The Actuarial Profession
making financial sense of the future

Minimising Uncertainty in Longevity Risk Modelling
Steven Baxter, Club Vita LLP & Hamish Wilson, Hymans Robertson LLP

Insights and Practical Applications

6 October 2011

What we will cover

- Insights from rating factors
- Using results to minimise uncertainty
  - Reserving
  - Profitable pricing
- Topical issues
  - Impaired annuities
  - Test A-chats

The Actuarial Profession
making financial sense of the future

Analysing experience and building rating factor models

"the extent to which all phenomena relevant to the purpose and the structure of the model have been modelled"

TAS-M Satisfactory Representation requirement

The power of numbers

5.6 million records

1.8 million pensioners
(inc deaths)

Detailed information
Gender
Affluence
Postcode / Lifestyle
Blue collar / White collar
Retirement Health
Early or age retirement
Etc...

18+ years back history

Continuously updated

High earners
4 times less likely to die (ages 60-64)
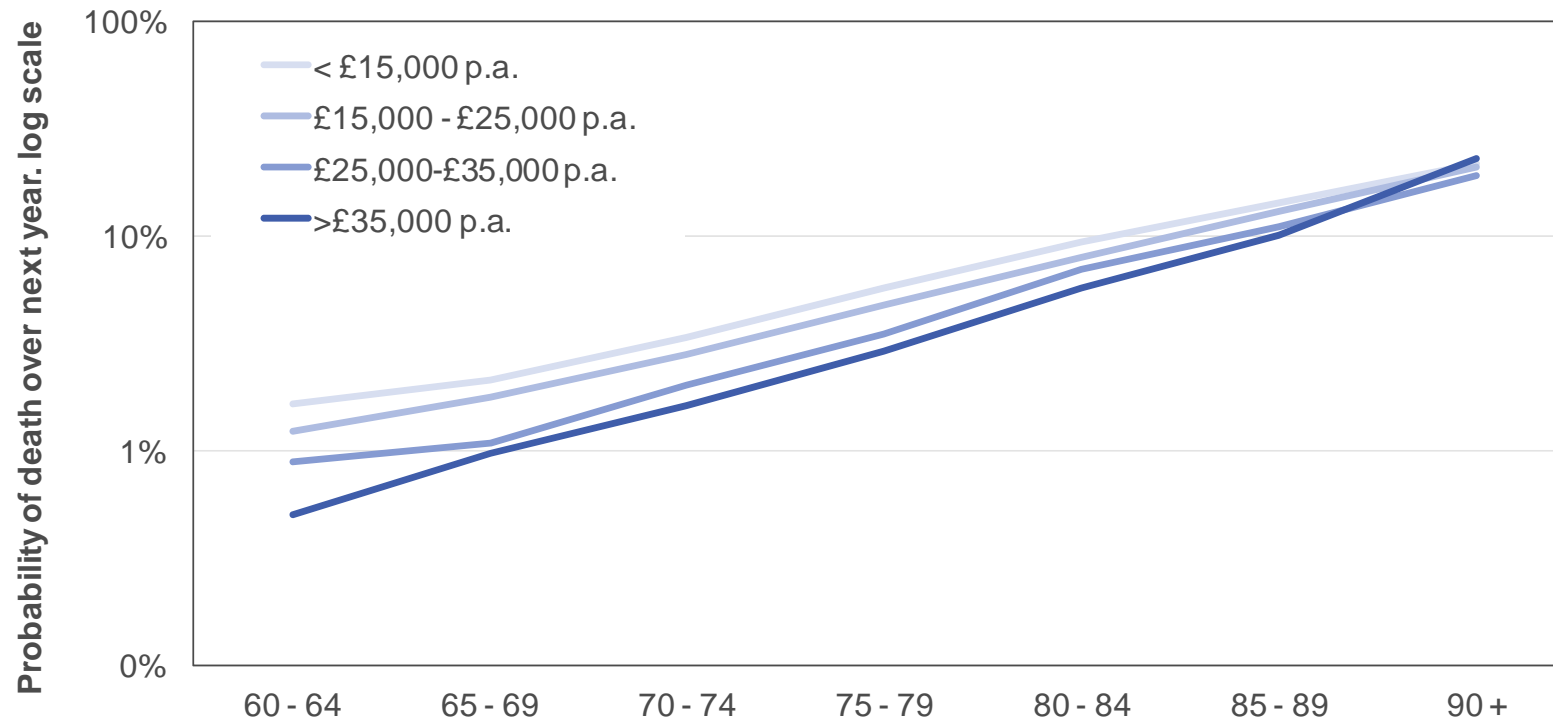15% more likely to leave a dependent

Grieving widows?
Loss of a partner below age 75
= 50% increase in mortality

Social cascade
Is the pattern of emerging
improvements different amongst
blue-collar and white collar
workers?

Experience tells us shape matters

Crude death rates split by salary at retirement, revalued with RPI)
(Men, 2006-2010)

Legend:
- < £15,000 p.a.
- £15,000 - £25,000 p.a.
- £25,000-£35,000 p.a.
- >£35,000 p.a.

Y-axis: Probability of death over next year. log scale (100%, 10%, 1%, 0%)

X-axis: 60 - 64, 65 - 69, 70 - 74, 75 - 79, 80 - 84, 85 - 89, 90+

The danger of relying on experience analysis...
If affluence could be allowed for by a multiple to a standard table the above lines would be parallel.
Traditional 'A/E' experience analyses tend to focus on ages 70-80 and the bulk of the membership – it is **easy to miss the true shape of mortality and differences amongst groups**.
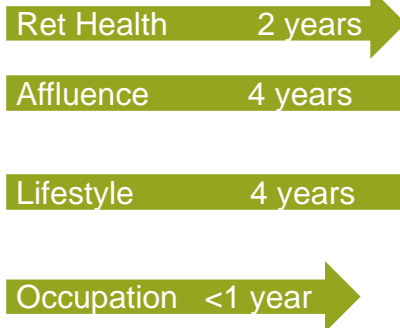
Rating factor models help understand diversity

The healthy, wealthy have 12 years extra life expectancy from 65
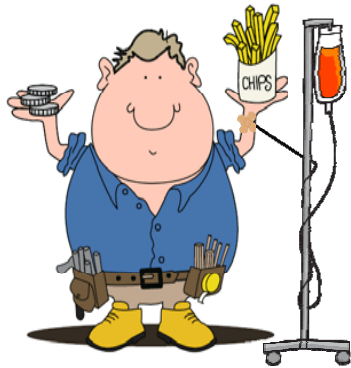
Life expectancy from 65: **10.9 years**

- Ill health retirement
- Low affluence
- Unhealthy lifestyle postcode
- Manual worker

Ret Health	2 years
Affluence	4 years
Lifestyle	4 years
Occupation	<1 year

Life expectancy from 65: **22.8 years**

- Normal health retirement
- High affluence
- Healthy lifestyle postcode
- Non-manual worker

Source: Club Vita

5

Practical Applications

Understanding an annuity book

Consider the range of life expectancies for men aged 65 ......

Life expectancy from age 65
(excludes future improvements)
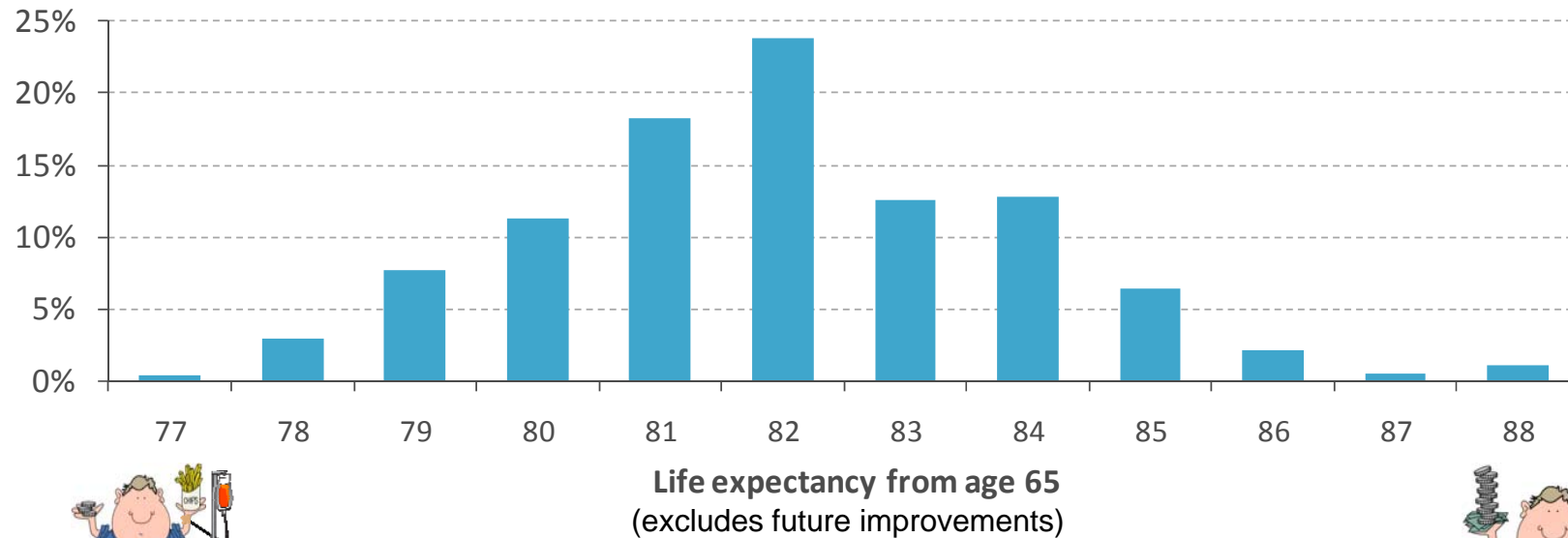
Potential to **understand changing business mix**.
Potential **scope to capture benefit** for existing portfolio from postcode and/or annuity amount.
Potential to **reduce uncertainty** for new business by underwriting using earnings as well as postcode.

Source: Club Vita

Added insights, added value?

The financial impact for different portfolios...

Impact on past service liability of applying VitaCurves
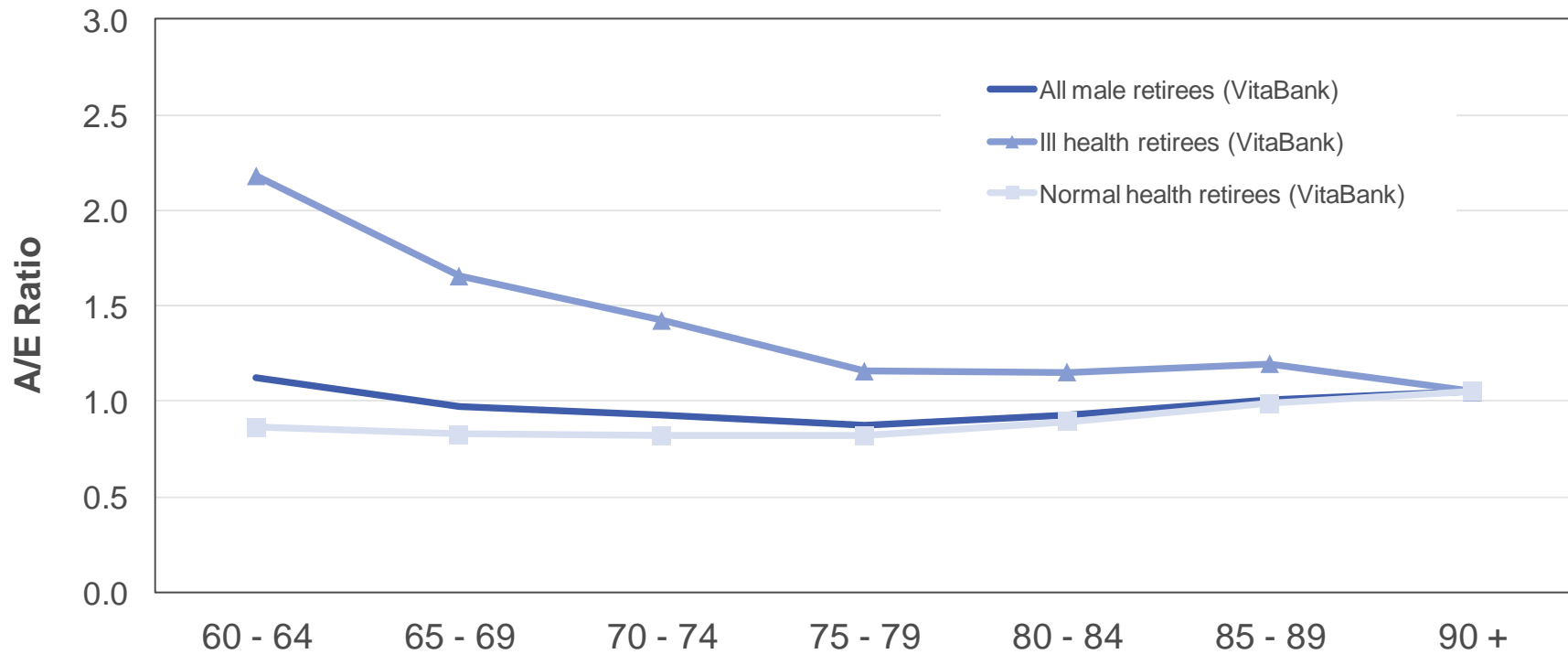

Largest portfolio
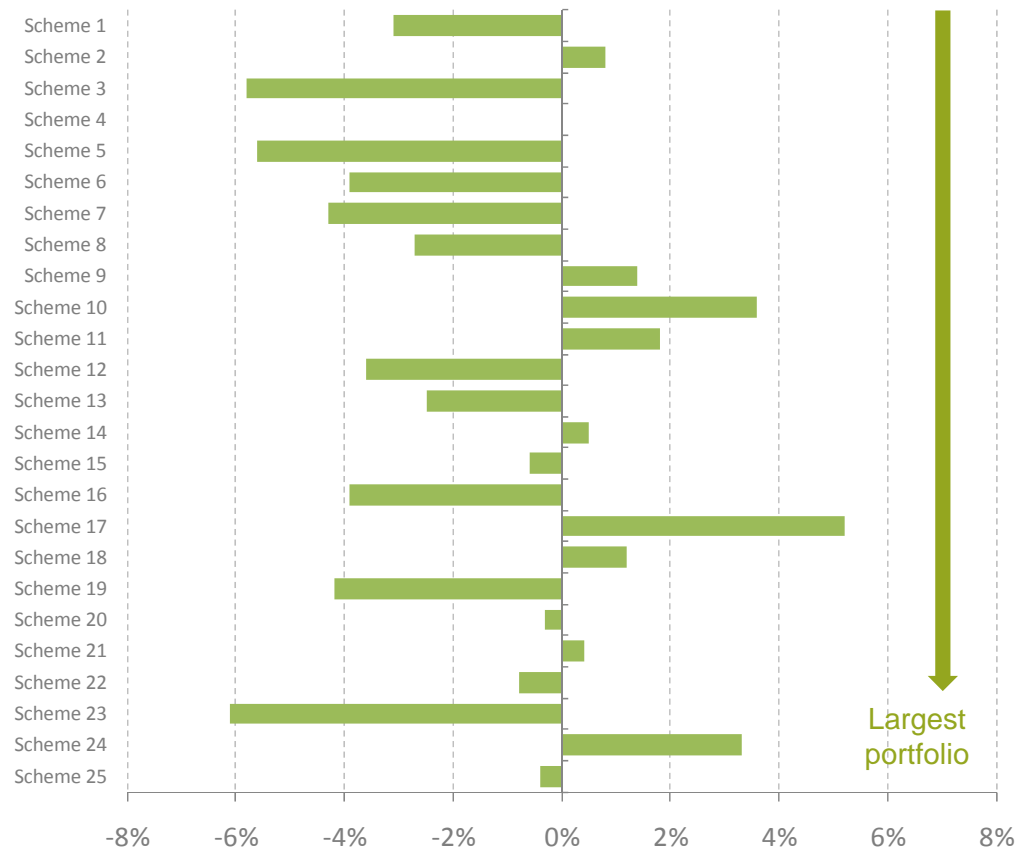
Majority of users of the baseline mortality model enjoyed a **reduction in their capital reserving** with **less uncertainty** in their baseline.

Many have gained **valuable insights** as how the **business mix has been changing,**

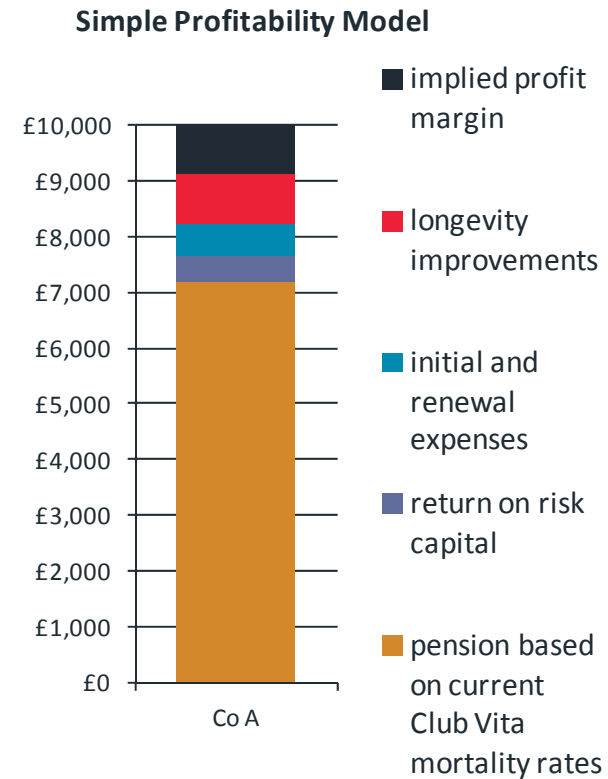# Using the model: Enhanced Annuities

Ill health effects persist

Men

Expected derived from PNML00 series. Data excludes unknown health status and widowers

Using the model: More Granular Pricing
A story of two Kingstons

Annuities analysed across 2 distinct postcodes: Kingston Upon Hull

......and Upon Thames

Simple Profitability Model

Range of pension quotes for a pot of £10,000, male retirement age 65

Legend:
- Male Thames
- Male Hull

Categories: Co A, Co B, Co C, Co D

Profitability model legend:
- implied profit margin
- longevity improvements
- initial and renewal expenses
- return on risk capital
- pension based on current Club Vita mortality rates

(Co A)

Source: Hymans Robertson analysis of publically available annuity quotations.

Preferred customers?

Different lifestyles of annuitants leads to significant profit variability

Profit Margin (age 65 low affluence):
Poor lifestyle (Hull)
vs good lifestyle (Thames)

Co A profit: male 14% Hull, 3% Thames.
female 4% Hull, 0.5% Thames

- ◆ Co A Male
- ▲ Co A Female
- ◆ Co B Male
- ▲ Co B Female
- ◆ Co C Male
- ▲ Co C Female
- ◆ Co D Male
- ▲ Co D Female

Kingston Upon Thames (y-axis: 0%, 5%, 10%, 15%)

Kingston Upon Hull (x-axis: 0%, 5%, 10%, 15%, 20%, 25%)

Source: Hymans Robertson analysis of publically available annuity quotations.
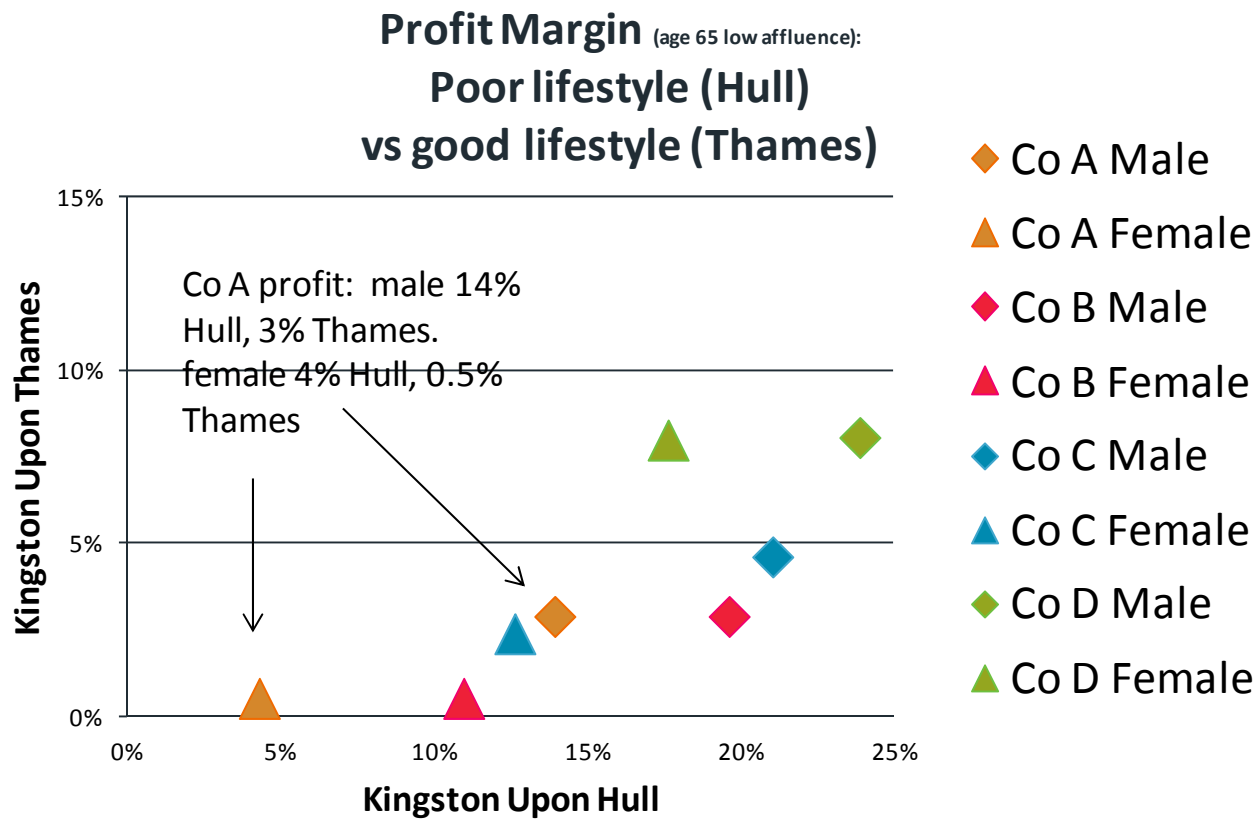
Who will Hamish and Steven be buying an annuity from?

Different affluence of annuitants leads to significant profit variability

How does affluence affect profit margins within a postcode? (males, age 65 Hull)

high affluence   mid affluence   low affluence
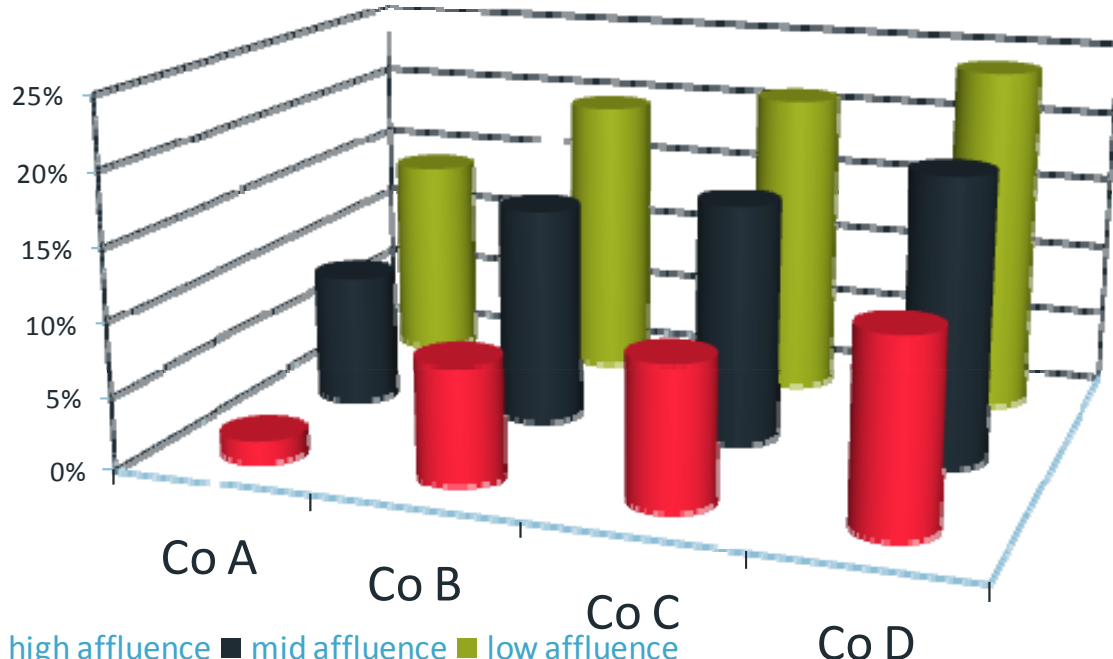
Using Affluence **as well as** postcode gives better price to risk
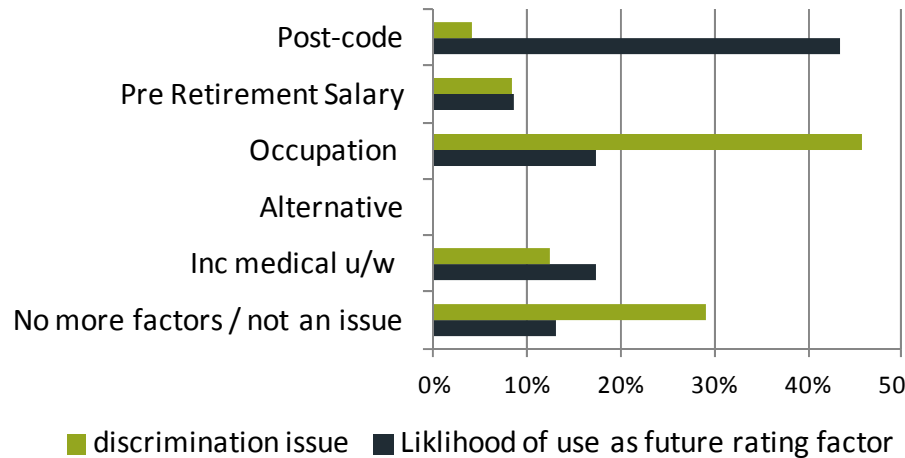
Losing our gender...

"there are no reasonable and effective alternatives to the use of gender in insurance pricing"

Comie Europeen des Assurances, February 2011

Hands up if you agree!

Gender Ban – Your thoughts before today...

Most Likely Factor - Annuity Pricing

Categories (top to bottom): Post-code, Pre Retirement Salary, Occupation, Alternative, Inc medical u/w, No more factors / not an issue

Axis: 0% to 50%

Legend: ■ discrimination issue ■ Liklihood of use as future rating factor

Belief that postcode pricing will become more common, followed by occupation

But greater concerns about indirect discrimination issues in using occupation

All Factors - Annuity Pricing

Categories (top to bottom): Post-code, Pre Retirement Salary, Occupation, Alternative, Inc medical u/w, No more factors / not an issue

Axis: 0% to 100%

Legend: ■ discrimination issue ■ Liklihood of use as future rating factor

Overall, strong belief that all post-code, salary and occupation will be used

Survey available to take at www.surveymonkey.com/s/TMWZJF7

14
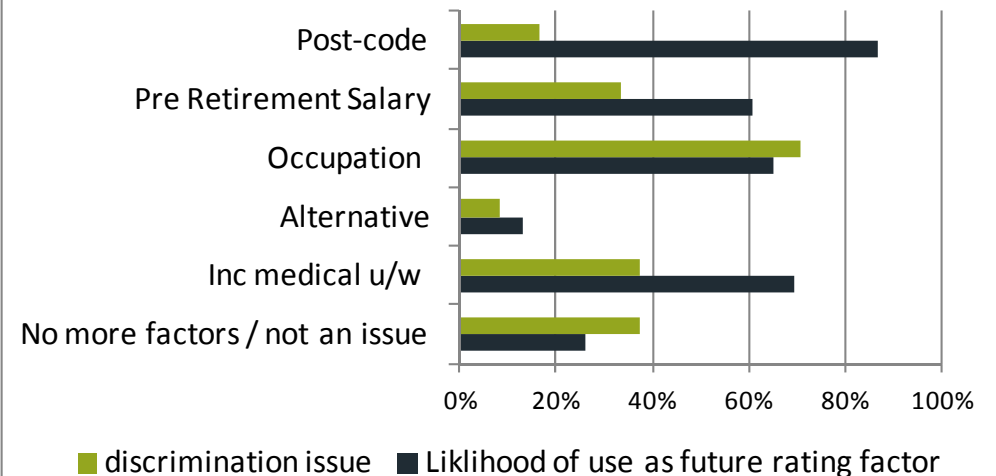
How important is gender as a rating factor?

Suppose you have the following information available to you:

- Age
- Gender
- Affluence
  - – Annuity amount
  - – Salary
- Lifestyle (via postcode)
- Health at retirement
- Former occupation

Which is it most important to allow for?

Rating factor	Explanatory power
Age	2,663
Retirement Health	107
Gender	**100**
Lifestyle	77
Affluence	32
Blue/White collar	7

Explanatory power is the drop in scaled deviance based on a logistic binomial GLM with variables added sequentially, with order determined using step-wise GLM procedures. Deviations have been scaled to be shown relative to gender (=100). Two-way interaction terms have been split evenly between the interacting variables. Analysis is based upon 969,358 pensioner lives with complete, clean data on all six factors, and using data spanning 2007-2009. Affluence shows the combined impact of annuity amount and salary.

Dropping gender...

Rating factors for annuitants	
Across ages	

Rating factor	Explanatory power
Age	2,663
Retirement Health	107
Gender	**100**
Lifestyle	77
Affluence	32
Blue/White collar	7

Explanatory power is the drop in scaled deviance based on a logistic binomial GLM with variables added sequentially, with order determined using step-wise GLM procedures. Deviations have been scaled to be shown relative to gender (=100). Two-way interaction terms have been split evenly between the interacting variables. Analysis is based upon 969,358 pensioner lives with complete, clean data on all six factors, and using data spanning 2007-2009. Affluence shows the combined impact of annuity amount and salary.,

Rating factors for post Test A-Chats	
Dropping gender from our model	

Rating factor	Explanatory power
Age	2,744
Retirement Health	166
Lifestyle	100
Affluence	24
Blue/White collar	3

Explanatory power is the drop in scaled deviance based on a logistic binomial GLM with variables added sequentially, with order determined using step-wise GLM procedures. Deviations have been scaled to be shown relative to lifestyle (=100). Two-way interaction terms have been split evenly between the interacting variables. Analysis is based upon 969,358 pensioner lives with complete, clean data on all six factors, and using data spanning 2007-2009. Affluence is the combined impact of annuity amount and salary.

Three key insights

1. Rating factor models can add value in **pricing** and **reserving**

2. Key to allow for anti-selective effects of impaired annuities

3. Post Test Achats we expect to see greater use of postcode as a rating factor.

Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenters.

For questions which occur to you

after the event please contact:

steven.baxter@clubvita.co.uk

hamish.wilson@hymans.co.uk