Overview

- Market and product features
  - Impaired pension annuities
  - Immediate needs annuities
- Impact on standard annuity market
- Longevity and enhanced annuities
- Pricing

Impaired Pension Annuities – A success story?

- 1995 Stalwart launched a smoker annuity
- 1995 PAFS launched a fully impaired annuity
- 1996 Stalwart launched a lifestyle annuity

**Current Providers**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Axa Sun Life</td>
<td>Pension Annuity Friendly Society</td>
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<tr>
<td>Britannic Retirement Solutions</td>
<td>Pinnacle</td>
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<tr>
<td>GE Life</td>
<td>Prudential</td>
</tr>
<tr>
<td>MGM</td>
<td>Reliance Mutual</td>
</tr>
<tr>
<td>Norwich Union</td>
<td>Scottish Widows</td>
</tr>
</tbody>
</table>
Impaired Pension Annuities – A success story?

- Success in terms of sales
- Represent around 20% of conventional annuities sold under open market options
- Some of the niche players hold significant market share
- Amendments made to product design

Impaired Pension Annuities - Features

- Mortality assessed using factors other age and gender
  - Lifestyle factors – smoking, geographical area residence, obesity
  - Medical impairments
- Lead time from quote to commencement of annuity
- Verification of individual risk factors – medical evidence obtained large number of cases
- Balance additional acquisition costs against the benefit of the enhancement from extra mortality
- Take up rate

Impaired Pension Annuities – Common Application Form

- Developed over the last couple of years
- Accepted by most providers
- Most IFAs now accustomed to completing a single form
- Medical evidence from the GP is shared
- Any additional medical information is obtained by the provider directly
Impaired Pension Annuities - Longevity

- For a significant enhancement the extra mortality needs to be significant, permanent, verifiable.
- For a significant enhancement mortality improvements act over only a few years also due to improvements in conditions other than the main impairment.
- Mortality improvements for people with less serious conditions or with lifestyle impairments are important.

Impaired Pension Annuities - Longevity

Course of Chronic Disease

- Original
- Postponed
- Severe Symptoms
- Symptom Threshold
- Presented
- Sub clinical disease
- Age
- Death

Impaired Pension Annuities – Potentially severe conditions

- Other conditions
- Cancer
- Prostate cancer
- Other cancers
- Stroke
- Heart disease
- Diabetic retinopathy
Pension Annuities – Range of Market Rates

Standard and Enhanced Annual Annuity Amounts
Male, Age 65, Purchase Price £10,000

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Enhanced</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>□</td>
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<td>□</td>
<td>□</td>
</tr>
<tr>
<td>1000</td>
<td>□</td>
<td>□</td>
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Impaired Pension Annuities – Impact on standard rates

<table>
<thead>
<tr>
<th>Impairment</th>
<th>Proportion of Pension Policies</th>
<th>Uplift in Annuity p.a.</th>
<th>Implied Extra Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>2%</td>
<td>50%</td>
<td>+190%</td>
</tr>
<tr>
<td>Moderate</td>
<td>3%</td>
<td>35%</td>
<td>+125%</td>
</tr>
<tr>
<td>Slight</td>
<td>5%</td>
<td>15%</td>
<td>+40%</td>
</tr>
<tr>
<td>None</td>
<td>90%</td>
<td>0%</td>
<td>-11%</td>
</tr>
<tr>
<td>Weighted Total</td>
<td>100%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

- Aggregate mortality for all pensions annuities is +0%

Impaired Pension Annuities – Impact on standard rates

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</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>4%</td>
<td>50%</td>
<td>+190%</td>
</tr>
<tr>
<td>Moderate</td>
<td>6%</td>
<td>30%</td>
<td>+125%</td>
</tr>
<tr>
<td>Slight</td>
<td>10%</td>
<td>15%</td>
<td>+40%</td>
</tr>
<tr>
<td>None</td>
<td>80%</td>
<td>0%</td>
<td>-24%</td>
</tr>
<tr>
<td>Weighted Total</td>
<td>100%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

- Increased proportion of impaired pension annuities
- Annuity payments for non-impaired lives reduced by about 5%
Immediate needs Annuities - Providers

<table>
<thead>
<tr>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Britannic Retirement Solutions</td>
</tr>
<tr>
<td>Pension Annuity Friendly Society</td>
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<tr>
<td>BUPA</td>
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<tr>
<td>PPP Lifetime Care</td>
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<tr>
<td>GE Life</td>
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<td>Scottish Widows</td>
</tr>
<tr>
<td>Norwich Union</td>
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</tbody>
</table>

Impaired Needs Annuities – Potentially severe conditions

- Heart failure
- Cardiomyopathy
- Stroke
- Vascular dementia
- Other conditions
- Pre-senile Dementia
- Alzheimer’s Disease
- Senility
- Other conditions
- Vascular dementia
- Stroke

Immediate Needs Annuities – Pension Annuities

Features Compared

<table>
<thead>
<tr>
<th>Feature</th>
<th>Pension Annuity</th>
<th>Immediate Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compulsory purchase</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Average age</td>
<td>60-65</td>
<td>80-85</td>
</tr>
<tr>
<td>Multiple impairments</td>
<td>Yes</td>
<td>Three parties</td>
</tr>
<tr>
<td>Percentage of standard lives</td>
<td>More</td>
<td>Higher</td>
</tr>
<tr>
<td>Capital protection</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Purchase price range</td>
<td>Most severe cases for large funds</td>
<td>Some demand for very large premiums</td>
</tr>
<tr>
<td>Common application form</td>
<td>Nearly all</td>
<td>Most providers</td>
</tr>
</tbody>
</table>
Key Factors in Pricing Annuities

- Expected pattern of mortality
- Rate of interest earned
- Expenses
  - Administration
  - Underwriting

Underwriting Impaired Annuities

- ‘Broad Brush’ approach
  - Single impairments e.g. smoker annuities
  - Points scoring approach
- Individually underwritten
  - Impairments
  - Symptoms exhibited
  - Date of diagnosis
  - ADL’s failed

Mortality data

- No standard tables
- Actuarial modelling
- Limited data available
  - Existing blocks of business
  - Scientific research papers
  - Underwriters/CMO judgement and expertise
Survival curves for impaired lives may be concave or convex, depending on the nature of the impairment.

- **Concave impairments** are those that exhibit high mortality initially, with a subsequent decreasing force of mortality, e.g. stroke, most forms of cancer.
- **Convex impairments** are those that exhibit low mortality initially, with a subsequent increasing force of mortality, e.g. Alzheimer's

For a given life expectancy, changing the shape of the curve changes the present value of annuity payments significantly, e.g. 10-20%.

Insufficient to just have life expectancy of individual.
Form of Survival Model

- There are many different types of model we could use. For example:
  - Multiple of mortality
    \[ q_x = (1+m) \times q_x \]
  - Addition to mortality
    \[ q_x = q_x + c \]
  - Exponential model
    \[ S(t) = \exp(-\lambda t) \]
  - Weibull model
    \[ S(t) = \exp(-\lambda t^\alpha) \]

Fitting a model to an existing block of business

- Using a non-parametric model
- Kaplan-Meier Estimation
  - The KM method gives the non-parametric estimate of \( S(t) \). This is a step function, with \( S(t) \) taking a step downward at each time \( t \) at which a death was observed in the data.

Using a non-parametric model

KM Plot: Entire Dataset

![KM Plot: Entire Dataset](image)
Using a non-parametric model

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**FORM**

Fitting a Regression Model

- We notice that survival depends on at least one variable, i.e. the underwriter's assessment of the life expectancy (LE).
- We will allow for explanatory variables by using the Weibull regression model:

\[
Y = \ln X = \mu + \sum_{i} \beta_{i} z_{i} + \sigma W
\]

Where:
- \( W \) is the extreme value distribution function with density function:

\[
f_{W}(w) = \exp(\exp(w - w^*)
\]

(\( w^* \) is the survival time; \( z_i \) values of explanatory variables)

---

Fitting a Regression Model

- We find the estimates of \( \mu, \beta_i, \) and \( \sigma \) using a statistics program that can fit linear regression models (e.g. R).

- The survival curve for an individual is then given by:

\[
S(t) = \exp(-\lambda t^{\alpha})
\]

Where:
- \( \alpha = 1/\sigma \)
- \( \lambda = \exp(-\sum_{i} \beta_{i} z_{i} / \sigma) \)

- Shape: \( \alpha \)
- Scale: \( \lambda \)
Fitting a Regression Model

- Let's fit this model to our dataset, using LE as the only variable:

```r
> summary(survreg(Surv(survival, status) ~ 1 + le, data=survdata))
```

Call:
survreg(formula = Surv(survival, status) ~ 1 + le, data = survdata)

Value Std. Error     z        p
(Intercept)  6.393     0.1092 58.57 0.00e+00
le           0.260     0.0474  5.48 4.15e-08
Log(scale)  -0.243     0.0381 -6.38 1.76e-10

Scale= 0.784
Weibull distribution
Loglik(model)= -3309.7   Loglik(intercept only)= -3327.4
Chisq= 35.46 on 1 degrees of freedom, p= 2.6e-09
Number of Newton-Raphson Iterations: 6
n= 1065

对比拟合的模型与KM图，对所有LE为3的情况进行比较。

Our choice of model, using LE as a regression variable, looks to be a good one.

We can try to improve the model by adding additional variables. We can check how useful each variable is by testing the hypothesis:

\[ H_0: \beta_i = 0 \]

If we can reject this hypothesis, then \( z_i \) has useful predictive power in our model.
Fitting a Regression Model

- In our example, the best regression model was one based on the following variables:
  - Ln(Life expectancy)
  - Number of ADLs failed
  - Age at entry

\[ Y = \ln X = 2.7134 + 0.4033\ln(LE) - 0.0605\text{ADL} - 0.0198\text{Age} + 0.776W \]

Data available from Research Papers

- Survival analysis
- Relevance of studies
  - size
  - location
  - study bias
- Multiple impairments
- Conditions not clearly defined such as frailty

OBSERVATIONS
Probability of survival over 5 years of follow-up in patients with a first ever stroke in 1989-1990
Observations
Probability of survival over 10 years of patients with Alzheimer’s disease when institutionalised

Interpretation of Research Papers
- Duration since diagnosis
- Age at diagnosis
- Gender
- Regional variations
- Affect of affluence
- Improvements over time

Future Improvements in Mortality
- Impact of medical advances
- Historical improvements:
  - Breast cancer 1 year survival rate 2% every 5 years
  - Breast cancer 5 year survival rate 4% every 5 years
  - Lung cancer 1 year survival rate 1.5% every 5 years
  - Lung cancer 5 year survival rate 0.5% every 5 years
- Less data available for other disease processes
- Mortality improvement rate has significant impact on annuity value
Significant Factors for Impaired Life Mortality Assumptions

- Life expectancy
- Shape of the survival curve.
- Duration since diagnosis – whereabouts on the survival curve are you?
- Future mortality improvements – are improvements likely to be lower or higher than for standard annuities?

Conclusions

- Important to have confidence in your survival model, because if you get it wrong, this can have a significant financial effect.
- Data collection and analysis of emerging experience is essential