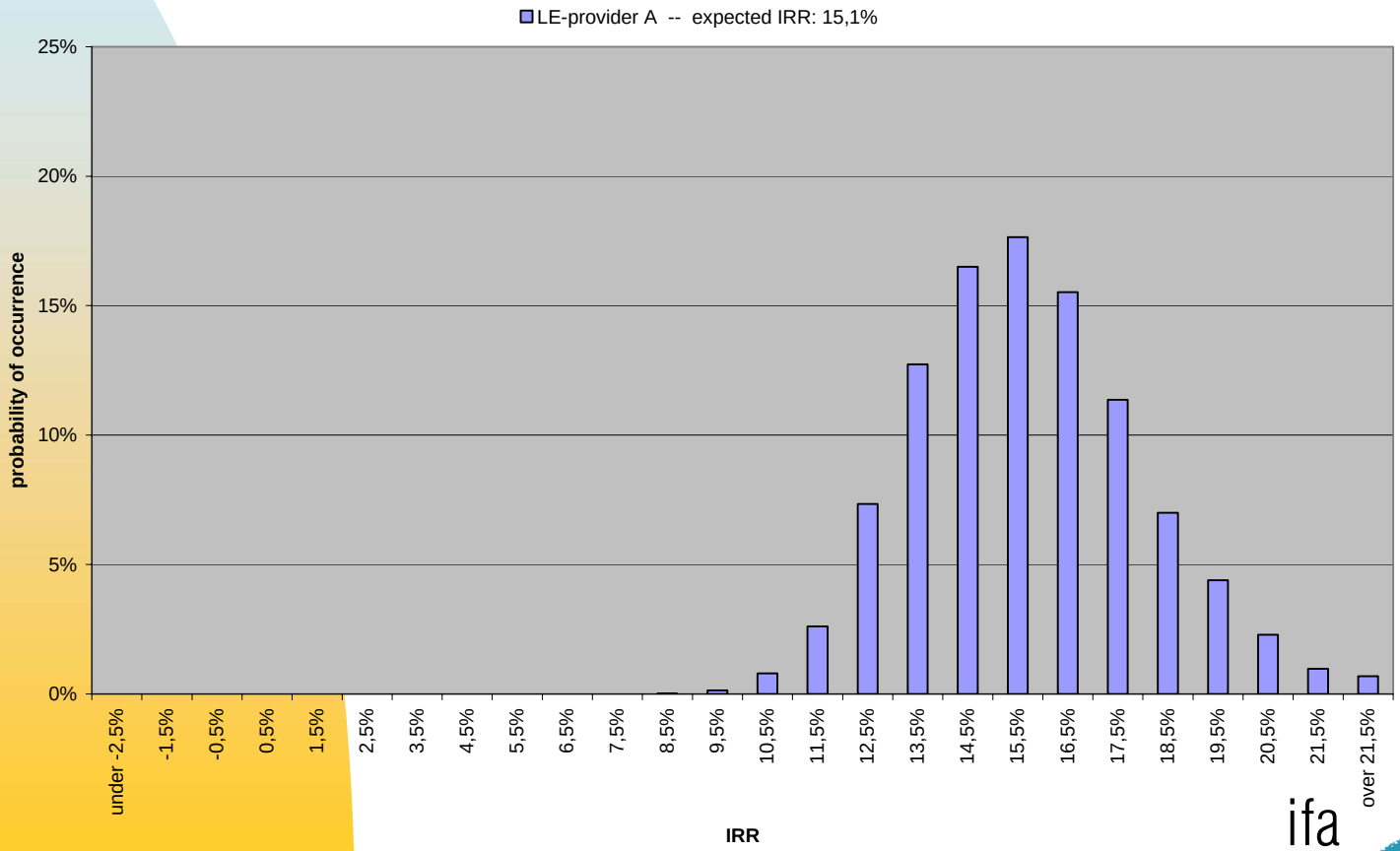
Life Expectancy Estimates and Life Settlements

- **A correct assessment of Life Expectancies is essential, in particular for investors**
  - Example
    (real policies from different portfolios and real LE estimates):

    - An investor buys a portfolio of 125 policies for a certain price.
    - He relies on the projections of LE-provider A
    - The projections give a mortality probability for each year
      - → So the investor knows for each policy which return it will achieve with what probability
      - → With suitable mathematical tools, he can calculate which return the portfolio will achieve with what probability

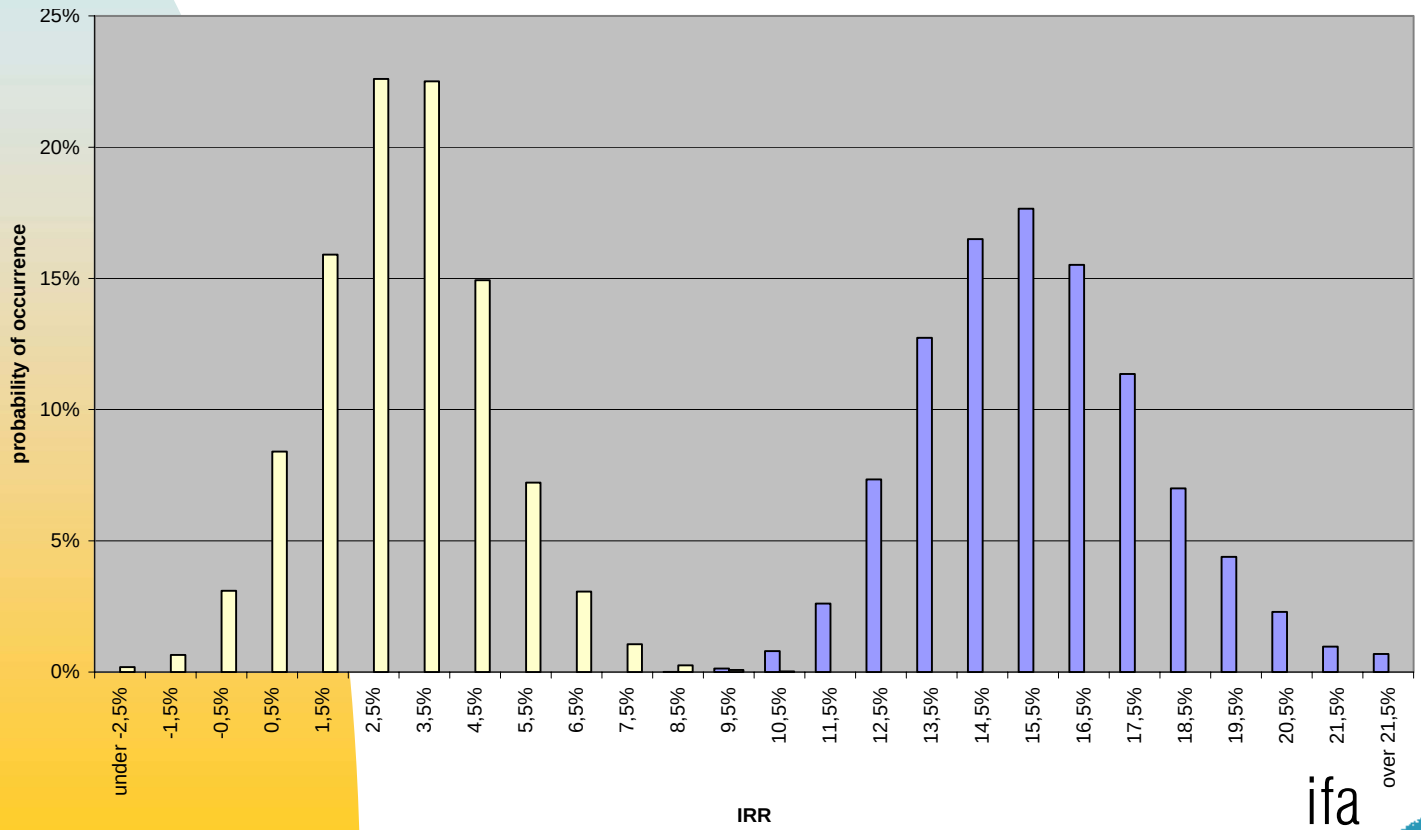
Life Expectancy Estimates and Life Settlements

- **Risk / Return profile of the portfolio assuming LE-provider A is right**
  - Expected IRR = 15.1%, “impossible” to earn less than 9% p.a.



Life Expectancy Estimates and Life Settlements

- **But: If LE-provider B is right, it was a very bad investment**
  - left: LE provider B: Expected IRR = 2.5%, significant probability of losing money
  - right: LE Provider A: Expected IRR = 15.1%, impossible to earn less than 9% p.a.



Life Expectancy Estimates and Life Settlements

- **Consequences**
  - There are two major risks
    - a) The LE-provider being “systematically” wrong
    - b) The risk of chance
      - 50% of the insured should die before their LE
      - 50% of the insured should die after their LE
      - By mere chance, there can be more of the latter
    - Risk b) is diversifiable
      - In the example: If the given mortality probabilities are correct, the IRR will very likely be within +/- 4% of the expected IRR (range becomes smaller for larger portfolios)
    - Risk a) can be huge if you trust the wrong LE-provider
      - In the example: 12.5% difference in expected return

Life Expectancy Estimates and Life Settlements

- **Consequences**
  - Investors using too conservative estimates will be systematically outbid and not be able to buy policies
    - Investors using correct estimates have the same problem if other investors use too aggressive estimates
  - Investors using too aggressive estimates will pay too much and achieve returns that are much smaller than calculated
    - Additional problem: liquidity planning

Life Expectancy Estimates and Life Settlements

- **Consequences**
  - All market participants should be interested in “correct” estimates
  - How can you determine which estimates are correct?
    - Medical methods
    - Actuarial/statistical methods
      - Only ex post, i.e. by comparing actual to projected number of deaths
      - This can be done in different ways yielding different information about the quality of providers

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Some Actuarial Issues of Life Expectancy Estimates

- **Basic Idea of Life Expectancy Estimation**
  1. A so called base table gives annual mortality probabilities (and thus the life expectancy) for an average person
     - average could be e.g. average male US-citizen, average female non-smoking insured,...
  2. Medical assessment: Is the mortality of a certain individual above or below average?
     - Quantify by how much (debits/credits)
     - 75 debits means: Annual mortality probability of individual = 1.75 * average mortality probability
     - → These mortality probabilities are used to calculate the individual life expectancy

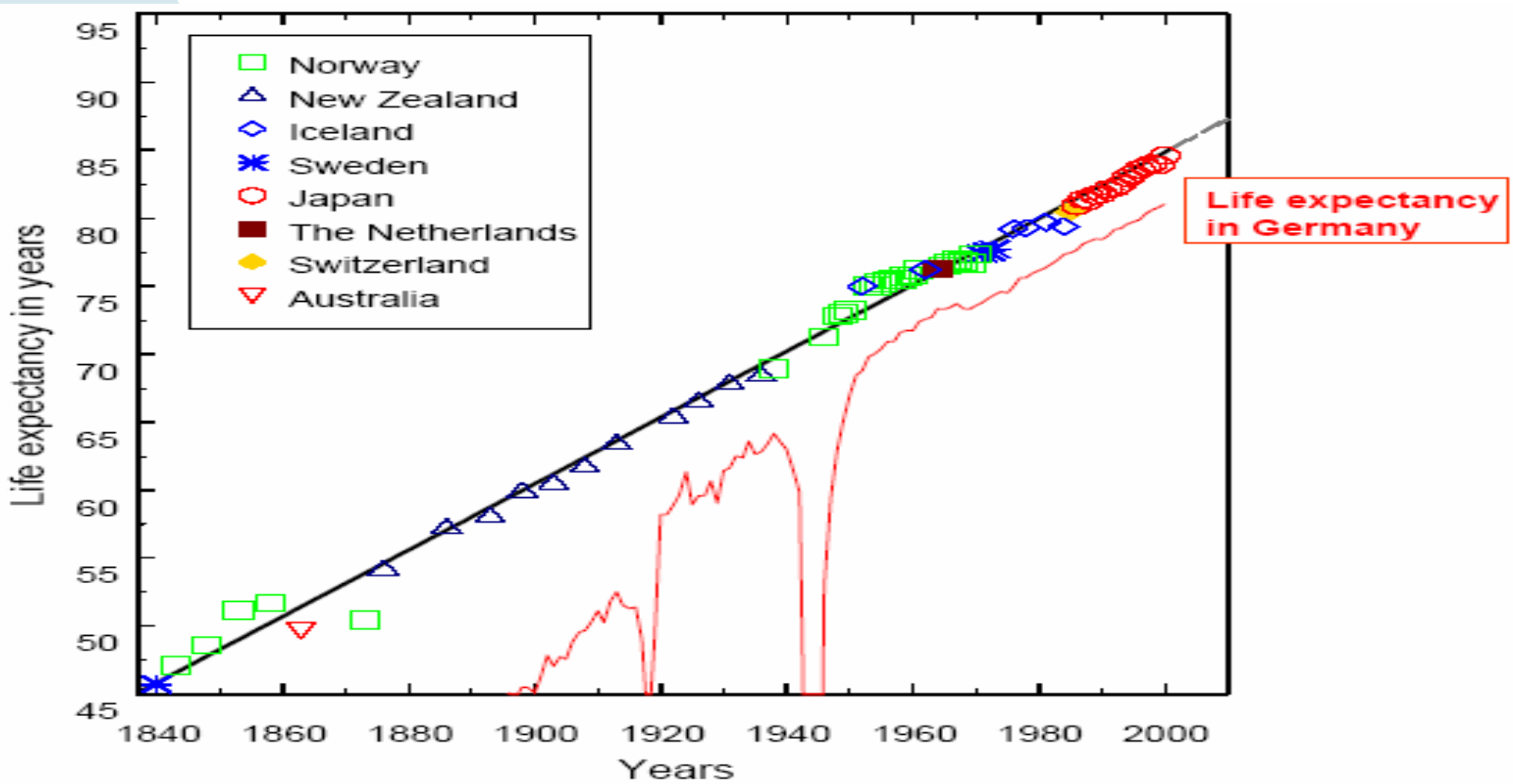
- In what follows: Some questions you should ask your LE-provider

Some Actuarial Issues of Life Expectancy Estimates

- **Is the base table appropriate for the considered business?**
  - Different groups of people have different average mortality
    - male / female
    - smoker / non-smoker
    - average US-citizen vs. average insured
    - but also: rich vs. poor
      - Who has a longer life expectancy: A millionaire with diabetes or a poor person with no medical condition?
      - The owner of a $3m policy is probably more wealthy than average → he belongs to a different group of people
    - does the base table reflect future increase in longevity?
      - is today's one year mortality probability for an 80 year old the same as the one year mortality probability 10 years from now for a then 80 year old?

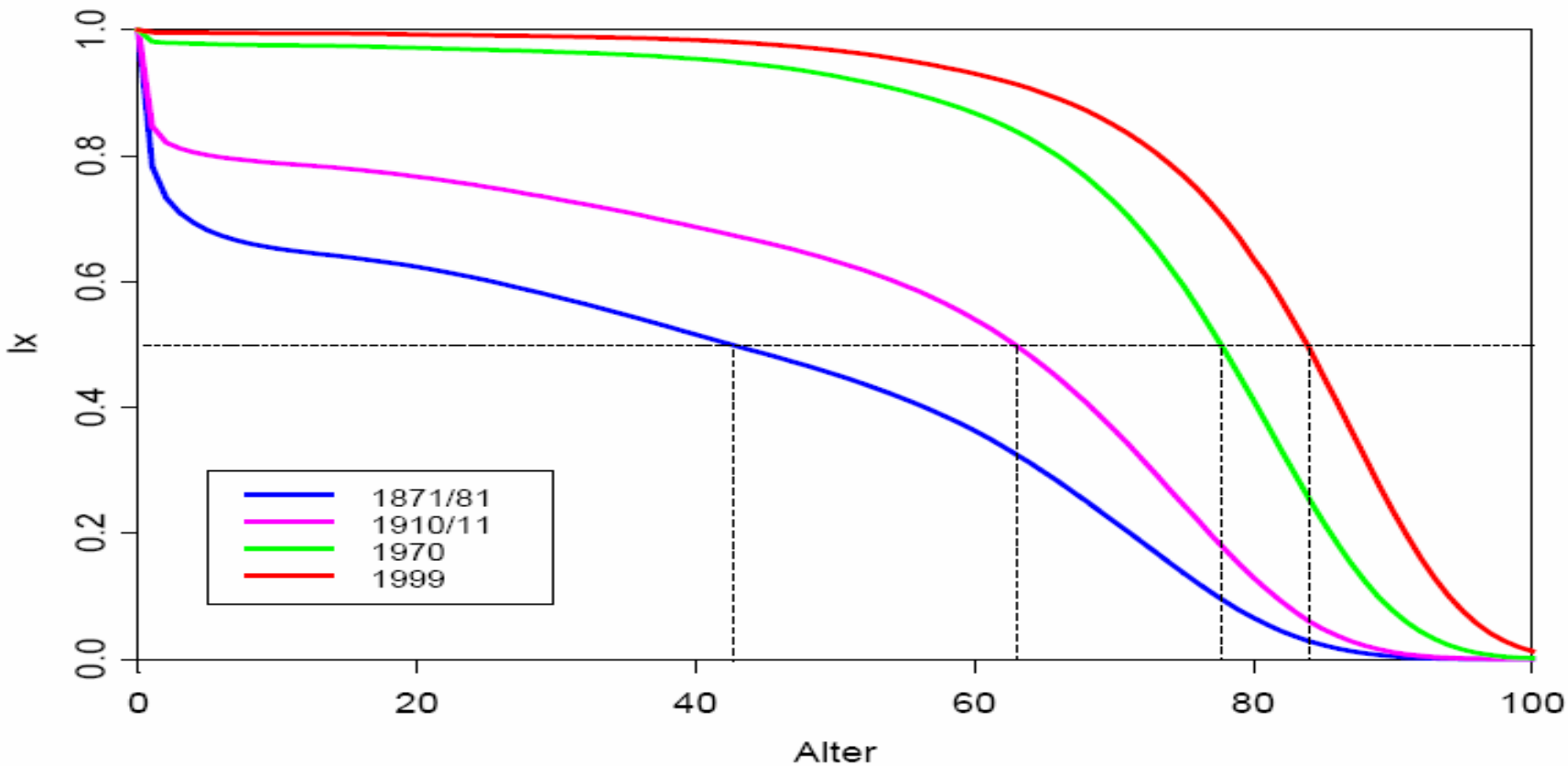
Some Actuarial Issues of Life Expectancy Estimates

- **Detour: Increase in longevity**
  - Life Expectancy in the “healthiest country”



Some Actuarial Issues of Life Expectancy Estimates

- **Detour: Increase in longevity**
  - Today's increase in longevity is achieved by increasing life expectancy of the elderly



Some Actuarial Issues of Life Expectancy Estimates

- **Does the debiting reflect peculiarities of the elderly?**
  - The relative impact of a certain impairment on mortality probabilities is often decreasing in age
    - A certain impairment may triple the mortality probabilities of a 30 year old (200 debits)
    - The same impairment may only result in a 25% increase of the mortality probabilities of an 80 year old
  - The older an individual, the more impairments are already reflected in the base table
    - An 85 year old lady with nothing else than mild osteoporosis may be healthier than an average 85 year old lady (base table)
      - Maybe, she should receive credits, not debits

Some Actuarial Issues of Life Expectancy Estimates

- **How is co-morbidity considered?**
  - One impairment results in 50 debits, another impairment in 75 debits
  - An insured has both
  - → The appropriate number of debits is usually not 50+75
  - Depending on the specific impairments it may be more or less!

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Some Actuarial Issues of Life Expectancy Estimates

- **Is the quality of the LE projections monitored on a regular basis?**
  - If so, how?
- **We think that it is necessary that an LE provider continuously monitors his quality and adjusts the methodology if necessary.**
- **The rest of this presentation: Our opinion on how the quality of LE projections should be measured.**

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How to evaluate Life Expectancy Estimates

- **Detour: How not to**
  - Count how many people have died before their LE and how many have died after their LE
  - This method yields meaningful results only after all insured have either died or outlived their LE
  - Before that time, it makes the provider look more conservative
  - Because at the beginning, only early deaths are possible
    - So even if the provider is too aggressive, you start counting a few early deaths and conclude that the provider is conservative
    - It will be years until the late deaths occur and you realize that the provider is too aggressive
  - Solution: Compare actual to expected number of deaths

How to evaluate Life Expectancy Estimates

- **Actual/Expected Ratio**
  - What is the expected number of deaths?
    - Example:
      - Assume a portfolio of 100 individuals
      - All were underwritten 1 year ago
      - All had a 17% mortality probability in the first year
      - Then we would expect that by today, 17 of them should have died
      - → Expected number of deaths = 17
    - More realistic example:
      - Portfolio consists of individuals that were underwritten at different times and with different mortality probabilities
      - For each individual: With which probability should he have died until today?
      - Sum of these probabilities = expected number of deaths

How to evaluate Life Expectancy Estimates

- **Actual/Expected Ratio**
  - Calculate the expected number of deaths and compare it to the actual number of deaths
    - This gives the so-called actual/expected ratio
  - about 100% → actual number of deaths = expected number
    - → underwriting is OK
  - smaller ratio → underwriting is too aggressive
  - higher ratio → underwriting is too conservative
  - Open question: What is an acceptable range?
    - Is 98% still acceptable? 90%? 80%?
    - → "Probability Distribution of the Number of Deaths" (see below) gives an answer

How to evaluate Life Expectancy Estimates

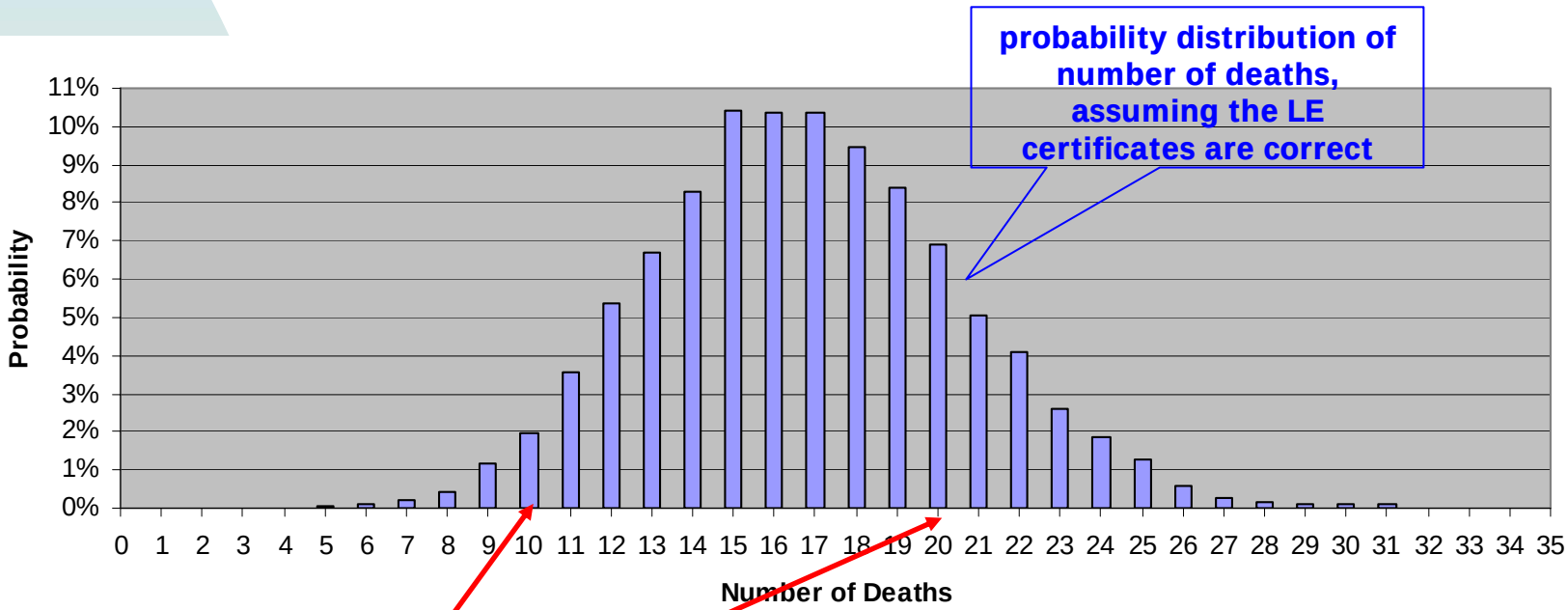
- **Actual / Expected Ratio**
  - This analysis should be performed
    - for the whole portfolio
    - for segments:
      - by age
      - by gender
      - by main impairment
      - ...
    - Segmentation allows to conclude in which areas the underwriting is too conservative/too aggressive/on target

How to evaluate Life Expectancy Estimates

- **Probability Distribution of the Number of Deaths**
  - The actual/expected ratio ignores the element of chance
    - We are dealing with probabilities!
  - If the actual/expected ratio deviates from 100%, the reasons can be inappropriate underwriting or mere chance
  - → You need to determine if a given deviation could be caused by chance or if it is “statistically significant”
    - significant means it is very unlikely that the deviation could have been caused by pure chance
  - For this purpose: calculate the probability distribution of the number of deaths under the assumption that the mortality probabilities given by the LE provider are correct.

How to evaluate Life Expectancy Estimates

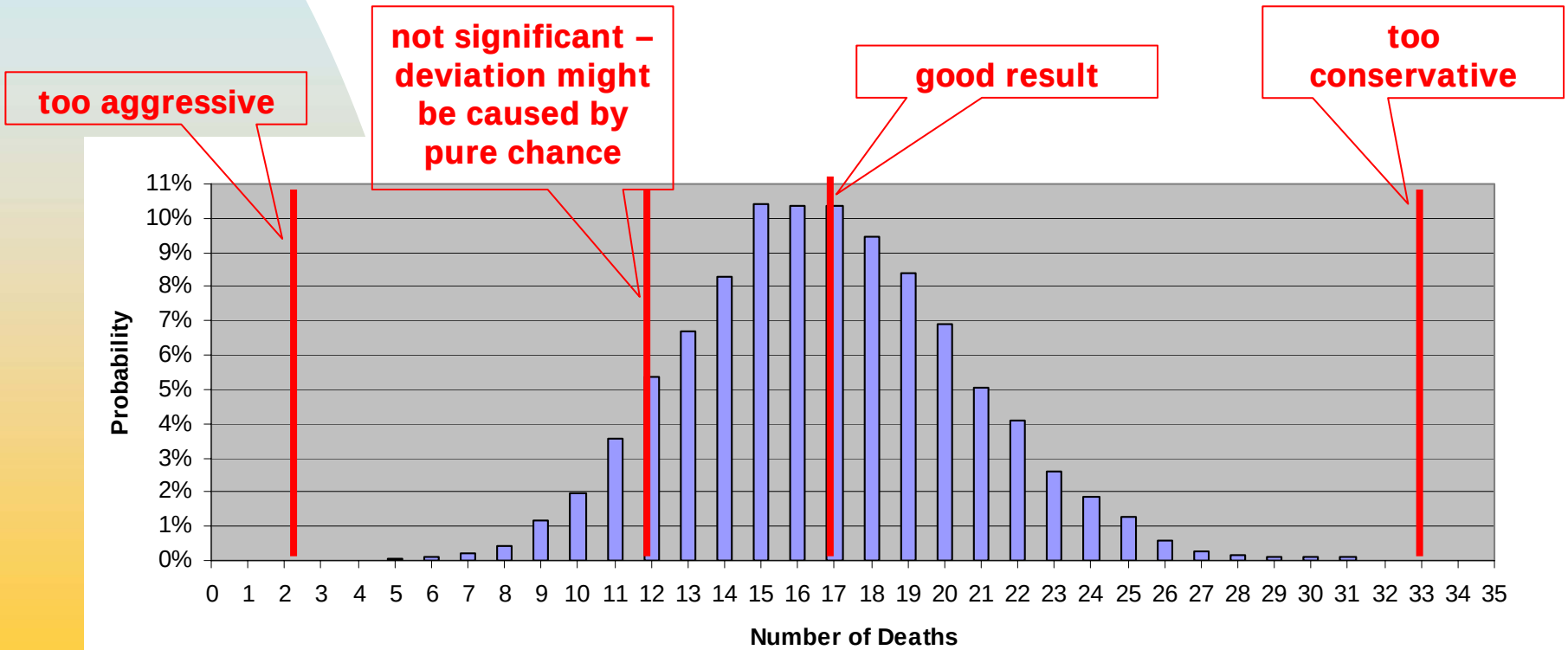
- **Probability Distribution of the Number of Deaths**
  - The probability distribution, assuming the underwriting is correct, will typically look like that:



  - With approx. 2% probability, 10 persons should have died.
  - With approx. 7% probability, 20 persons should have died.

How to evaluate Life Expectancy Estimates

- **Probability Distribution of the Number of Deaths**
  - By comparing with the actual number of deaths (red columns), the quality of the underwriting can be assessed:



How to evaluate Life Expectancy Estimates

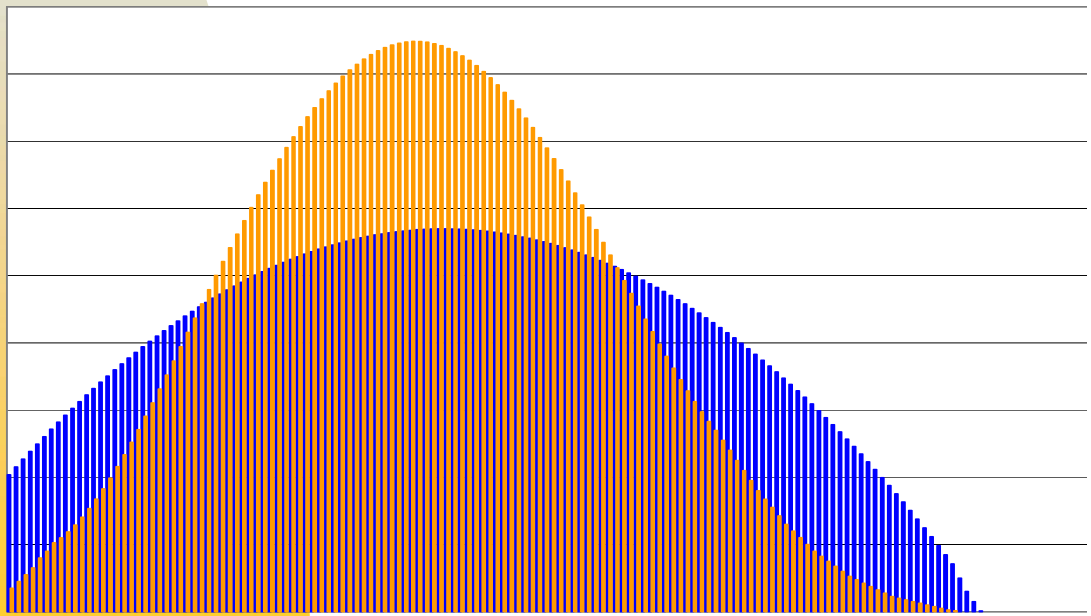
- **Probability Distribution of the Number of Deaths**
  - This is of particular importance for “young and small” portfolios
    - The actual/expected ratio measures the “relative” deviation i.e. the percentage deviation between actual and expected number of deaths
    - Probability theory (law of large numbers):
      - A large relative deviation of actual to expected can be caused by pure chance for small portfolios.
      - But for a large portfolio, a large deviation is virtually impossible.
        - → If the deviation is too large, we can conclude that it can not be caused by chance but that rather the given probabilities are wrong.

How to evaluate Life Expectancy Estimates

- **Probability Distribution of the Number of Deaths**
  - This analysis should also be performed
    - for the whole portfolio
    - for segments
      - by age
      - by gender
      - by main impairment
      - ...
    - Segmentation allows to conclude in which areas the underwriting is too conservative/too aggressive/on target

How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - This part of the analysis gives information about the correctness of the shape of the mortality curve and therefore if the used base tables, selection periods, multipliers vs. flat extras, etc. are appropriate
  - Example: Same LE, different shape:



How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - If the mortality curves were completely correct (i.e. the **LE is correct and the shape of the mortality curve is correct**), then
    - About 10% of the people should die before the 10th percentile of the mortality curve
    - About 20% of the people should die before the 20th percentile of the mortality curve
    - About 30% of the people should die before the 30th percentile of the mortality curve
    - ...
    - Everybody should have died at the end of the mortality curve.

How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - If the **LE is correct but the shape of the mortality curve is wrong** (here: actual shape is “steeper” than projected shape), then
    - The number of people who died before the 10th, 20th, 30th and 40th percentile would be below 10%, 20%, 30% and 40%, respectively, but actual values would approach expected values at some point.
    - The number of people who died before the 50th percentile would then be roughly 50%.
  - This could e.g. happen, if life expectancies are projected correctly on average, but the effects of selection are not properly considered.

How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - Therefore, it should be analyzed,
    - Of those people that have reached their 5th percentile, how many have died before the 5th percentile.
    - Of those people that have reached their 10th percentile, how many have died before the 10th percentile.
    - Of those people that have reached their 15th percentile, how many have died before the 15th percentile.
    - ...
  - This will result in a table similar to the following:

How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - Typical result of this analysis - Total number of cases: 11,273

Percentile	5th	10th	15th	20th	25th	30th	35th	40th	45th	50th
Number of cases that reached Percentile	9,266	8,064	6,979	6,185	5,201	4,287	3,568	3,017	2,498	2,104
Deaths before percentile	458	799	1,056	1,261	1,283	1,281	1,237	1,194	1,103	1,047
(in %)	*4.9%*	*9.9%*	*15.1%*	*20.4%*	*24.7%*	*29.9%*	*34.7%*	*39.6%*	*44.2%*	*49.8%*
Expected deaths before percentile	463	806	1,047	1,237	1,300	1,286	1,249	1,207	1,124	1,052
Actual / Expected	**98.9%**	**99.1%**	**100.9%**	**101.9%**	**98.7%**	**99.6%**	**99.0%**	**98.9%**	**98.1%**	**99.5%**

  - Provider has good results (close to 100% all over).
  - → Not only are the given life expectancies correct, but also the shape of the mortality curves

How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - Typical result of this analysis - Total number of cases: 11,273

Percentile	5th	10th	15th	20th	25th	30th	35th	40th	45th	50th
Number of cases that reached Percentile	9,266	8,064	6,979	6,185	5,201	4,287	3,568	3,017	2,498	2,104
Deaths before percentile	367	653	845	1,006	1,052	1,023	983	955	887	844
(in %)	*4.0%*	*8.1%*	*12.1%*	*16.3%*	*20.2%*	*23.9%*	*27.6%*	*31.7%*	*35.5%*	*40.1%*
Expected deaths before percentile	463	806	1,047	1,237	1,300	1,286	1,249	1,207	1,124	1,052
Actual / Expected	**79.3%**	**81.0%**	**80.7%**	**81.3%**	**80.9%**	**79.5%**	**78.7%**	**79.1%**	**78.9%**	**80.2%**

  - Provider's ratios are too low (about 80% all over).
  - → The average life expectancies given by the provider are too aggressive

How to evaluate Life Expectancy Estimates

- **Shape of the Mortality Curve**
  - Typical result of this analysis - Total number of cases: 11,273

Percentile	5th	10th	15th	20th	25th	30th	35th	40th	45th	50th
Number of cases that reached Percentile	9,266	8,064	6,979	6,185	5,201	4,287	3,568	3,017	2,498	2,104
Deaths before percentile	344	607	823	1,006	1,090	1,119	1,126	1,134	1,098	1,054
(in %)	*3.7%*	*7.5%*	*11.8%*	*16.3%*	*21.0%*	*26.1%*	*31.6%*	*37.6%*	*44.0%*	*50.1%*
Expected deaths before percentile	463	806	1,047	1,237	1,300	1,286	1,249	1,207	1,124	1,052
Actual / Expected	**74.3%**	**75.3%**	**78.6%**	**81.3%**	**83.8%**	**87.0%**	**90.2%**	**94.0%**	**97.7%**	**100.2%**

  - The 50% figure is close to 100%. Thus the given life expectancies are correct.
  - However, the provider significantly overestimates the number of early deaths. The shape of the mortality curve is wrong. The actual curve is steeper than the given curve

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  - This analysis should again be performed
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    - Segmentation allows to conclude in which areas the underwriting is too conservative/too aggressive/on target

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Summary

- **The quality of LE-providers is by far the highest risk factor for purchasers of life settlements**
  - We believe that it has not been analyzed properly by many investors
- **Quality of providers can be analyzed with actuarial methods**
  - So far, only few providers perform such analyses
- **More sophisticated and more meaningful analyses than the ones currently used are possible**
  - Actual to projected (are the results good on average)
  - Actual to distribution (are the deviations significant)
  - Shape of the curve (do early deaths occur as projected)
  - Segmentation
- **Investors should demand such analyses as part of their due diligence before deciding which provider to use**