The Actuarial Profession
making financial sense of the future

ICA and ICG

A life office's experience

Workshop E05

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Contents

The Actuarial Profession
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Background – Three Different ICAs

GE Life Limited

- Annuities
- Equity release

GE Pensions Limited

National Mutual Fund

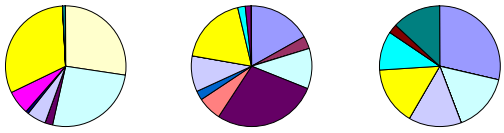
- With-profits fund with annuity guarantees
- Relatively low cash guarantees
- Little non-profit business in the fund

GE Pensions Limited

New Business Fund

- Unit-linked pensions
- Some other non-profit business
- Final salary pension scheme

(Variation in risks:)



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- Background
- **Development**
- Technical Issues
- ICG Experience
- Future Developments
- Summary

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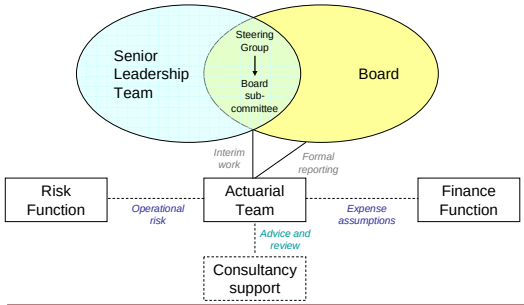
Development – Project Structure



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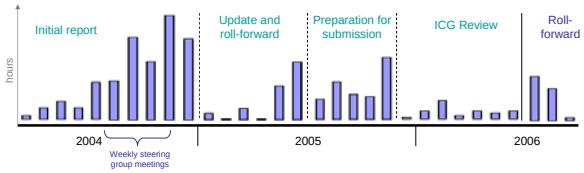
Development – Actuarial Work

Part-time team of **Actuarial Function Holder** and **3** actuaries

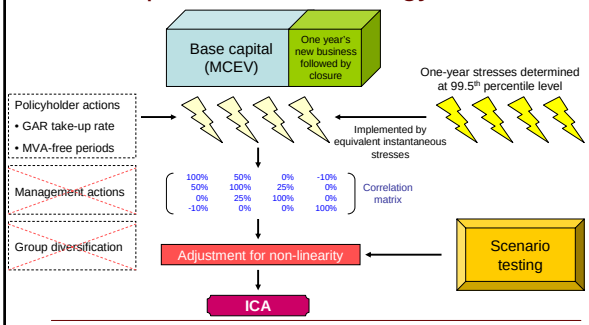
Over **3,500** Actuarial man-hours from commencement to receipt of ICG

Different computer systems used for each ICA

Advice and review from external consultants, but about **95%** of work in-house



Development - Methodology



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  - Stress interaction
  - Operational risk
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What's the problem?

"Sum of squares" result inadequate:

- Assumes linearity
- Requires normal distributions
- Ignores correlation behaviour at tails

Tackle this point with Monte Carlo simulation...

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Building a model – worked example

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Building a model – worked example

		Shock in					
	Variable (0 = unshocked) 1 in 200 stress	Equity prices E -45%	Property prices P -30%	Interest rates Y -124bp	Annuitant mortality M 1	Interest rate volatility V 0.5	TFC sacrifice T 1
A	Assets Equities Properties Fixed interest Cash, other **Total assets**	x(1+E)	x(1+P)	f(Y)			
S L	Liabilities Asset shares GAOs **Total liabilities**	x A' / A f(S)	x A' / A f(S)	x A' / A f(S, Y)	f(M)	f(V)	f(T)
	Estate = A - L						

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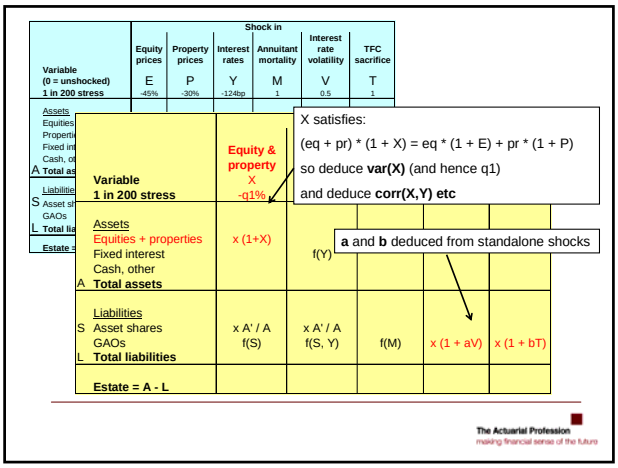
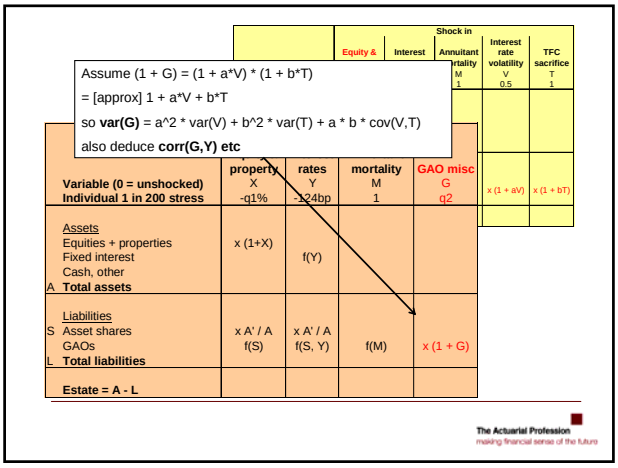
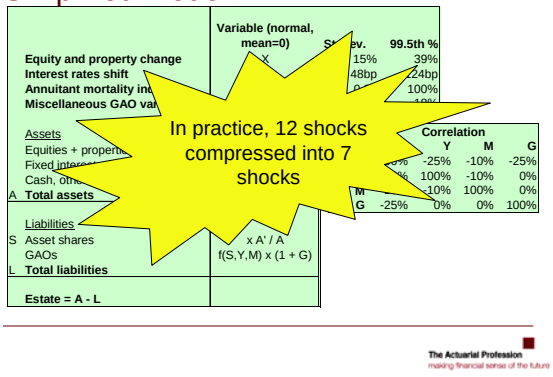




Simplified model



Implementation & simulation

	Variable (normal, mean=0)	St. dev.	99.5th %
Equity and property change	X	15%	39%
Interest rates shift	Y	48bp	124bp
Annuitant mortality index	M	0.39	100%
Miscellaneous GAO variation	G	0.07	18%

Correlation

	X	Y	M	G
X	100%	-25%	-10%	-25%
Y	-25%	100%	-10%	0%
M	-10%	-10%	100%	0%
G	-25%	0%	0%	100%

Assets		
Equities + properties	x (1+X)	
Fixed interest	f(Y)	Model bond portfolio with set of zero-coupon bonds
Cash, other	Constant	
A Total assets		
Liabilities		
S Asset shares	x A' / A	
GAOs	f(S,Y,M) x (1 + G)	f(S,Y,0) and f(S,Y,1) estimated by fitting suitable curves to known results from valuation program. For other M, interpolate / extrapolate
L Total liabilities		
Estate = A - L		

$$\begin{pmatrix} 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 \\ -0.02 & 0.00 & 0.00 & 0.07 \end{pmatrix} \times \begin{pmatrix} Z1 \\ Z2 \\ Z3 \\ Z4 \end{pmatrix}$$

- Z1, Z2, Z3 ... are independent N(0,1)
- Sample 1 million times, take 99.5th % loss
- Π
- "sum of squares

Interaction modelling - comments

- Model implemented in Excel using VBA:
  25 minutes to run through 1,000,000 x 7 Z-values
- Use tail of losses coming out of simulation:
  - Estimate confidence interval for 99.5th %
  - Identify shock combinations of particular concern
  - Demonstrate scenario testing (FSA)
  - Model robustness – rework some results accurately
- Can use log-normal shock variables –
  algebra on correlations more tricky

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Technical Issues – Operational Risk

GE Life Approach

- Step 1: Start by considering ways in which the cost of operational risk can manifest itself
  1. Payments imposed by third parties
  2. Compensation payable to third parties in respect of losses
  3. Internal remedial costs
  4. Unnecessary expenditure / poor value for money
  5. Unrecoverable overpayments
  6. Systematic process costs exacerbated by unusual events
  7. Investment losses
  8. Loss of value of future new business
  9. Costs associated with increased lapses
  10. Unanticipated existing liabilities

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Technical Issues – Operational Risk

- Step 2: Develop each category
  - e.g. "Payments imposed by third parties" → fines, levies, unanticipated tax, legal settlements, regulatory development, Euro entry … etc.
- Step 3: Estimate 99.5th percentile loss / loss distribution for each risk
  - Draw on data where available
  - Consultation with managers
  - 'Delphi' techniques (e.g. impact on lapses as a result of reputational damage)
- Step 4: Aggregate losses
  - Initially using correlation matrix and estimates of correlations …
  - … later by developing risk distributions and stochastic modelling
- Step 5: Consider correlations with other risks

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Technical Issues - Miscellaneous

- Low volumes of data – difficulties with:
  - valuing assets for which a market does not exist
  - setting certain stress assumptions
  - setting certain correlation assumptions
- Judgement as to what is a "1 in 200 year" event
- Valuation of pension scheme liabilities
  - differences in mortality assumptions
- Non-linearity issues
- Tax issues
- Validity of correlation matrix for fat-tailed and one-sided risks

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Correlation matrix approach to aggregation *can* be prudent
(not necessarily representative example)

Risk	Distribution
A	Normal, with 99.5th percentile loss calibrated to **–37**
B	Normal, with 99.5th percentile loss calibrated to **–2**
C	Displaced lognormal, with mean of zero, 99.5th percentile calibrated to **–26** and 99.9th percentile calibrated to –60
D	Displaced lognormal, with mean of zero, 99.5th percentile calibrated to **–70** and 99.9th percentile calibrated to –200
E	Normal, with 99.5th percentile loss calibrated to **–22**
F	Normal, with 99.5th percentile loss calibrated to **–39**
G	Displaced lognormal, with mean of zero, 99.5th percentile calibrated to **–25** and 99.9th percentile calibrated to –75
H	Displaced lognormal, with mean of zero, 99.5th percentile calibrated to **–37** and 99.9th percentile calibrated to –75
I	Normal, with 99.5th percentile loss calibrated to –2

Assume no correlations or interactions

"Sum of squares"
99.5th percentile = **-104.65**

1,000,000 simulations
Mean = -0.06
Median = +1.65
99.5th percentile = **-100.27**

What of other distributions, and with correlations or interactions …?

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ICG Experience - Submission

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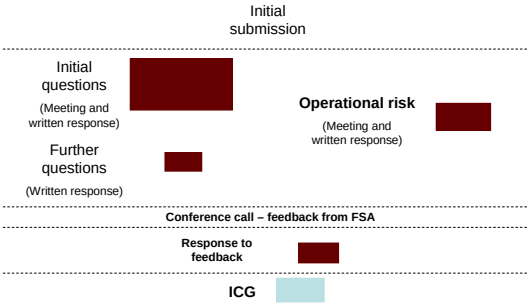
ICG Experience - Process



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Future Developments

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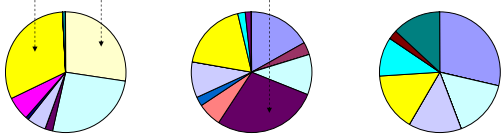
GE Pensions Limited
National Mutual Fund

GE Pensions Limited
New Business Fund

Mitigating actions to address key risks are primarily asset matching and reinsurance



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Summary - Achievements

- Board and management now better placed to quantify risks and prioritise management actions.
- Greater impetus given to risk mitigation measures.
- ICA work has influenced other business decision-making (e.g. MCEV replacing premiums as a measure of sales achievement).

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