The Actuarial Profession
making financial sense of the future

GIRO conference and exhibition 2010
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Reality of the Use Test

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A Reality of the Use Test…
Interpreting and communicating results

Agenda

- Introduction
- Interpreting and judging model results
- Communicating the results

Introduction
The use test

Key principle

- “The undertaking’s use of the internal model shall be sufficiently material to result in pressure to improve the quality of the internal model”

Introduction
The use test

For this workshop

- **Principle 1:** Senior management, including the administrative or management body, shall be able to demonstrate understanding of the internal model
- **Principle 6:** The internal model shall be used to support and verify decision-making in the undertaking
- **Principle 7.** The SCR shall be calculated at least annually from a full run of the internal model, and also when there is a significant change to the undertaking's risk profile, assumptions underlying the model and / or the methodology arising from decisions or business model changes, and whenever a recalculation is necessary to provide up to date information for decision-making or any other use of the model, or to fulfil supervisory reporting requirements

Introduction
How can we use the model?

Specific strategic decisions

- Reinsurance purchasing
- Investment allocation
- Capital allocation
- M&A activity

Day-to-day updates

- Revisions to business plan
- Development of an individual risk
- Changes in wider economic or market conditions

Introduction
How do we use the model?

It is important to have:

- Quick turnaround
- Results we understand
- Clear communication
- Results which are free from mistakes

Which requires:

- Model to be designed with use in mind
- A clear, straightforward process
- Flexible, prepared team

Introduction
How do we use the model?

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Which requires:

- Model to be designed with use in mind
- A clear, straightforward process
- Flexible, prepared team

A Reality of the Use Test…
Interpreting and judging model results

Learn throughout the model process

- As part of the main update cycle
  - Model checks
  - Understanding the model
  - Judging the results
- For specific updates

Interpreting and judging model results
Model checks

The average

- Ensure that the average is consistent with the business plan
- Need to look wider than profit / loss ratio
- And not just the total

Helps detect

- General errors in the entering of assumptions
- Model errors or peculiarities

Interpreting and judging model results
Model checks

Key percentiles and correlations

- For key variables – what you get out is consistent with what you put in, useful in a complex model
- Key results can be communicated as part of the internal review
- Check correlations to pick up impact of causal linkages

Helps detect

- General errors in the entering of key assumptions
- Model errors or peculiarities
- Inconsistencies in the understanding of assumptions

Interpreting and judging model results
Model checks

The extreme

- Look at simulations in the extreme tails

Helps detect

- Large errors impacting only a small proportion of the simulations
- Model not responding appropriately in extreme conditions

Interpreting and judging model results
Model checks

Gross vs net

- Look at the implied reinsurance performance
- And the distribution of this

Helps detect

- Errors made in entering reinsurance details
- Errors made in entering claims assumptions
- Assumptions inconsistent with reinsurance pricing

Interpreting and judging model results
Model understanding

Sensitivities and scenarios

- Vary parameters in the model and record change in results
- Sensitivities should be realistic
- Also test representative scenarios
- Should not be mechanical

Useful for

- Establishing importance (or otherwise) of areas of the model
- Performing “dry runs” on possible decision areas

Interpreting and judging model results
Model understanding

Collar simulations

- Sort the simulations by capital requirement
- Select a group of simulations around the risk level
- For key indicators calculate the difference between the average over those simulations and the average over all simulations

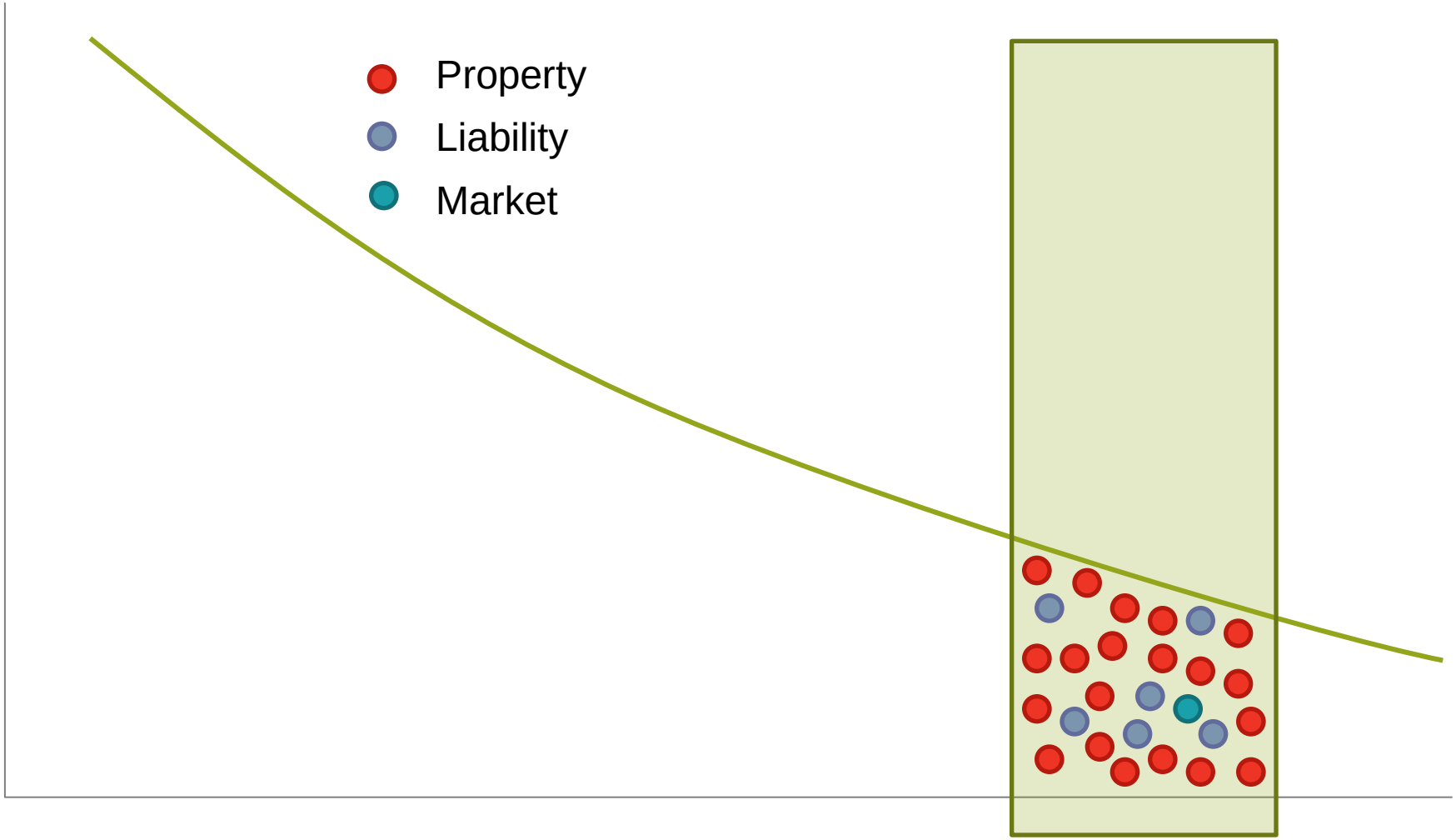
Useful for

- Identifying the key drivers of the capital requirement

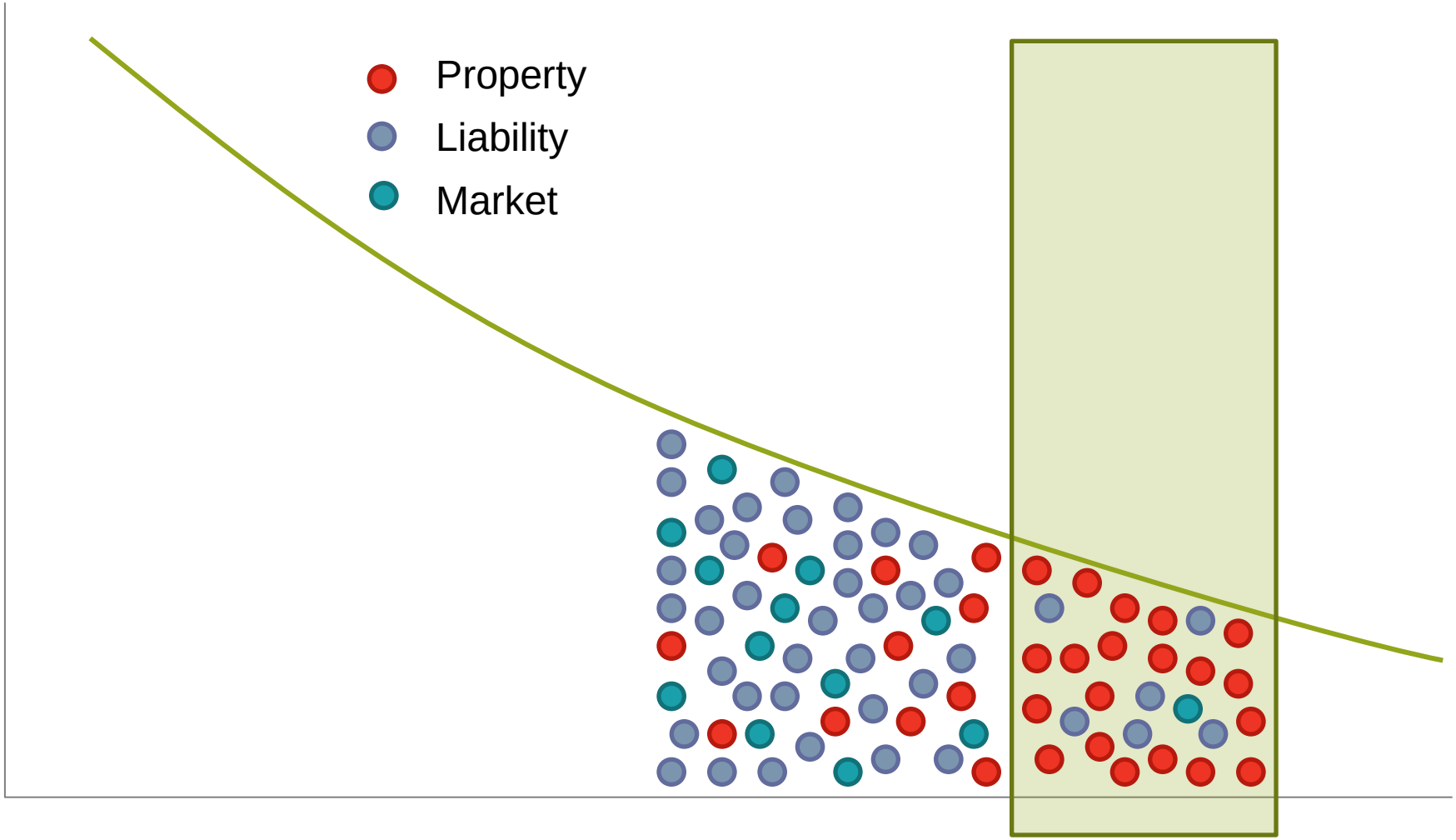
Caution

- Can create too narrow a focus

Interpreting and judging model results
Collar simulations – narrow focus



Interpreting and judging model results
Collar simulations – narrow focus



Interpreting and judging model results
As part of the main cycle

As part of the main cycle

- Model checks
  - Average
  - Key percentiles and correlations
  - Extremes
  - Gross vs Net
- Understanding the model
  - Collar simulations
  - Sensitivities and scenarios
- Judging the results

Interpreting and judging model results
For specific updates

Danger of concentrating on the capital

- If results do not match preconceptions
  - Mistake
  - Inappropriate model
  - Preconceptions are wrong
- If results match preconceptions?

We need a procedure to ensure the result is valid

Interpreting and judging model results
For specific updates

The process needs to be

- Be capable of identifying key issues
- Quick
- Easy to interpret
- Easy to communicate
- Transferable
- Suitable for all circumstances

Interpreting and judging model results
Component analysis

Suggested methodology

- Breakdown the profit and loss into component causes
- For each, standalone, calculate the “stress” - the difference between:
  - the expected value
  - the 99.5th percentile (or other percentile)
- Check the correlations between the key components
- Create a standard schedule of the stresses
- Track how these change with new runs

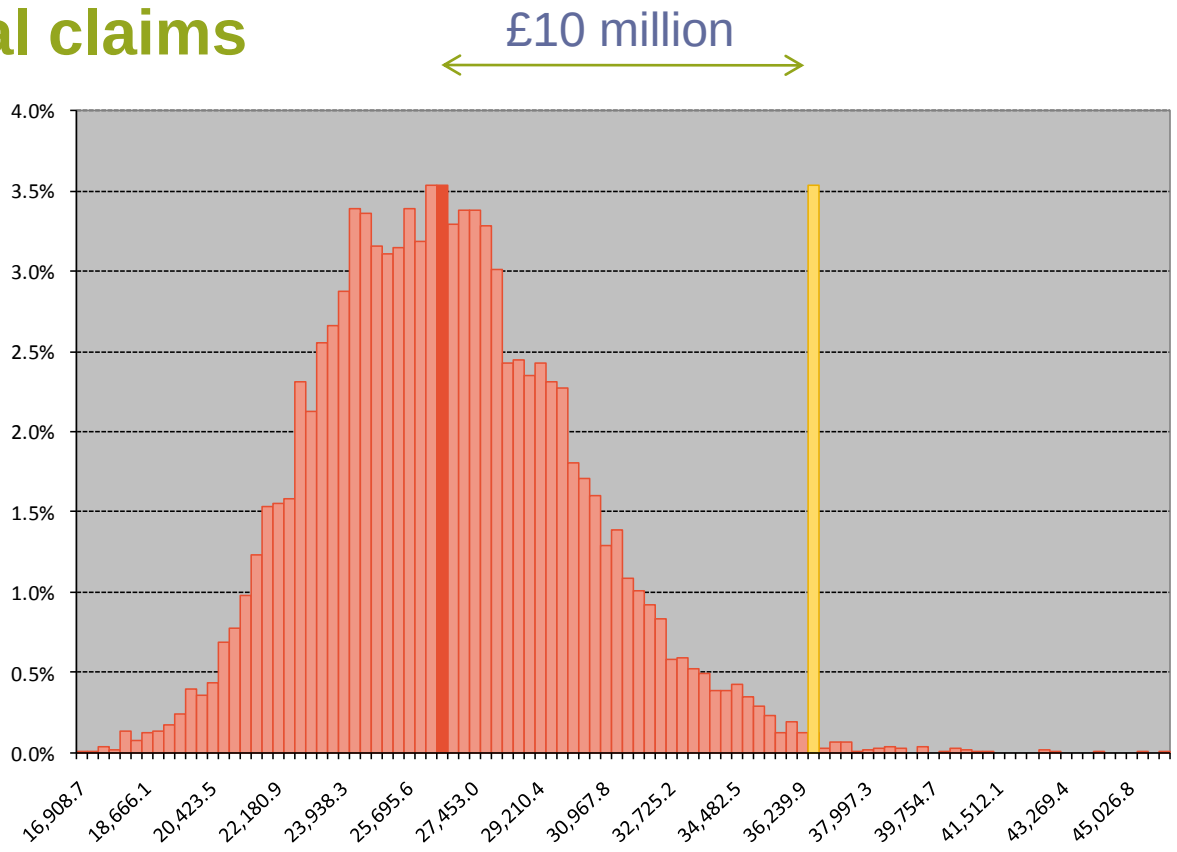
Interpreting and judging model results
Component analysis

Simple illustration

- Company writing liability business
- Focus on claims and reserve risk only, so 4 components
  - Attritional claims
  - Large claims
  - Reserve run-off
  - Disputed claim
- Looking over a one-year time horizon
- Only Individual XOL reinsurance

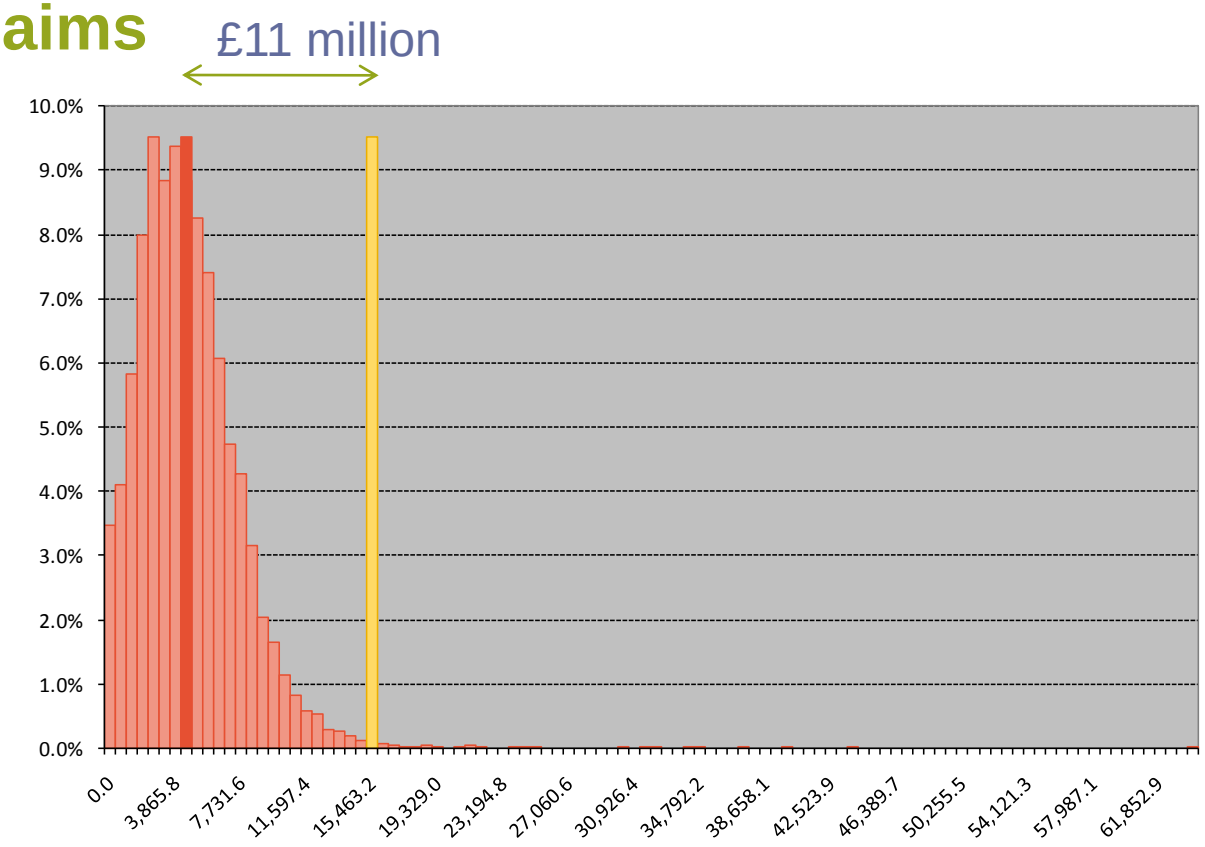
Component analysis
Example

Attritional claims



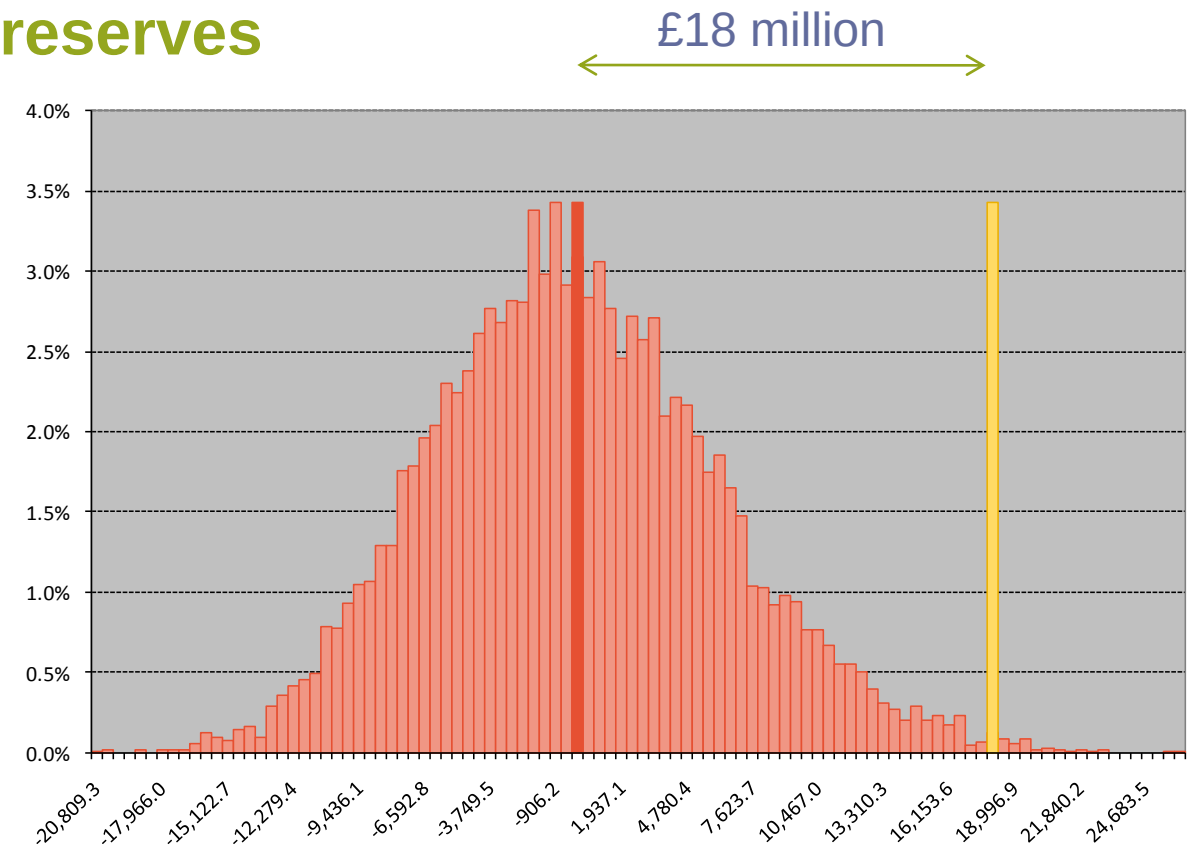
Component analysis Example

Large claims



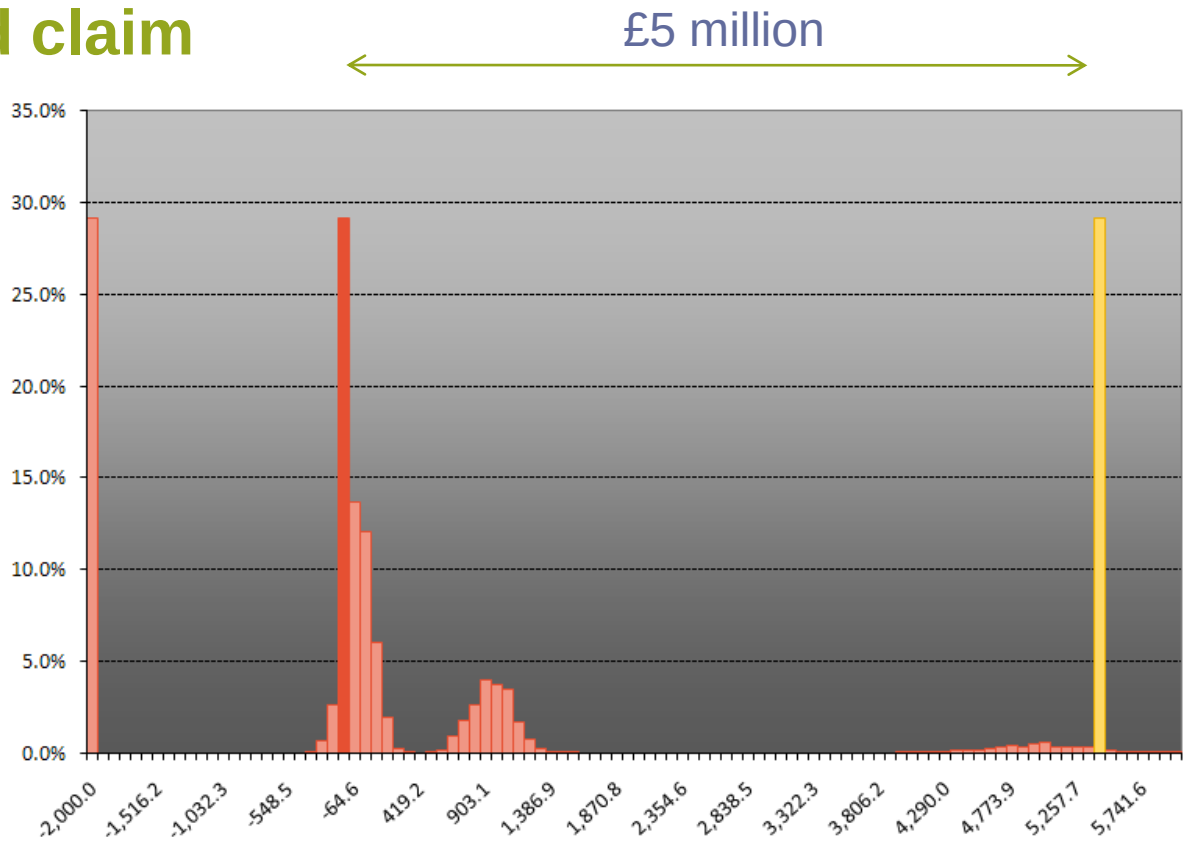
Component analysis Example

Historic reserves



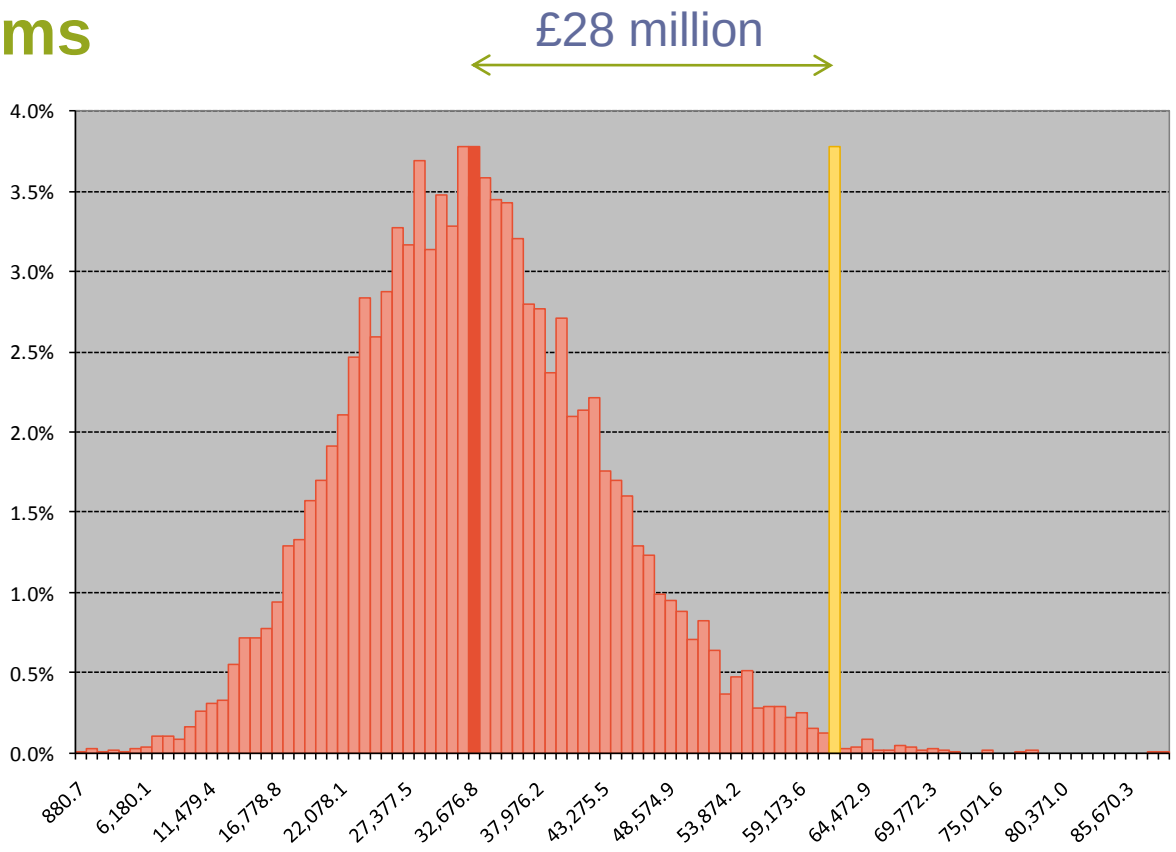
Component analysis
Example

Disputed claim



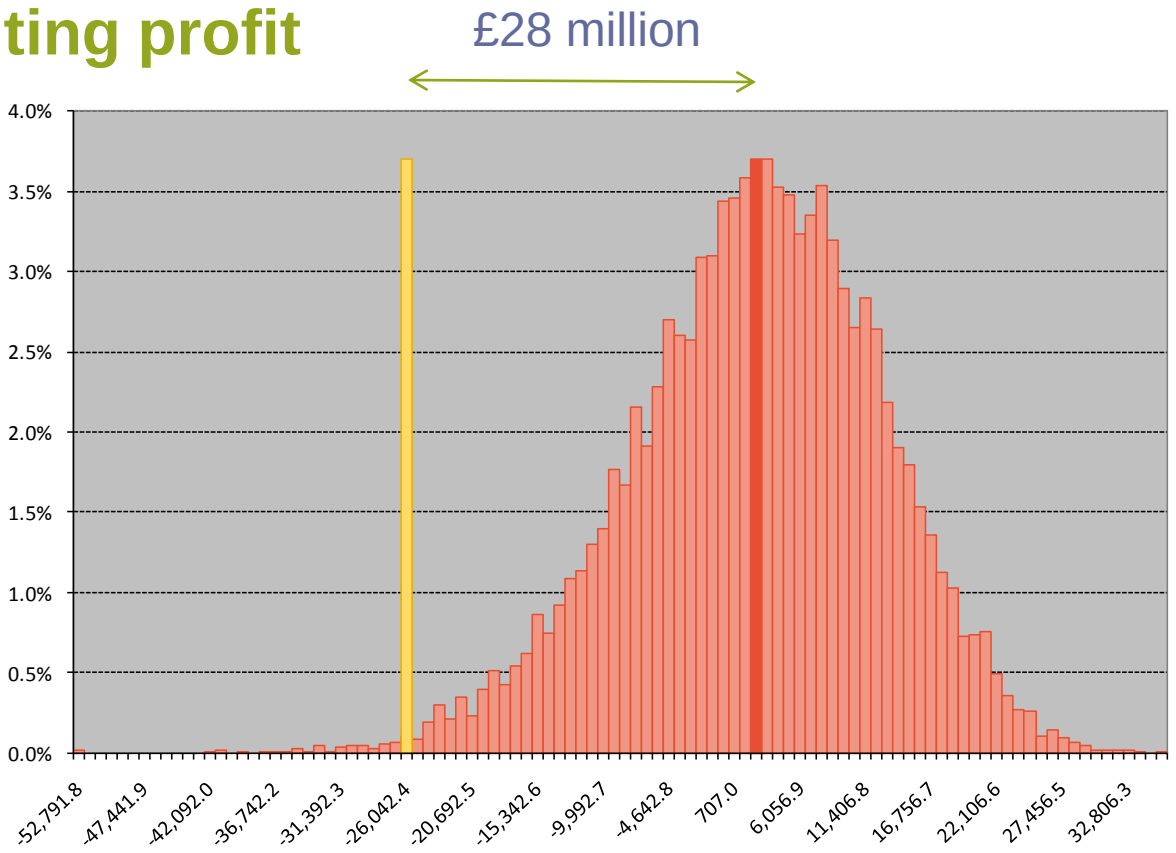
Component analysis
Example

Total claims



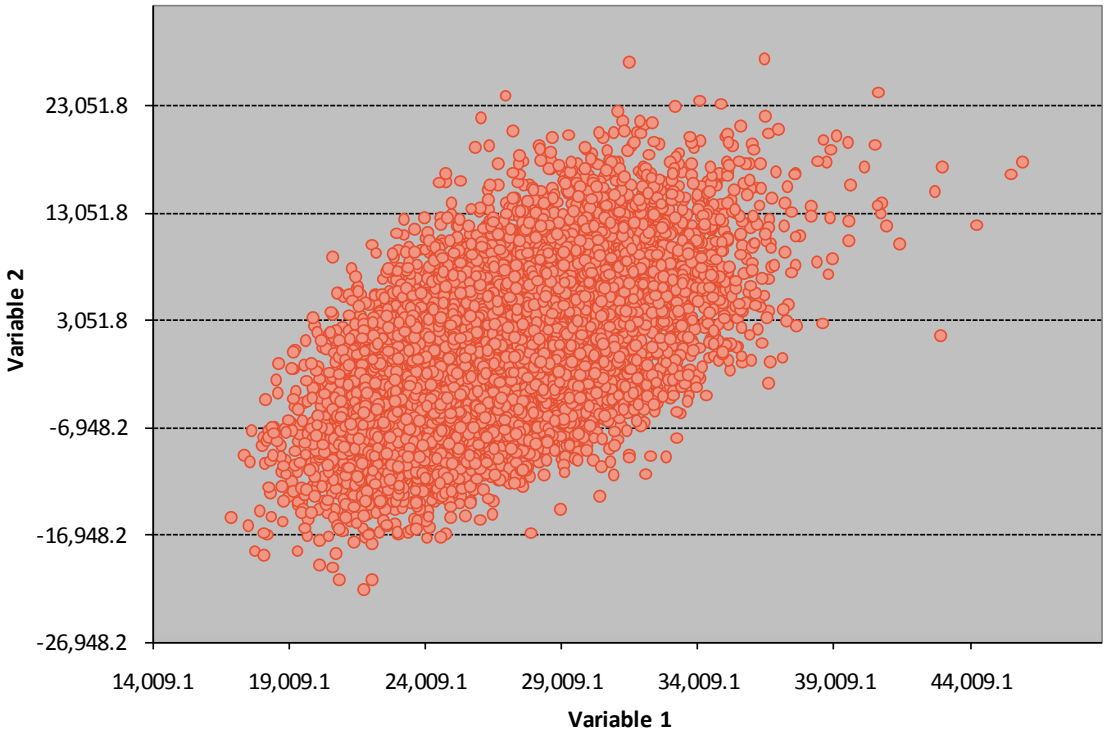
Component analysis
Example

Underwriting profit



Component analysis
Example

Key correlation – Attritional and Reserves



50% correlation

Component analysis Example

Base components

Component	Base Value
Attritional	10
Large	11
Reserves	18
Dispute	5
Total claims	28
Profit	5
Capital	23

Total difference from mean

Expected profit

Total loss = capital over 1 yr

Component analysis Example

Scenario 1: Resolution of disputed claim

Component	Base Value
Attritional	10
Large	11
Reserves	18
Dispute	5
Total claims	28
Profit	5
Capital	23

Disputed claim has now been settled, albeit for 1 million worse than expected.

But at least the risk has been removed from the book…

Component analysis
Example

Resolution of disputed claim

Component	Base Value	Scenario
Attritional	10	10
Large	11	11
Reserves	18	18
Dispute	5	0
Total claims	28	28
Profit	5	5
Capital	23	23

Component analysis Example

Scenario 2: Growth in earned exposure

Component	Base Value
Attritional	10
Large	11
Reserves	18
Dispute	5
Total claims	28
Profit	5
Capital	23

Volumes of business being written has increased significantly, we now expect to earn an extra 30% in the year

What does this mean for our capital position, do we need to act?

Component analysis
Example

Adding 30% earned exposure

Component	Base Value	Scenario
Attritional	10	13
Large	11	14
Reserves	18	18
Dispute	5	5
Total claims	28	32
Profit	5	8
Capital	23	24

Component analysis
Example

Adding 30% earned exposure

Component	Base Value	Scenario	Or…
Attritional	10	13	13
Large	11	14	18
Reserves	18	18	18
Dispute	5	5	5
Total claims	28	32	34
Profit	5	8	8
Capital	23	24	26

Interpreting and judging model results
Component analysis

Advantages of this analysis

- Quick and transferable
- Standardised
- Easy to interpret and communicate
- Easy for multiple people to review
- Can form the core of model change analysis
  - Senior management review
  - Regulatory communication
- Assist with other Model Tests

Component analysis
Profit and Loss Attribution

After the year

Component	Stress	Result
Attritional	10	2
Large	11	(5)
Reserves	18	(3)
Dispute	5	(1)
Total claims	28	(7)
Profit	5	(2)
Capital	23	

Interpreting and judging model results
Component analysis

Considerations

- What to group?
  - Same component across correlated lines
  - Small components on the same line
  - Shared reinsurance
  - Possibly 2-teir analysis
- Incorporating exposure and rate volatility
  - Requires standardisation
- Expanding over multiple years

Interpreting and judging model results
Conclusion

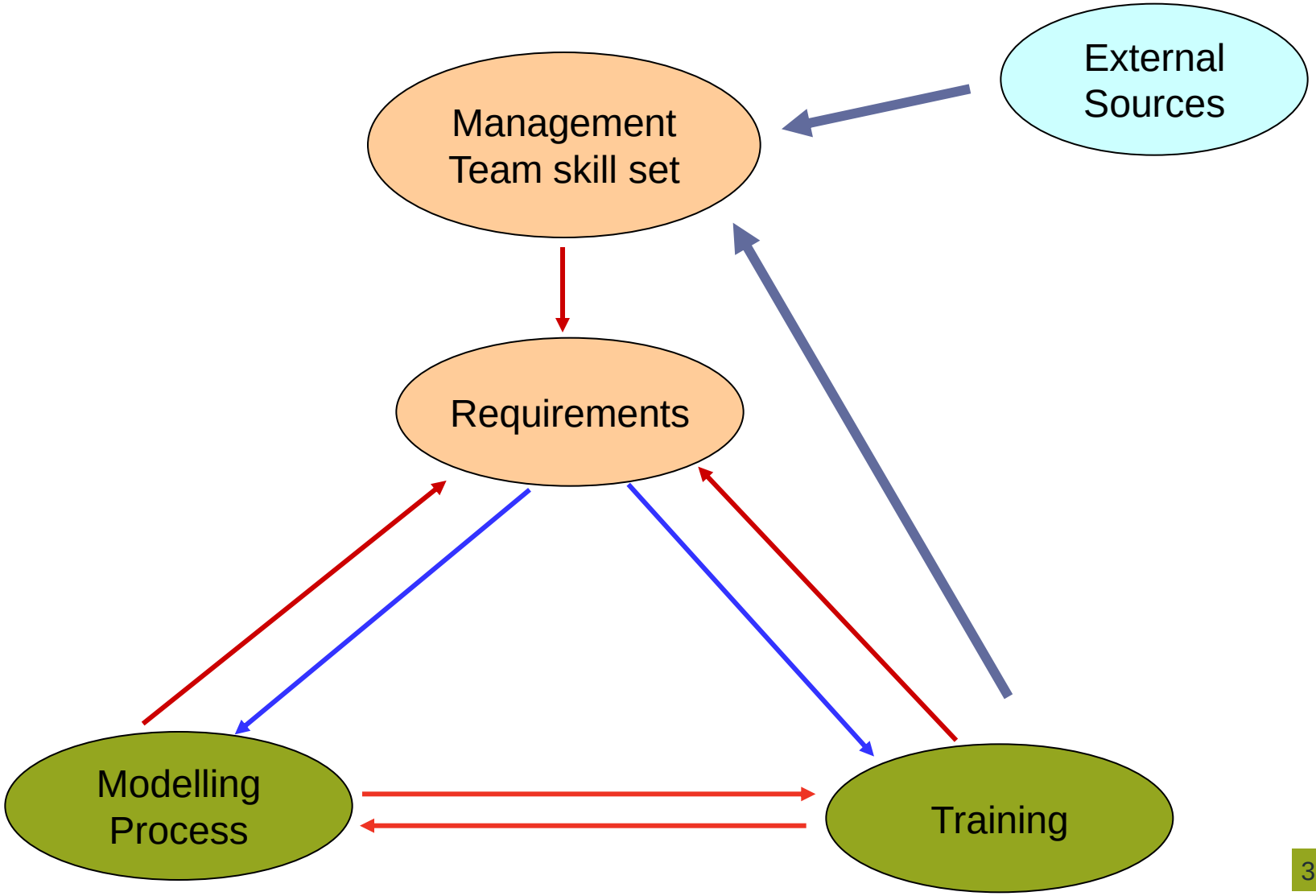
What we need to consider

- Preparation is key
  - Design the required outputs into the model
  - Learn and understand throughout the process
  - Important to document this knowledge
- Develop the process
  - Train multiple people
  - Develop standardised structures

Communicating the results
Overview

- MI requirements are ever-changing
- Current Management Requirements
- Use Test Foundation Principle
- Impact on Decisions
- Showing Results
- Quick Validation & Audit Trail
- Parameter update: Automated check and log
- Model update: Automated check and log
- Reporting example

MI requirements are ever-changing



Current Management Requirements

1. Result is valid
2. Show different options
3. Help with important decisions
4. Explain result in understandable terms
5. Explain limitations of analysis

Use Test Foundation Principle

- "The undertaking's use of the internal model shall be sufficiently material to result in **pressure to improve** the **quality** of the internal model"

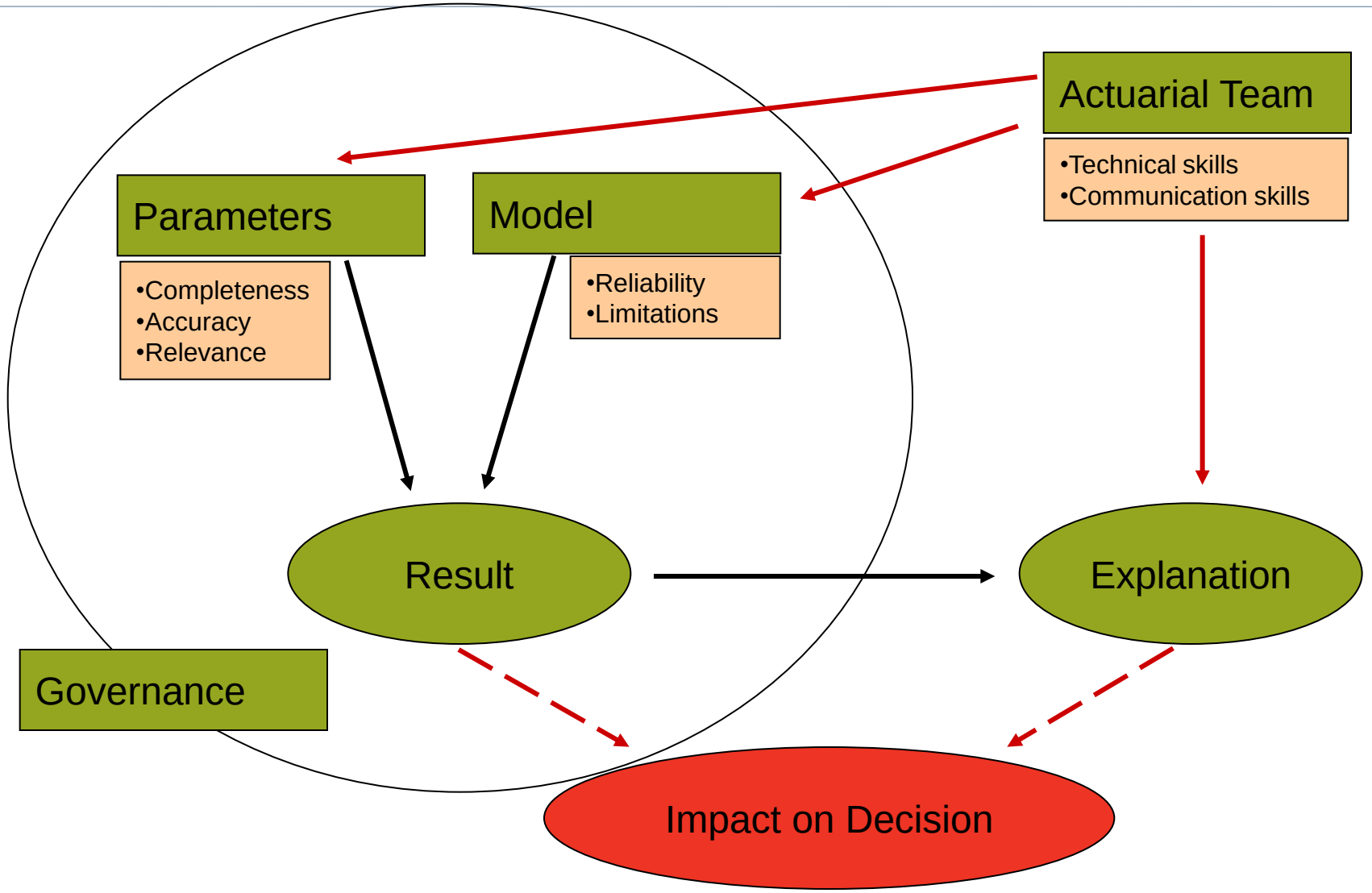
- *Source:* Level 2 Implementing Measures on Solvency II: Articles 120 to 126 – Tests and Standards for Internal Model Approval (former CP 56), 3.14 p19

➢ Highlighting ***limitations*** is key

➢ But, need to prove model quality to management

⇒ ***Quick Validation & Audit Trail***

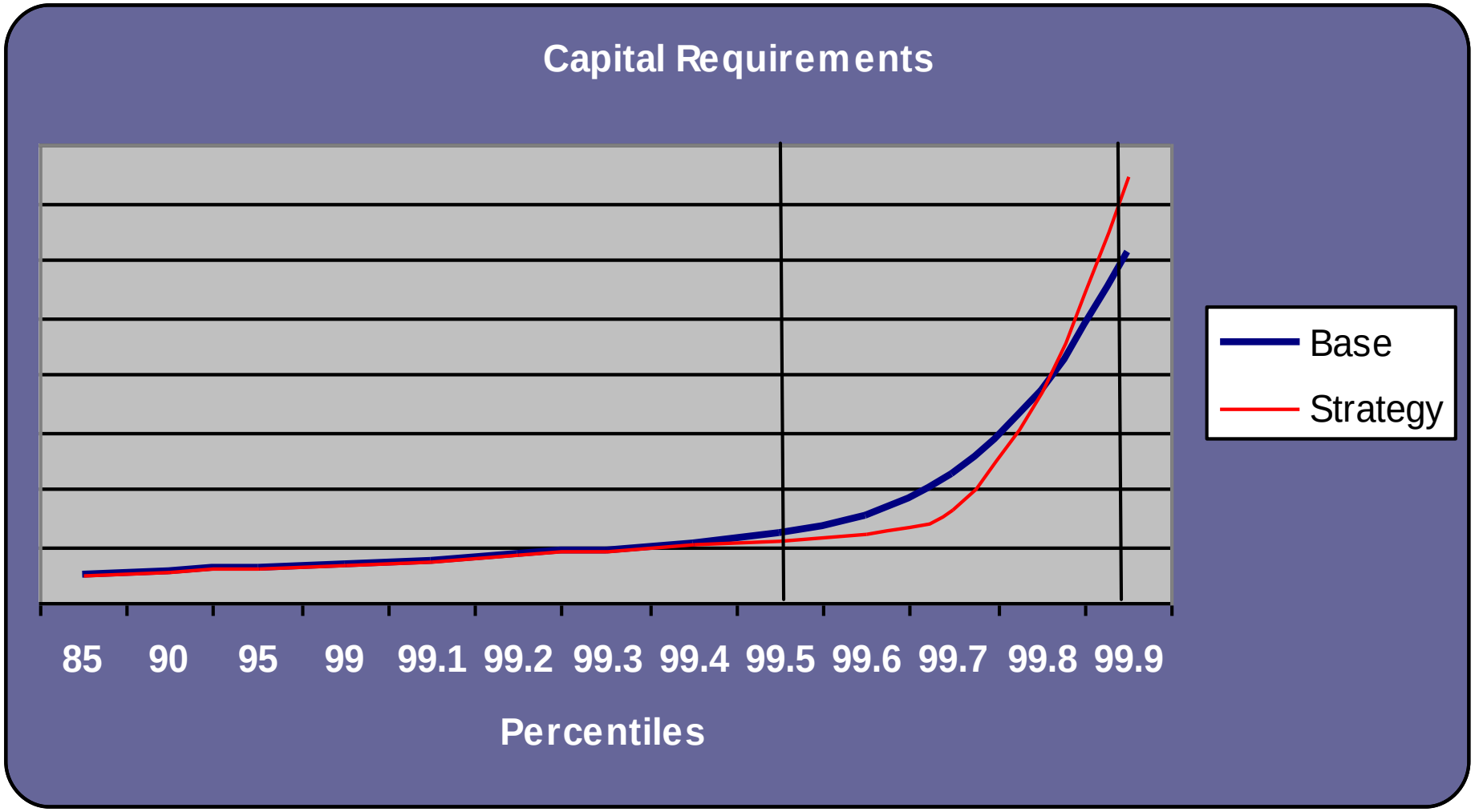
Impact on Decisions



Showing Results

- Risk – return relationship
- Define risk
  - VaR
  - TVaR
  - Downsize Risk
  - Standard Deviation
- Define Return
- Return on Capital
  - SCR
  - Economic Capital (ORSA)
  - Rating Agencies Capital

Capital Measure



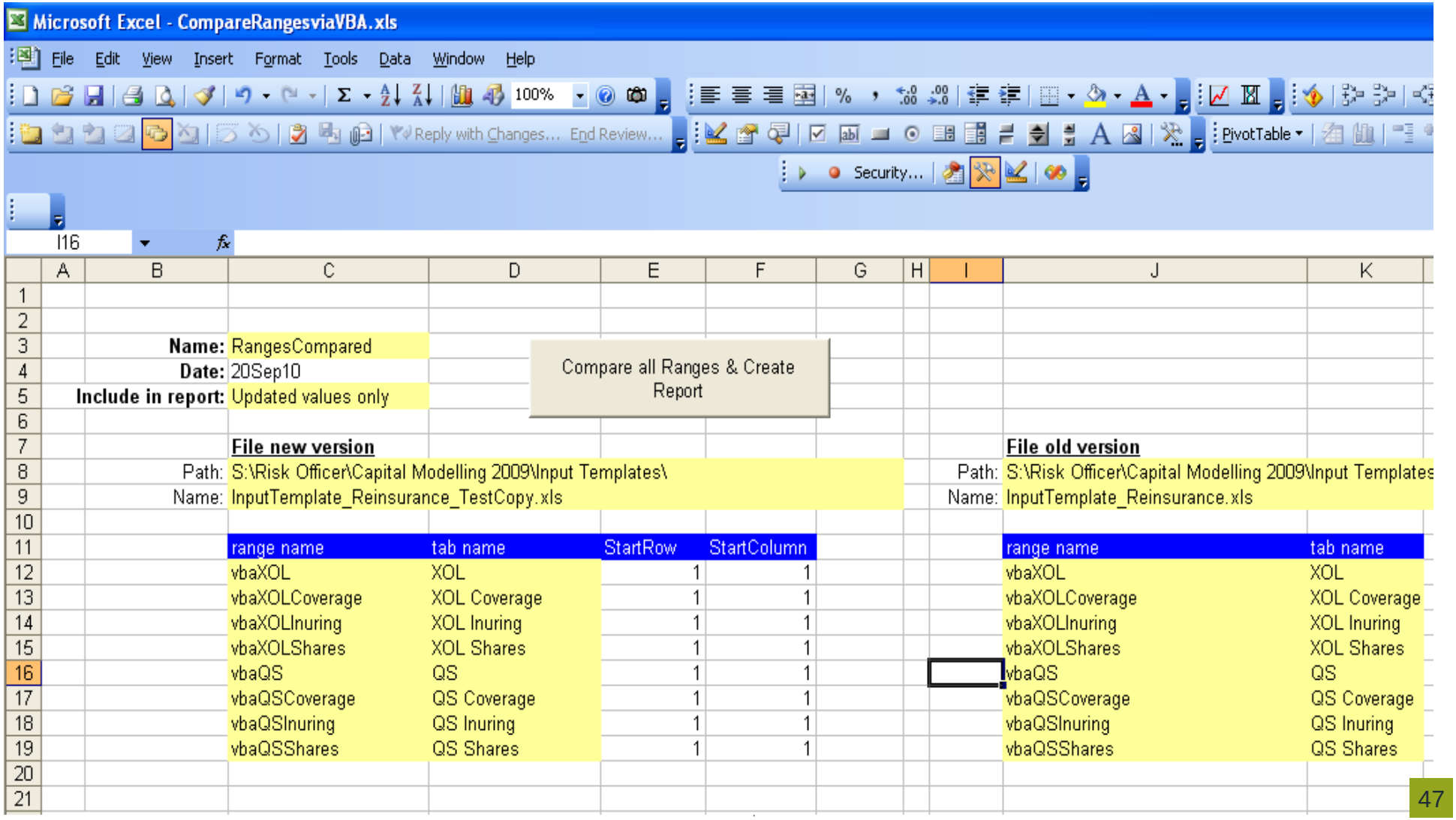
Quick Validation & Audit Trail

- Model
  - Confirm model name & seed
  - Show base capital (before update)
  - Show model structure updated correctly
- Parameters
  - Show that what should have changed has changed
  - Show that what shouldn’t have changed hasn’t
  - List key assumptions and sensitivity
- Governance
  - Regular Validation Reports increase reliability

Parameter update: Automated check and log

- Automated comparison of values in 2 ranges in Excel.
- Automated text format report showing:
  - Audit trail (model, range, date etc)
  - Changes (which cell has changed from what into what)
  - All the comparisons made (for completeness)
- Helps with audit
  - Ranges can be of different size – allows for additions and deletions between 2 versions
  - Changes are documented automatically

Example for Reinsurance Input Template



Name:	RangesCompared	
Date:	20Sep10	
Include in report:	Updated values only	

File new version	
Path:	S:\Risk Officer\Capital Modelling 2009\Input Templates\
Name:	InputTemplate_Reinsurance_TestCopy.xls

range name	tab name	StartRow	StartColumn
vbaXOL	XOL	1	1
vbaXOLCoverage	XOL Coverage	1	1
vbaXOLInuring	XOL Inuring	1	1
vbaXOLShares	XOL Shares	1	1
vbaQS	QS	1	1
vbaQSCoverage	QS Coverage	1	1
vbaQSInuring	QS Inuring	1	1
vbaQSShares	QS Shares	1	1

File old version	
Path:	S:\Risk Officer\Capital Modelling 2009\Input Templates
Name:	InputTemplate_Reinsurance.xls

range name	tab name
vbaXOL	XOL
vbaXOLCoverage	XOL Coverage
vbaXOLInuring	XOL Inuring
vbaXOLShares	XOL Shares
vbaQS	QS
vbaQSCoverage	QS Coverage
vbaQSInuring	QS Inuring
vbaQSShares	QS Shares

Parameter Update: Change Report

RangesCompared 19Sep10.txt - Notepad

File Edit Format View Help

```
19/09/2010 18:28:05  ============================================================
19/09/2010 18:28:05  Sub CompareAllRanges() started
19/09/2010 18:28:05
19/09/2010 18:28:08  Ranges 1: Old File =XOL!$B$3:$N$52 vs New File =XOL!$B$3:$N$52
19/09/2010 18:28:08  Comparison of ranges =XOL!$B$3:$N$52 and =XOL!$B$3:$N$52
19/09/2010 18:28:08  ============================================================
19/09/2010 18:28:08
19/09/2010 18:28:08  Ranges in files: S:\Risk Officer\Capital Modelling 2009\Input Templates\InputTemplate_Reinsurance.xls
and S:\Risk Officer\Capital Modelling 2009\Input Templates\InputTemplate_Reinsurance_TestCopy.xls
19/09/2010 18:28:08  ============================================================
19/09/2010 18:28:08
19/09/2010 18:28:08  Overview of the changes
19/09/2010 18:28:08  ----------------------
19/09/2010 18:28:08  Tab XOL, cell b3 was changed from Terrorism L1 10 to Terrorism L1 10 v2
19/09/2010 18:28:08  Tab XOL, cell c4 was changed from Reinsurer to Reinsurer v2
19/09/2010 18:28:08  Tab XOL, cell e5 was changed from 16494560.2684912 to 0
19/09/2010 18:28:08  Tab XOL, cell f6 was changed from USD to GBP
19/09/2010 18:28:08  Tab XOL, cell g11 was changed from 0 to 5000
19/09/2010 18:28:08  Tab XOL, cell k18 was changed from 0.03 to 0.05
19/09/2010 18:28:08  Tab XOL, cell h19 was changed from 25000000 to 20000000
19/09/2010 18:28:08  Tab XOL, cell i20 was changed from  to 0.2
19/09/2010 18:28:08  Tab XOL, cell j22 was changed from LOD to RAD
19/09/2010 18:28:08  Tab XOL, cell l25 was changed from 2 to 1
19/09/2010 18:28:08  Tab XOL, cell m26 was changed from 1 to 1.5
19/09/2010 18:28:08  Tab XOL, cell n26 was changed from 1 to 0.9
19/09/2010 18:28:08  Tab XOL, cell n52 was changed from  to 1
19/09/2010 18:28:08
19/09/2010 18:28:08  ================================================================
19/09/2010 18:28:08  ================================================================
19/09/2010 18:28:08  End of comparison of ranges =XOL!$B$3:$N$52 and =XOL!$B$3:$N$52
19/09/2010 18:28:08  of new file InputTemplate_Reinsurance_TestCopy.xls vs InputTemplate_Reinsurance.xls
19/09/2010 18:28:08  ================================================================
19/09/2010 18:28:08  ================================================================
19/09/2010 18:28:08  Ranges 2: Old File ='XOL Coverage'!$B$4:$BA$103 vs New File ='XOL Coverage'!$B$4:$BA$103
19/09/2010 18:28:08  Comparison of ranges ='XOL Coverage'!$B$4:$BA$103 and ='XOL Coverage'!$B$4:$BA$103
19/09/2010 18:28:08  ============================================================
19/09/2010 18:28:08
19/09/2010 18:28:08  Ranges in files: S:\Risk Officer\Capital Modelling 2009\Input Templates\InputTemplate_Reinsurance.xls
and S:\Risk Officer\Capital Modelling 2009\Input Templates\InputTemplate_Reinsurance_TestCopy.xls
19/09/2010 18:28:08  ============================================================
19/09/2010 18:28:08
19/09/2010 18:28:08  Overview of the changes
19/09/2010 18:28:08  ----------------------
19/09/2010 18:28:08  Tab XOL Coverage, cell ba8 was changed from  to LL_S_PL_EUR
19/09/2010 18:28:08  Tab XOL Coverage, cell c9 was changed from LL_S_Terrorism_EUR to
19/09/2010 18:28:08
19/09/2010 18:28:08  ================================================================
19/09/2010 18:28:08  ================================================================
19/09/2010 18:28:08  End of comparison of ranges ='XOL Coverage'!$B$4:$BA$103 and ='XOL Coverage'!$B$4:$BA$103
19/09/2010 18:28:08  of new file InputTemplate_Reinsurance_TestCopy.xls vs InputTemplate_Reinsurance.xls
```

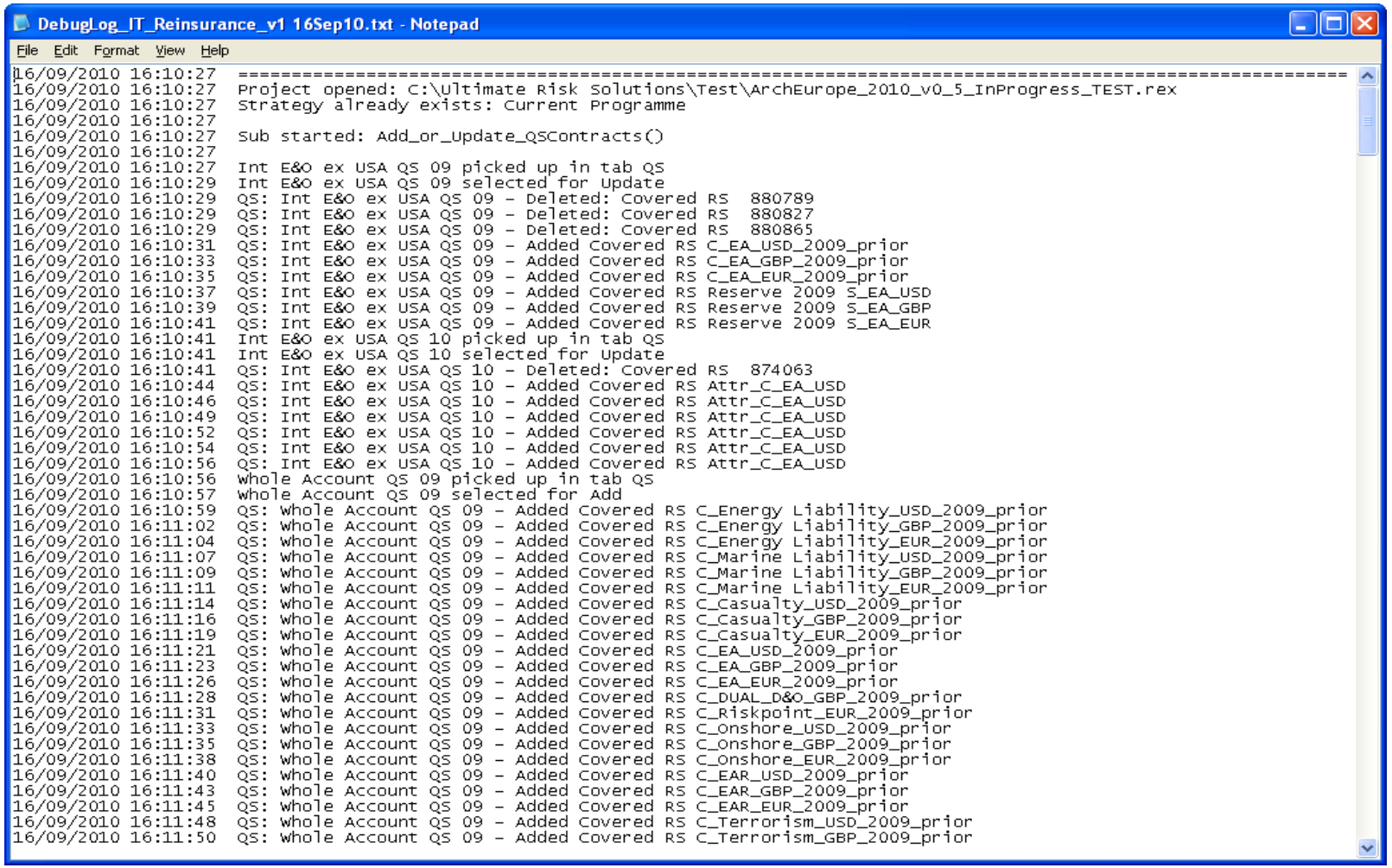
Model update: Automated check and log

Text format report is created while model is being updated:

- Audit trail (model, date, VBA process etc)

- Helps with audit & documentation
  - Update process documented in detail
  - Error checks built in and logged

Model Update: Change Report



DebugLog_IT_Reinsurance_v1 16Sep10.txt - Notepad

File Edit Format View Help

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16/09/2010 16:10:27  Strategy already exists: Current Programme
16/09/2010 16:10:27
16/09/2010 16:10:27  Sub started: Add_or_Update_QSContracts()
16/09/2010 16:10:27
16/09/2010 16:10:27  Int E&O ex USA QS 09 picked up in tab QS
16/09/2010 16:10:29  Int E&O ex USA QS 09 selected for Update
16/09/2010 16:10:29  QS: Int E&O ex USA QS 09 - Deleted: Covered RS  880789
16/09/2010 16:10:29  QS: Int E&O ex USA QS 09 - Deleted: Covered RS  880827
16/09/2010 16:10:29  QS: Int E&O ex USA QS 09 - Deleted: Covered RS  880865
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16/09/2010 16:11:40  QS: Whole Account QS 09 - Added Covered RS C_EAR_USD_2009_prior
16/09/2010 16:11:43  QS: Whole Account QS 09 - Added Covered RS C_EAR_GBP_2009_prior
16/09/2010 16:11:45  QS: Whole Account QS 09 - Added Covered RS C_EAR_EUR_2009_prior
16/09/2010 16:11:48  QS: Whole Account QS 09 - Added Covered RS C_Terrorism_USD_2009_prior
16/09/2010 16:11:50  QS: Whole Account QS 09 - Added Covered RS C_Terrorism_GBP_2009_prior
```

Reporting example

Applying a new Reinsurance structure

Strategy Description

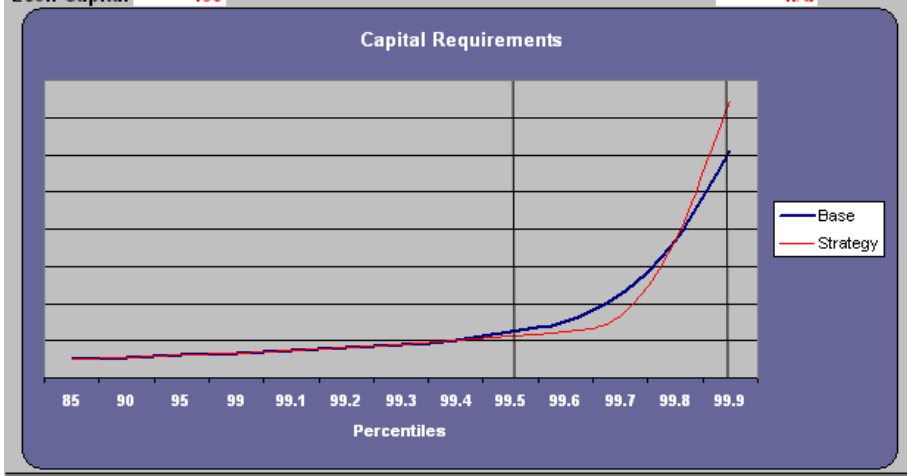
New XOL treaty was added placed with a single BB rated reinsurer
This treaty is shared between the Company and the Syndicate

Limitations

Model risks
Parameter risk
Proxy: shared reinsurance was modelled by adjusting the company and syndicate large loss FREQUENCY based on estimated exposure (GNEP)

Result section

SCR	90	Profit	n/a	ROC	n/a
Econ Capital	130				n/a



Notes

Preference based on Economic Capital differs from preference based on SCR

Credit risk in tail to be reduced by choosing a better - rated reinsurer

Strategy results in extra cost. Therefore ROC measure is not applicable

Validation section

base Model:	GOMinsurance_2010_v2.1	
Seed:	20	
base SCR:	95	99.50%
base Economic Capital	120	99.90%

Prove unchanged

	Base	Strategy
GWP	105	105
GCI	75	75
(others)	...	...

Prove changed

Link to log: RangesCompared 19Sep10.txt

Prove model update

Link to log: DebugLog_IT_Reinsurance_v1 16Sep10.txt

Explanation

SCR decreases: the new treaty gives better protection at the 1/200 year level without significant credit risk

Economic capital increases: in extremis the BB reinsurer defaults on the recoveries increasing capital requirements

Sensitivity section

	SCR levels			
	Change in key assumption			
Key Assumptions	-10%	-5%	5%	10%
Large loss frequency	87	89	92	98
Frequency correlation	84	88	93	100
Large loss severity	89	89	91	93

	Economic Capital levels			
	Change in key assumption			
Key Assumptions	-10%	-5%	5%	10%
Large loss frequency	125	128	133	140
Frequency correlation	122	127	134	145
Large loss severity	129	129	132	135

	S&P Capital levels			
	Change in key assumption			
Key Assumptions	-10%	-5%	5%	10%
Large loss frequency	n/a	n/a	n/a	n/a
Frequency correlation	n/a	n/a	n/a	n/a
Large loss severity	n/a	n/a	n/a	n/a

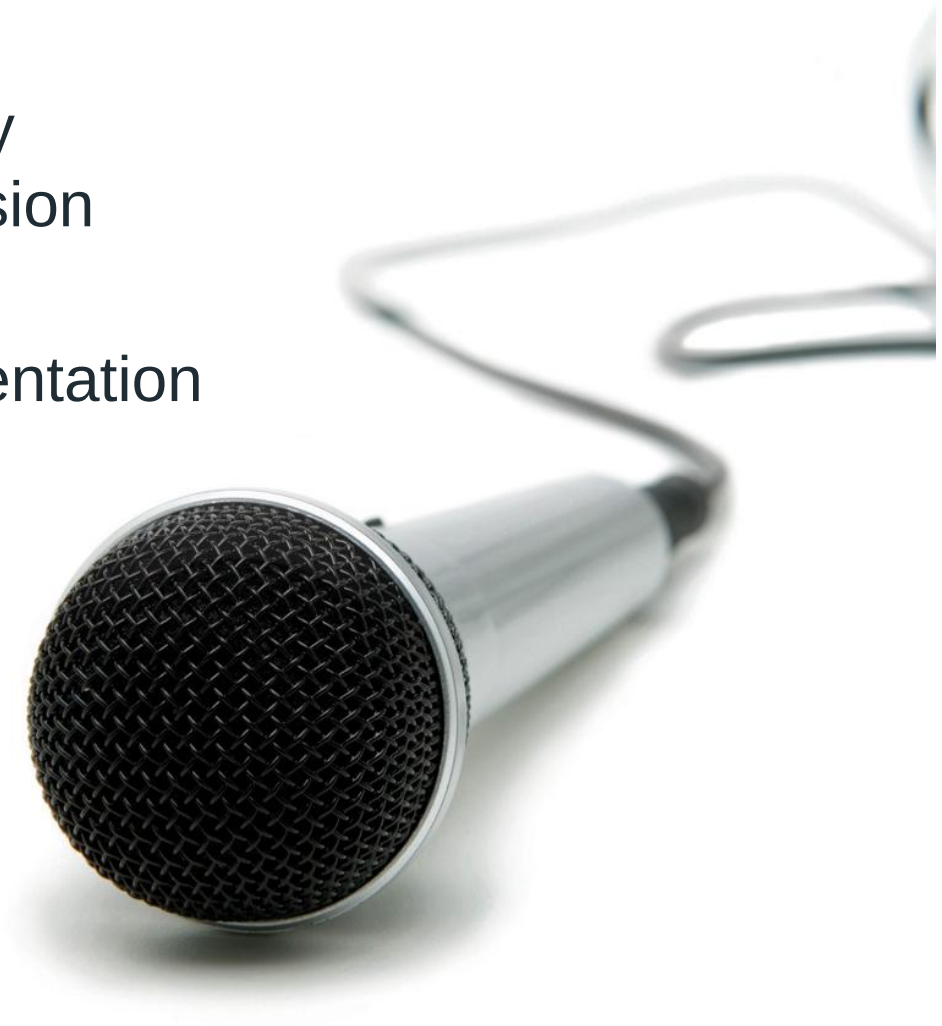
Conclusion

- For management to make informed decisions
  - Highlight limitations
  - Quick Validation & Audit Trail
- Requirements will change regularly

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 presenter.



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