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Life Conference 2012
John Gunn and Joan Coverson

# E11: Gender Neutral Pricing
How (not) to foul it up!

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## Introductions

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## Gender Neutral Pricing
## How (not) to foul it up

### Part 1 – How to foul it up

- Ignore the ruling
- Manipulate around the ruling
- Miss important predictors of gender mix

### Part 2 – How not to foul it up

- Consider important predictors of gender mix
- Consider variability
- Model interactions

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Fouling it up!

## Part 1 : How to foul it up

### Context

The context of this section is the UK IFA protection market, but the content would equally apply to any competitive, price driven market.

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## Could we ignore the Gender Directive?

- There are rumours that other EU countries will not be ready to implement by 21 December and will continue to write business on gender differentiated terms
- What would happen if a company in the UK did this?

| | | |
|---|---|---|
| Non compliant female price | £8 | ← Female business goes here |
| Compliant gender neutral price | £9 | ← Male business goes here |
| Non compliant male price | £10 | |

- At face value, in a rational market
  - female business would go to the noncompliant office
  - and male business to the compliant office

## Could we ignore the Gender Directive?
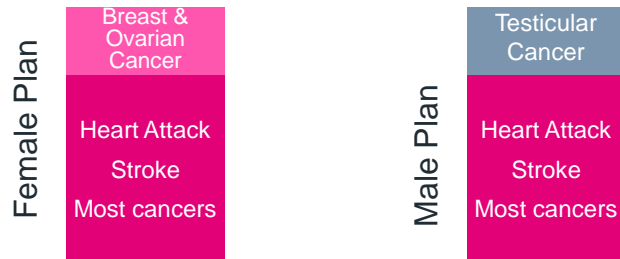
So, why would we comply?

- Savvy males would apply as females to take advantage of the lower rate
- Regulatory challenge is likely
- Competitor challenge is inevitable
- Compensating the small number of male applicants could be complex or expensive
- Targeting female lives only puts a strict limit on growth

## Could we work round the Gender Directive?

The gender directive judgement applies only to premiums and benefits and, at face value, allows products to be developed that are targeted at one or other gender.

For example, a critical illness style contract could be constituted as follows

**Female Plan**

Breast & Ovarian Cancer

Heart Attack
Stroke
Most cancers

**Male Plan**

Testicular Cancer

Heart Attack
Stroke
Most cancers

## Would this work in practice?

For this arrangement to work in practice, we would need:

• consumers and intermediaries to understand the difference between the male and female plan and the importance of selecting the "correct" plan

• a material price differential to exist between male and female prices

| Age | Male Price | Female Price | Gender neutral price |
|-----|-----------|--------------|----------------------|
| 25  | £15.08    | £15.04       | £15.06               |
| 35  | £28.93    | £28.12       | £28.52               |

Source: moneysupermarket.com 24 October 2012. £100k level cover for 25 years, guaranteed premiums

Gender neutral prices are assumed to be the average of male and female prices

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## Would this work in practice?

### Benefits

Price advantage in some areas

### Disadvantages

Some consumers would buy "wrong" cover if cheaper

Development cost

Could constitute indirect discrimination / be subject to challenge

Does not work for Life or Income Protection

*Probably not!*
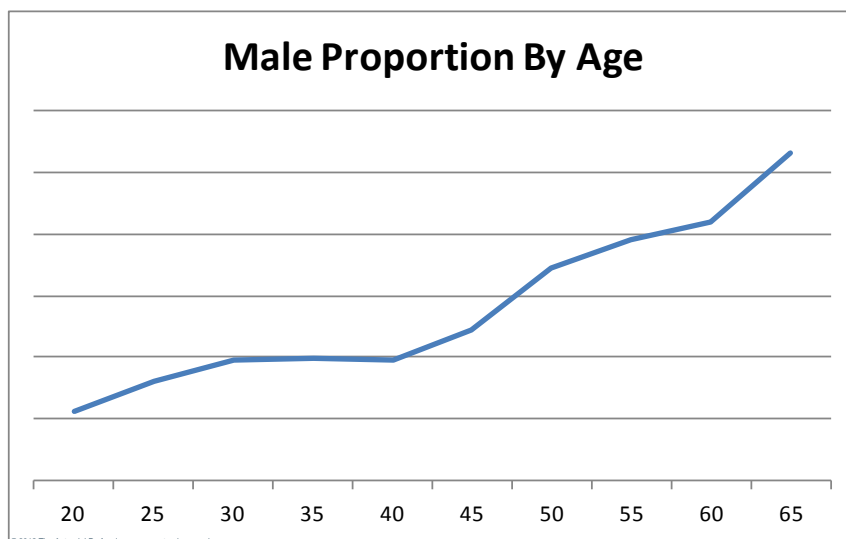
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# Pricing implications

Let's assume we have chosen to apply the directive and not work around with products…

… we can set our prices to be the average of our current male and female prices – what could go wrong with that?

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# Age impact

**Male Proportion By Age**

| 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 |

## Age impact

- We see a steady increase in the proportion of males by age
- What would be the impact of missing this feature?

| Age | Male Price | Female Price | 50:50 Price | Correct Age mix Price |
|-----|-----------|--------------|-------------|----------------------|
| 30  | £7.11     | £5.76        | £6.44       | £6.39                |
| 50  | £28.29    | £23.33       | £25.81      | £26.11               |

Source: moneysupermarket.com 24 October 2012. £150k level life cover for 20 years, guaranteed premiums

- Without competition, these small pricing errors may cancel out but
  - in a competitive market we would expect our mix to be highly skewed towards the area we underpriced

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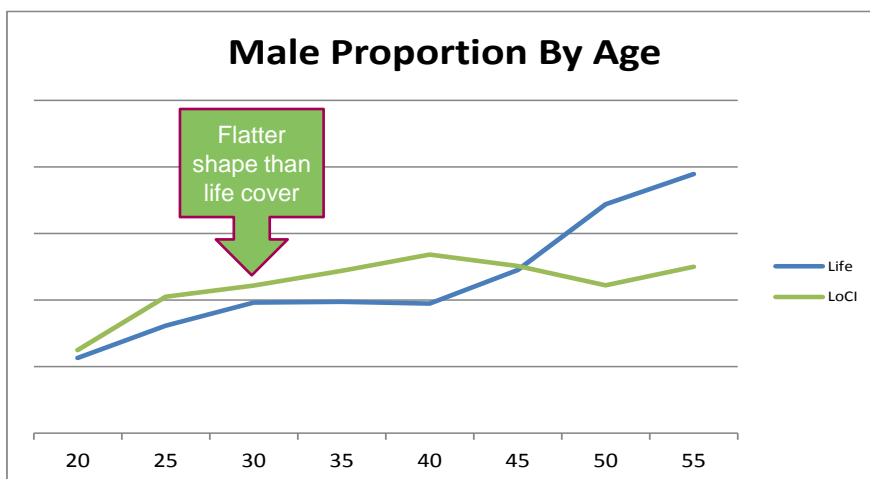
## Sum Assured impact



**Male Proportion By Sum Assured**

<100    100-200    200-500    500+
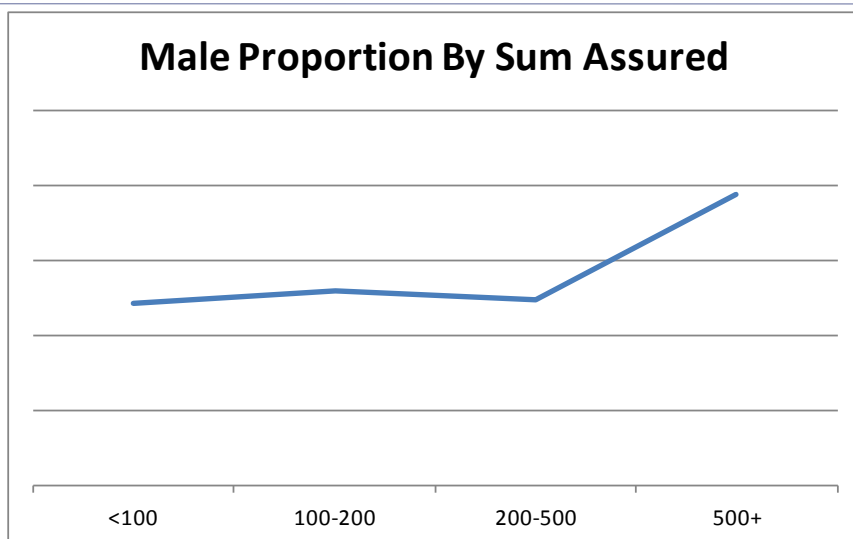
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## Sum Assured Impact

- We see a flat proportion of males by sum assured up to £500k but a higher proportion of males with sums assured £500k or above
- What would be the impact of missing this feature?

| SA | Male Price | Female Price | 50:50 Price | Correct SA mix Price |
|----|-----------|--------------|-------------|---------------------|
| £150k | £7.11 | £5.76 | £6.44 | £6.39 |
| £500k | £17.56 | £12.98 | £15.27 | £15.68 |

Source: moneysupermarket.com 24 October 2012. 30 ANB level life cover for 20 years, guaranteed premiums

- Without competition, these small pricing errors may cancel out but
  - in a competitive market we would expect our mix to be highly skewed towards the area we underpriced

## Combined Age and Sum Assured

**Male Proportion by Age and Sum Assured**



25%

7%

Legend: <100, 100-200, 200-500, 500+

X-axis: 30, 35, 40, 45, 50
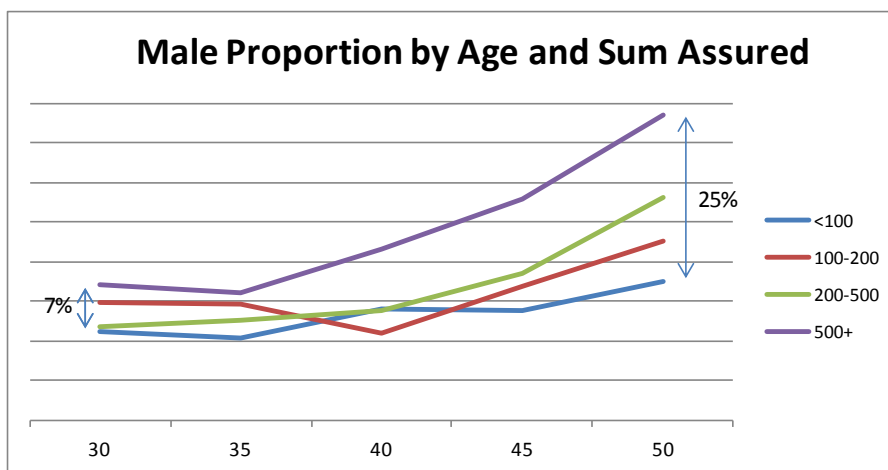
## Combined Age and Sum Assured impact

- We see some unusual patterns, but at most ages we see that the proportion of males increases with Sum Assured
- Reviewing the combined impact of Age and Sum Assured may therefore give clearer outcomes than reviewing Sum Assured on its own
- The other interesting feature is that the impact of Sum Assured is more pronounced at older ages than at younger ages
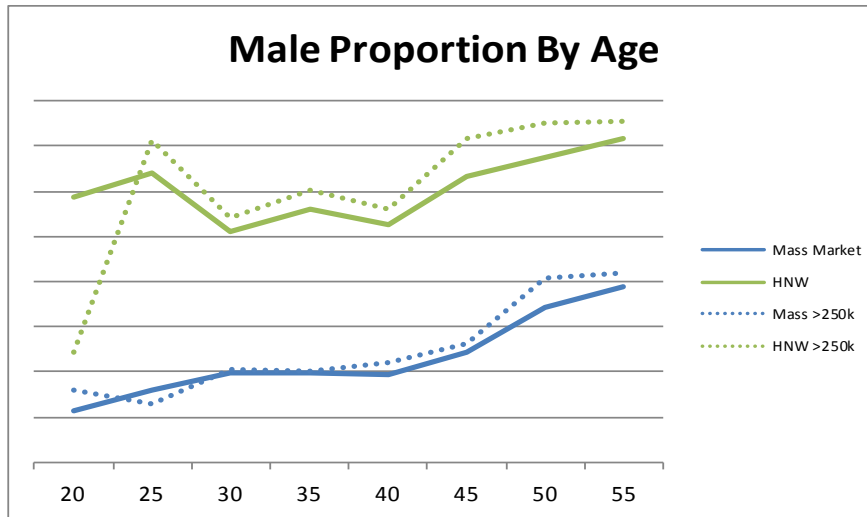
## Cover Type

**Male Proportion By Age**

Flatter shape than life cover

Life

LoCI

20    25    30    35    40    45    50    55

## Distribution channel

### Male Proportion By Age



Legend:
- Mass Market
- HNW
- Mass >250k
- HNW >250k

X-axis: 20, 25, 30, 35, 40, 45, 50, 55

## Distribution Channel

- For this portfolio, the proportion of males for a High Net Worth product is typically 20-30% higher than for a mass market product

- The dotted line shows mix for sums assured over £250k. This shows that distribution channel has more influence than sum assured on gender mix

- This would make a difference of up to 5% to the theoretical premiums that would be charged on a gender neutral basis.

## Joint Life Pricing



Male Proportion By Age

Life Cover

Life or Critical Illness Cover

Male Proportion By Age

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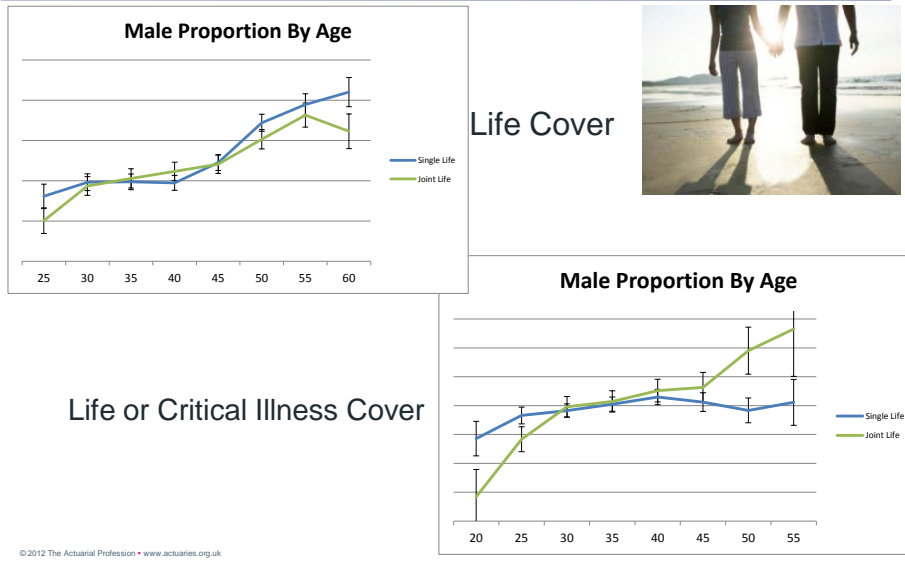
## Joint Life Pricing

- We might have expected that joint life cases would show a much flatter pattern by age
  - 95%+ of joint life cases are for one man and one woman
- It is therefore unexpected that we see that for most ages the male proportion for joint life business is very close to that for single life business
- However, at younger and older ages the proportions diverge
  - Any life offices with pricing mechanics that do not allow joint life cases to be priced independently of single life cases may therefore want to consider breaking this link

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Analysing and Modelling Gender Data

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## Inter Company Analysis

- 6 companies selling LTA and DTA mortality business in IFA market
- Gender mixes for recent business
- Excludes business cover where identifiable
- Shows
  - Patterns
  - Variability between companies
  - Effect on price of the variability

## Single Life % Male Policies - LTA
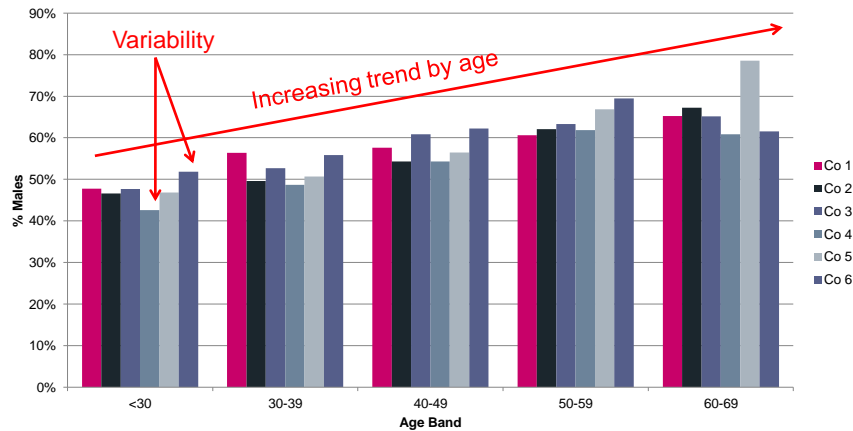
## Effect on Price of Variability - Examples

- Take the maximum difference in % males
- Assume female rates = 70% female rates
- If gender neutral rates determined on current mix
  - How different are rates between companies
  - Simple indication of price impact if you get the mix wrong!

| Age | Min male % | Max male % | Difference in price |
|-----|-----------|-----------|---------------------|
| 30 - 39 | 48.7% | 56.4% | 3.9% |
| 40 - 49 | 54.3% | 62.2% | 3.9% |
| 50 - 59 | 60.6% | 69.5% | 4.2% |

Single Life % of Male Sums Assured - LTA

Higher male %
More variability?
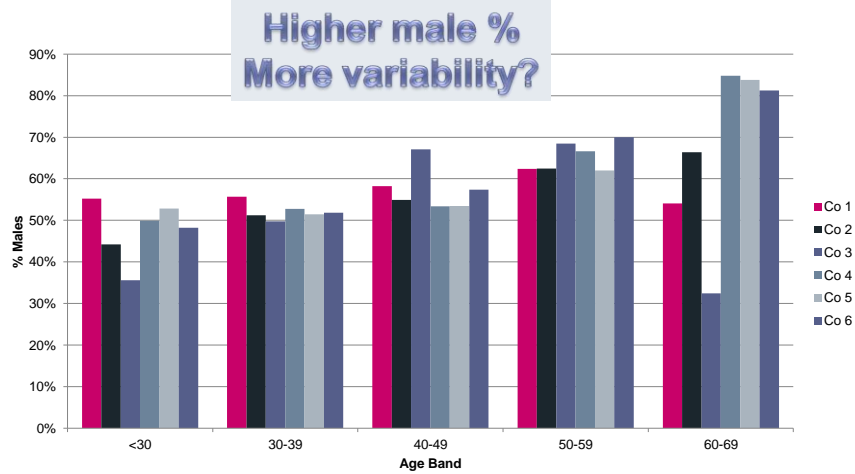
Single Life % Male Policies by Term - LTA

Range 66.7% – 82.6%
Price difference 7.4%

## Single Life % Policies by SA - LTA
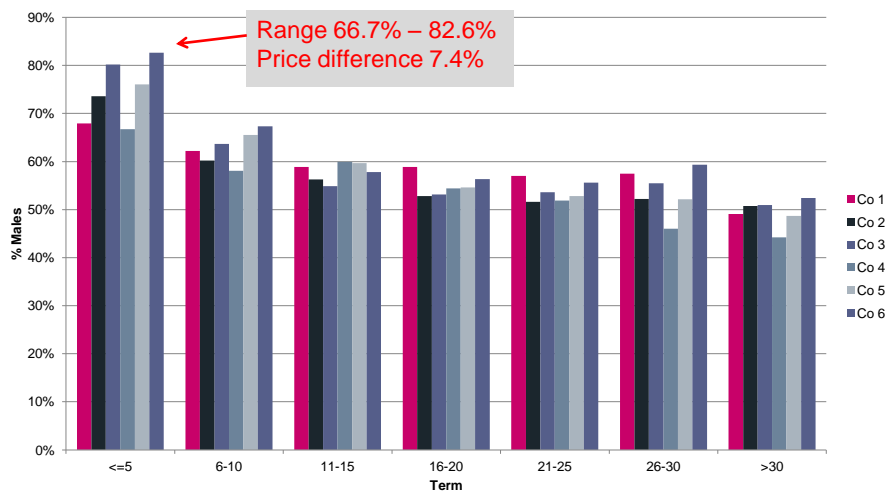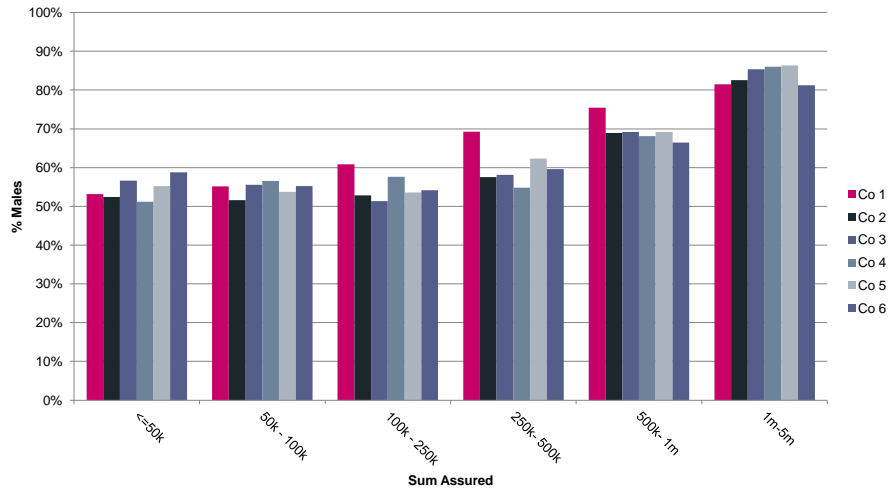


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## Joint Life Policies % Male - LTA
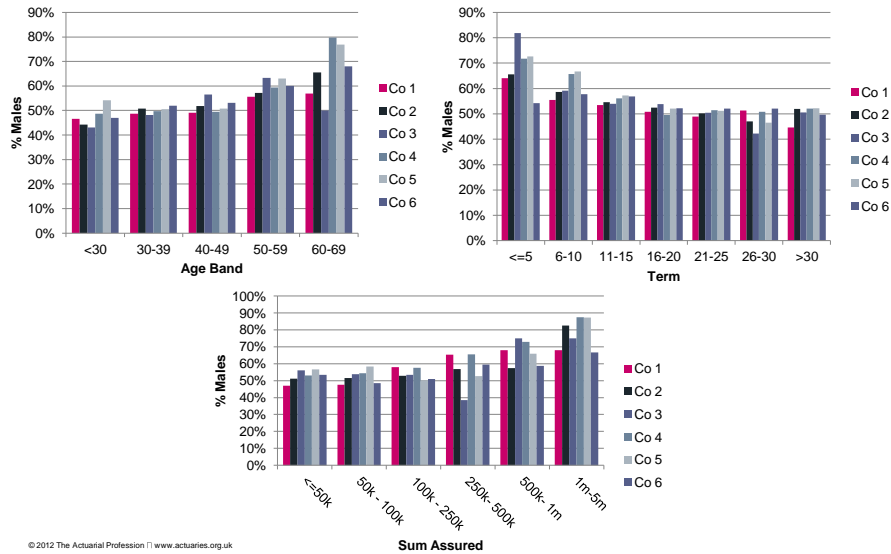


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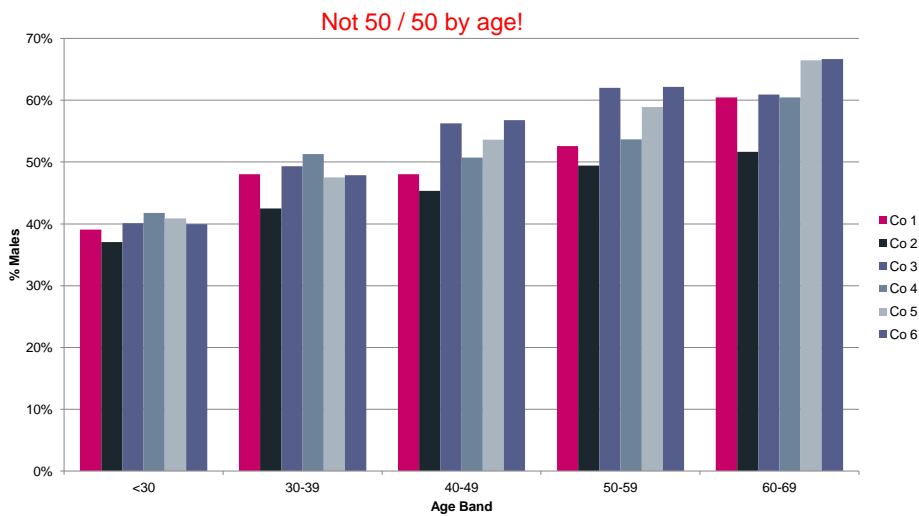
## And a Few DTA Splits (by Policy Count)

## Analysing Deeper

- One way splits only part of picture
- Multiple interactions e.g.
  - Sum assured and age
  - Age and term
- Predictive modelling gives more information

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# Producing a Model for Gender Mix

- Used GLM software in Glean
- Produce model on 50-75% of data
  - Test fit on remainder or all
- Model produces % males for any combination of multiple variables
- Principle can be used for any type of business (example = mortality)

# Developing the Model

**Step 1**
**One way analyses and identify main variables**

**Step 2**
**Produce model using single variables, eliminate non-significant**

**Step 3**
**Produce model with interactions**

**Step 4**
**Check fit and refine variables if necessary**

**Step 5, 6, 7........**
**Produce model, refine etc**

## Step 2
**Produce model using single variables, eliminate non-significant**

| Significant variables | Insignificant variables |
|---|---|
| Occupation class | Policy year |
| Age | Policy month |
| Cease age | |
| Policy term | |
| Family status | |
| Sum assured | |
| Product type (eg LTA, DTA) | |
| Smoker status | |

## Step 3
**Produce model with interactions**

- Test all combinations eg
  - Age
  - Age + term
  - Age + smoker status
  - Age + policy type
  - Age + Sum Assured
  - Sum Assured
  - Sum assured + term
  - Sum assured + smoker status   etc........................

## Step 4
**Check fit and refine variables if necessary**

- Exclude non-significant variables
- Refine variables e.g
  - Does banding give more significance than continuous?
  - Capping (SA / term etc)
  - Ln (x) instead of x

## Step 4
**Check fit and refine variables if necessary**

| Variables in Final Model | |
| --- | --- |
| 1) Cease age + age at entry | 11) Product type + ln(term) |
| 2) Cease age + ln (term) | 12) Product type + sum assured (capped) |
| 3) Family status + age at entry | 13) Ln (term) |
| 4) Family status + ln(term) | 14) Ln (term) + age at entry |
| 5) Family status + sum assured (capped) | 15) Sum assured (capped) |
| 6) Age at entry | 16) Sum assured (capped) + ln (term) |
| 7) Product type | 17) Smoker status + cease age |
| 8) Product type + cease age | 18) Smoker status + family status |
| 9) Product type + family status | 19) Smoker status + product type |
| 10 ) Product type + age at entry | |
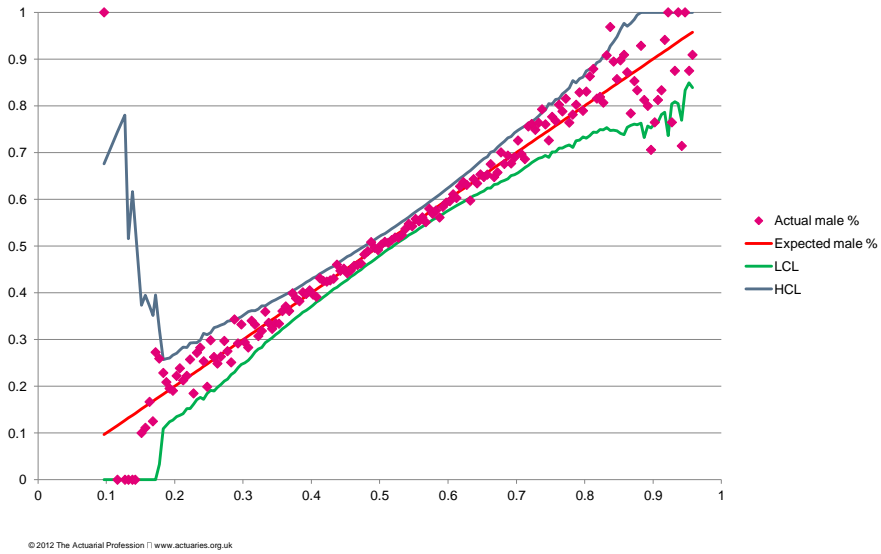
## Model Fit

## Model Fit excl Family Status
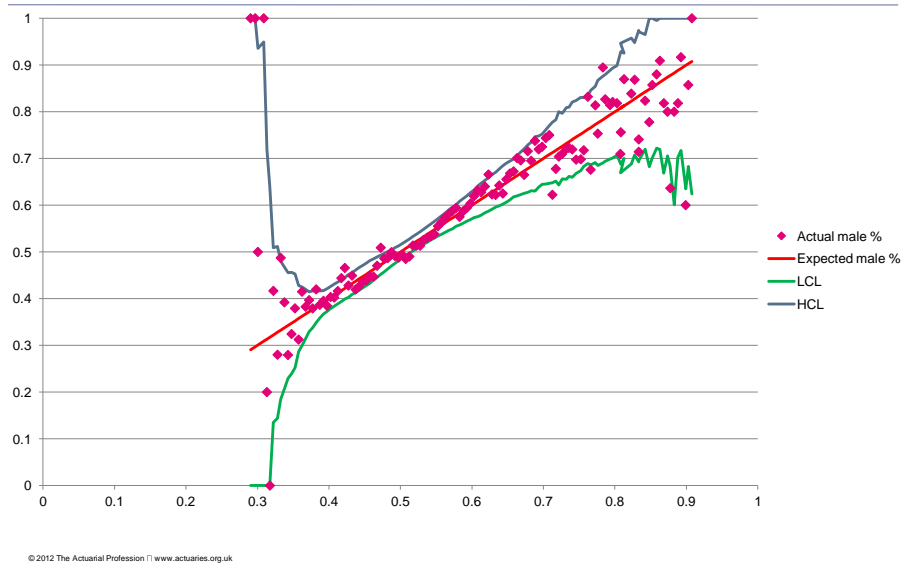
## Sample Output

| Rating factor | Value |
|---|---|
| Age Next Birthday at entry (whole years) | 45 |
| Policy Term (whole years) | 20 |
| Smoker status | Y |
| Sum assured | £150,000 |
| Cover type | Level Term Assurance |

| % Male |
|---|
| 56% |

## Variations

| Rating factor | Value |
|---|---|
| Age Next Birthday at entry (whole years) | 35 |
| Policy Term (whole years) | 20 |
| Smoker status | Y |
| Sum assured | £150,000 |
| Cover type | Level Term Assurance |

| % Male |
|---|
| 51% |

| Rating factor | Value |
|---|---|
| Age Next Birthday at entry (whole years) | 45 |
| Policy Term (whole years) | 5 |
| Smoker status | Y |
| Sum assured | £150,000 |
| Cover type | Level Term Assurance |

| % Male |
|---|
| 59% |

| Rating factor | Value |
|---|---|
| Age Next Birthday at entry (whole years) | 45 |
| Policy Term (whole years) | 20 |
| Smoker status | Y |
| Sum assured | £500,000 |
| Cover type | Level Term Assurance |

| % Male |
|---|
| 71% |

| Rating factor | Value |
|---|---|
| Age Next Birthday at entry (whole years) | 30 |
| Policy Term (whole years) | 5 |
| Smoker status | N |
| Sum assured | £300,000 |
| Cover type | Decreasing Term Assurance |

| % Male |
|---|
| 66% |

## Conclusion

- Competitive market = potential for getting it wrong
- Single factor analysis shows variability on many variables
- Multiway analysis gives added insight
- Variability between companies in identical markets
- Modelling gives further insights
- What will happen on 21$^{st}$ December???

## Questions or comments?

Expressions of individual views by
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