

Delegate Pack

# Solvency II: event on technical issues for general insurers intending to use an internal model



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Prudential Regulation Authority  
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## **Solvency II: event on technical issues for general insurers intending to use an internal model**

James Orr  
Richard Winter

1 May 2014

## **Agenda: Plenary one**

1. Introduction to today
2. Context of the PRA's approach and Solvency II
3. The PRA's internal model review process
4. Managing the risks of internal model approval
5. Solvency II myths
6. Validation
7. Is the result extreme enough to represent 1 in 200?
8. Summary
9. Questions

## **1. Introduction to today**

- a. Objectives
- b. Overview
- c. The legal context

## 1a. Objectives

- i. Assist firms in improving the quality (not quantity) of submissions.
- ii. Discuss methods by which work done and judgements made can be effectively justified and communicated.
- iii. Provide insight into the PRA's review process and thoughts on review work to date.

**The PRA wants to help general insurers improve the quality of their internal model submissions**



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## 1b. Overview

9:30 - 10:30	<b>Plenary one</b>	Overview of models and validation framework
10:30 - 11:00	Coffee	
11:00 - 12:30	<b>Plenary two</b>	Expert judgement and dependencies
12:30 - 14:00	Buffet lunch and networking	Hand in questions for plenary four by 14:00
	13:00-14:00 Drop in session one	Dependencies Expert judgement Supervisory statement 5/14
14:00 – 15:30	<b>Plenary three</b>	Premium and reserve risk modelling
15:30 – 16:00	Coffee	



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## 1c. The legal context

The material provided today is offered on the following basis:

- The PRA has prepared the information for today's event on the basis of the information available at 1 May 2014.
- Today's event is being held in order to facilitate readiness, but it should be acknowledged that this discussion is not taking place against the background of final adopted texts and firms should ensure they familiarise themselves with all obligations as they are published.
- **The Delegated Acts have not yet been published** and there are still Implementing Technical Standards (ITS) and Regulated Technical Standards (RTS) and guidelines to come.
- Ultimately, the adopted Level 2 regulations (delegated act and EIOPA ITS and RTS) will set out definitively what is required to comply with the Solvency II regime. Therefore providing firms are complying with the Level 2 regulations they will have complied with their obligations under EU law.
- **The comments made today do not represent a statement of PRA policy.**



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## 1c. The legal context (cont)

The material provided today is offered on the following basis:

- **None of the comments made in these slides should be taken to mean that the PRA considers that Level 2 should apply in advance of its formal coming into effect.** There may be discussion about actions firms can take in readiness for the Solvency II regime, but this does not create any legal obligation to comply earlier than the implementation date of 1 January 2016.
- **Any emphasis on a particular provision in the Solvency II regime in these materials should not be taken to imply that it is a priority or an area of particular supervisory concern for the PRA,** or vice versa. The PRA will have a duty to supervise the entire Solvency II regime consistently with the obligations in Level 1 and 2 texts.
- Where approaches for compliance with Level 2 are discussed, they merely represent a possible method of complying with Level 2 obligations and should not be interpreted as representing *the* only way which the PRA will accept. **Approaches are put forward for consideration rather than to be prescriptive.**
- Presenters may mention certain 'good practices' based on reviews to date for a sample of firms. **More 'good practices' or even 'better practices' may emerge as other firms' models are reviewed.** In addition, what is considered as a 'good practice' for a particular type of firm may not necessarily be considered such for all other firms.



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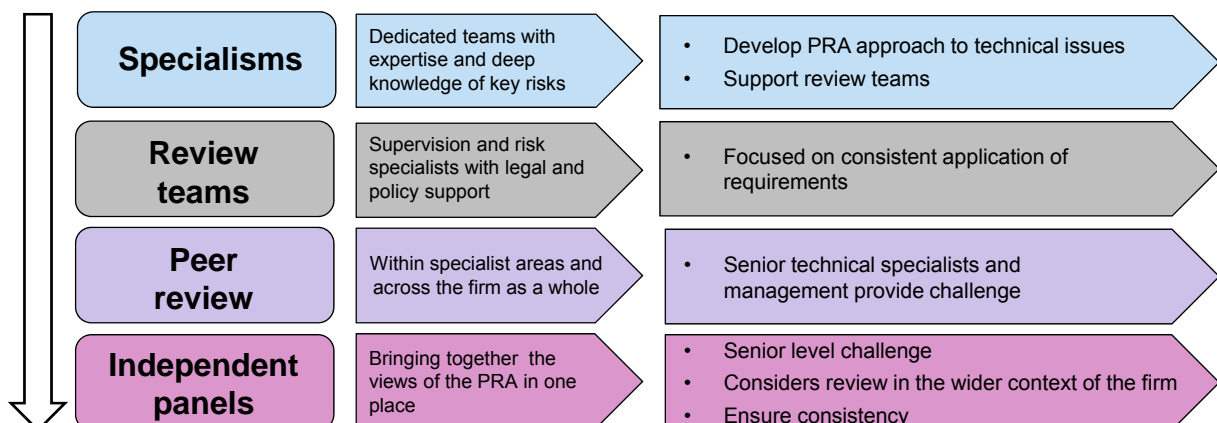
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## 2. Context of the PRA's approach and Solvency II

- **Risk-based capital models project into the future, based on:**
  - past data
  - beliefs on how the world will behave
- **Despite limitations, risk-based models can:**
  - provide insight into potential exposure
  - help rank risks
  - better manage risks accepted, retained and transferred
- **Good internal models will help firms manage risk better**

## 3. The PRA's internal model review process

Different skills and perspectives from across the PRA input to the internal model review process



## 4. Managing the risks of internal model approval

There are no firms currently in a position where model approval is assured

It is important that firms have a “Plan B” to know how they would manage if initially they are on standard formula

**The PRA will not give approval for a model that does not meet the Tests and Standards of Solvency II – capital add-ons cannot be used for this purpose**

## 5a. Solvency II myth number 1: Quality of documentation

**Myth:** The PRA assess the quality of documentation by how much it weighs when it is printed

- All documentation should exist, but not necessarily be presented to the PRA
- Documentation should be complete, clear and easy to follow
- Quality of documentation is more important than quantity
- Documentation should include clear evidence to justify the conclusions

Firms should consider which TASs\* apply and how they have complied with them



## 5b. Solvency II myth number 2: Use test

**Myth:** The use test means that firms have to ‘pretend’ that the model is perfect

**Myth:** The use test means that firms have to follow the output of the model for all purposes

- **Model needs to be fit for purpose – it does not need to be perfect**
- **Model should be a factor in the decision making process**
- **Limitations of model, and where appropriate plans to improve the model, should be communicated**

## 6a. Validation: Key findings from PRA reviews

### Effective independent challenge



- **Proportionality - focus validation on key judgements**
- **Testing of the model should confirm robustness**
- **Report outcomes and conclusions**
- **Feedback reactions to the conclusions to the business**

## 6b. Validation: Key findings from PRA reviews

### Justification

Is the model specified correctly? Are inputs appropriate?

Many firms are incorrectly calling this validation...

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### Validation

Checking outputs to ensure the model properly reflects the risk profile

Checking that processes and governance have been followed



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## 7. Is the result extreme enough to represent 1-in-200 ?

How has the issue of parameter error been handled?

How is claim inflation risk being taken into account?

Does the data used for parameterisation capture all possible outcomes? If not, what has been done about it?

Are there related assumptions that individually are treated as immaterial, but collectively become material?

Is the business plan being used a “best estimate” or does it assume that things get better – shifting the whole distribution?

Does the dependency structure properly capture the links between extreme events?



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This list is not exhaustive

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## 8. Summary

- The PRA wants to help firms to improve the quality of submissions
- Documentation: quality not quantity
- Models should be fit for purpose so they can be used
- Justification  $\neq$  Validation
- The PRA considers that the 1-in-200 in many models is understated



## 9. Questions?





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## **Expert judgement**

Rachel Evans  
Andy Macnair

1 May 2014

## Objectives

### To provide insight into:

- The PRA's thinking on expert judgement
- What the PRA has seen across the industry
- What has been really useful in review work

## Agenda

1. Definition of expert judgement
2. Expert judgement governance
3. Materiality of judgements
4. Making an expert judgement
5. Validation of expert judgement – some tools
6. Communication
7. Documentation
8. Summary
9. Questions

# 1. Definition of expert judgement

## EIOPA's preparatory guidelines:

*“the expertise of individual persons or committees with relevant knowledge, experience and understanding of the risks inherent in the insurance or reinsurance business”*

Reference: EIOPA-CP-13/011 Guidelines on Pre-Application of Internal Models 1.15 (definitions)

# 2. Expert judgement governance

- The Board needs to be able to rely upon the governance around expert judgements
- It is useful where firms have articulated their expert judgement governance in a 'policy'

Who makes judgements?

Escalation

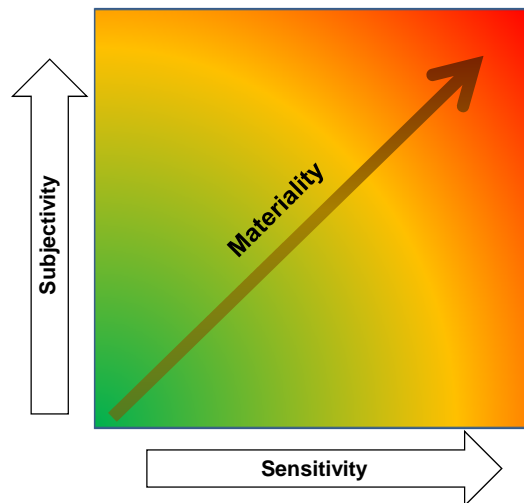
Justification

Documentation

Materiality

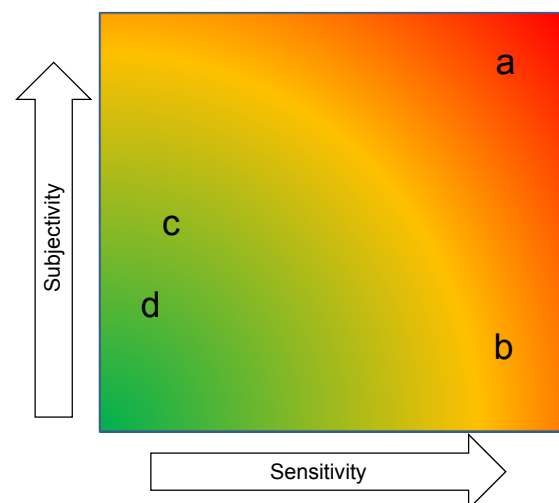
Validation

### 3a. Materiality of judgements: Defining materiality



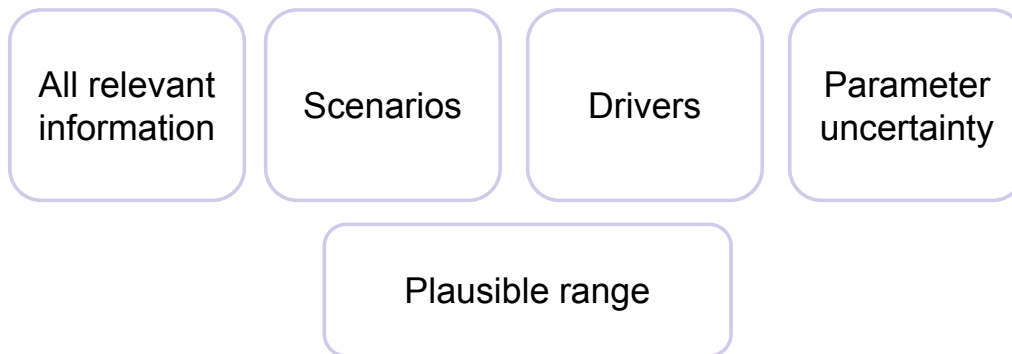
### 3b. Materiality of judgements: examples of expert judgement

- a. Choosing parameters for a major new line of business with no data
- b. Determining parameters for an existing major line of business with >15 years of data
- c. Over-riding parameters suggested by ESGs
- d. Deciding between two types of modelling platforms



## 4. Making an expert judgement

Things to consider:



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## 5. Validation of expert judgement – some tools

<b>Independent review</b>	How does changing the expert change the judgement?
<b>Stress and scenario testing</b>	Compare stresses and scenarios with model output
<b>Back testing – historical</b>	Compare judgements with historical experience

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## 6. Communication

Mitigate risk of misunderstanding

Feedback loop between providers and users

Make transparent the uncertainty

**Users of material assumptions should receive clear and comprehensive written information about those assumptions**



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## 7. Documentation

Use of expert judgement in setting assumptions

Experts involved

Rationale including information used

Selected assumptions and their materiality

Uncertainty in assumptions and results

Decision criteria and alternatives considered

Period of validity

Challenge and sign-off

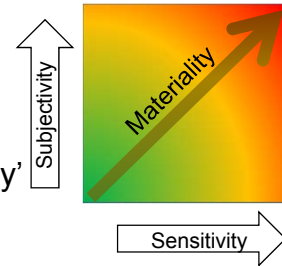


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## 8. Summary

- Materiality = sensitivity x subjectivity
- It is useful for the PRA to see an expert judgement 'policy'
- It is possible to validate expert judgement
- **Important points:**
  - To have a governance framework around expert judgements
  - Communication of material expert judgement to model users and the board
  - Documentation of judgements that links back to framework



## 9. Questions?





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## **Dependencies in internal models**

Dimitris Papachristou  
Faiz Ishtiaq

1 May 2014

## Objectives

### To provide insight into:

- Some of the key issues in dependency modelling
- What the PRA has seen across the industry
- Areas to consider in firms' internal model application



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## Agenda

1. Introduction
2. Dependency structures
3. Estimation
  - a) Statistical error
  - b) Expert judgement
  - c) One-year v ultimate
4. Scenario testing
5. Tail dependencies
6. Summary and questions



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## 1. Introduction...and a myth of diversification benefit

- Dependencies is one of the main factors determining capital requirements
- **However:**
  - It is not easy to estimate dependencies
  - It is not easy to guess the impact of dependencies on capital
  - It is not easy to assess dependencies



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## 1. Introduction...and a myth of diversification benefit

**Myth:** The PRA has a benchmark range for diversification benefit (DB) and firms need to be within this range.

- A single measure of dependencies is simple to communicate but it has limitations
- Single measures, such as the DB, depend on several factors which do not directly affect diversification, such as:
  - Granularity, number of risks, relative size of risks, treatment of expected profit and margins

**The PRA considers these types of diversification measure, but firms will not be assessed entirely on those**



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## 2. Dependencies

- a. Dependency structures
- b. Dependencies cannot be assessed in isolation – an example



### 2a. Dependency structures

- The dependency structure has a significant effect on the internal model output
- Firms do not always explain why the whole structure is appropriate



## 2a. Dependency structures

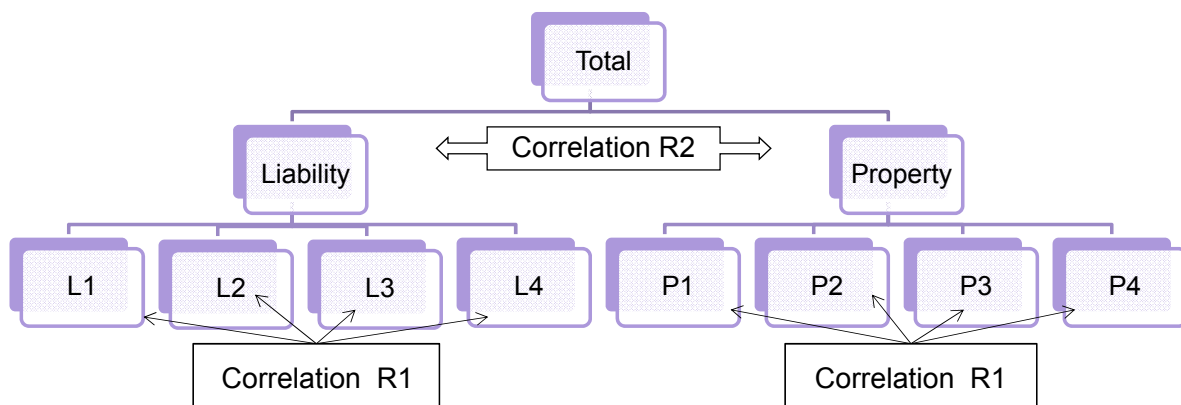
Some dependency structures often restrict the possible choice of parameters.

- Hierarchical (Cascade) structures:
  - Easier to explain and visualise
  - They include implicit assumptions that are not always clearly visible
  - As a result there may be inconsistencies in output correlations

**Firms should consider the impact of dependency structures on the intended uses of the model.**

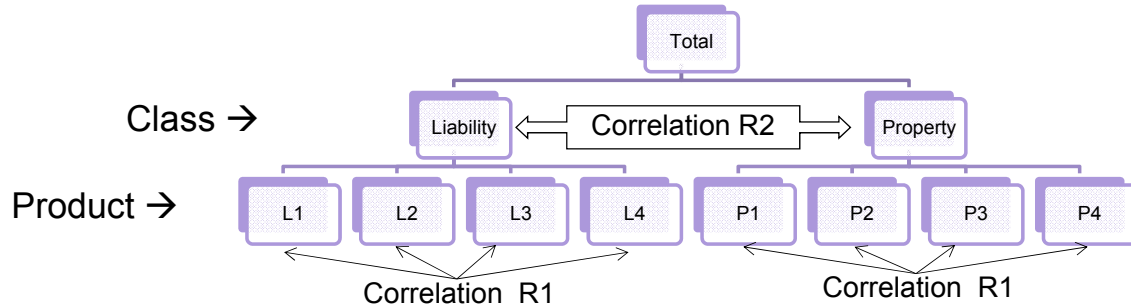
## 2b. Dependencies cannot be assessed in isolation

Example:



Assumption – all classes follow  $N(0,1)$

## 2b. Dependencies cannot be assessed in isolation



R1 – correlation between products within a class	R2 – correlation between classes	Total Capital
30%	0%	?
10%	40%	?



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## Question 2

Which comes up with the highest capital number?

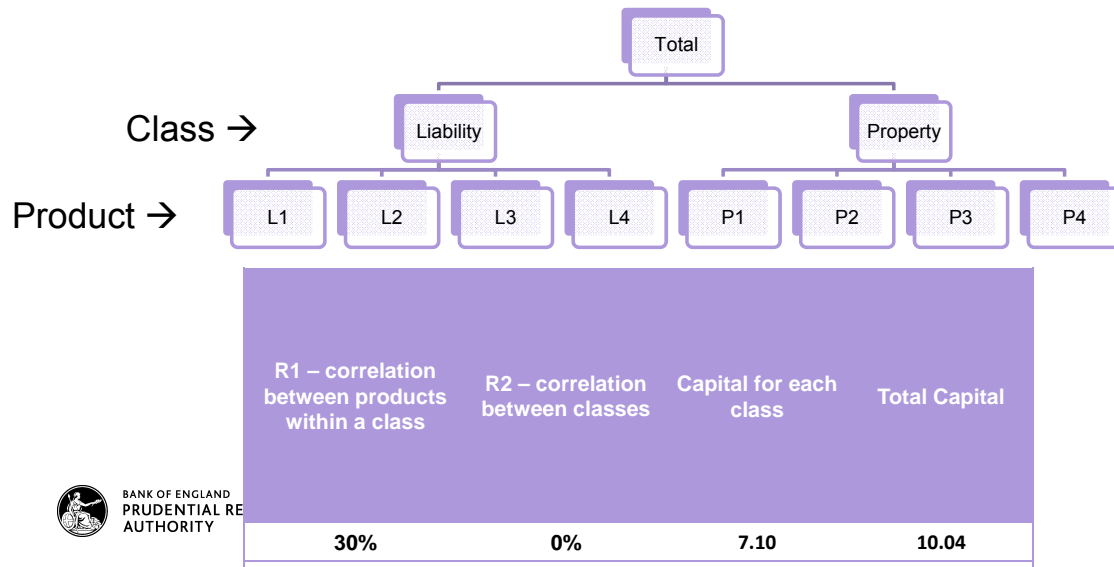
	R1	R2
a)	30%	0%
b)	10%	40%
c)	0%	60%



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## 2b. Dependencies cannot be assessed in isolation



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## 2b. Dependencies cannot be assessed in isolation

**Dependencies cannot be assessed in isolation of the other components of the model**

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### 3. Estimation

- a. Statistical error
- b. Statistical error – an example
- c. Using expert judgement
- d. One year

### 3a. Estimation: Statistical error

Estimation of correlations or other dependency parameters based on data usually involves a very high statistical error

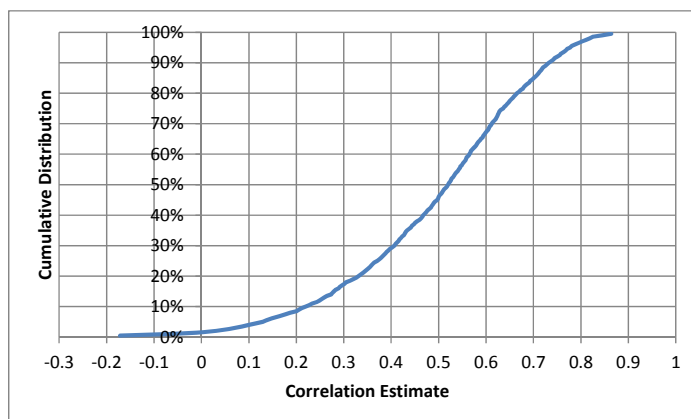
**Statistical error should be considered as part of both the estimation and validation process**

**The PRA has found it useful when firms:**

- consider confidence intervals in justifications of estimations based on data
- consider statistical error in validation tests, such as back-testing

### 3b. Estimation: statistical error – an example

- The distribution of the correlation estimator is too wide for inference
- Comparing to historic data is encouraged, but it is a weak test in this case



Assumptions: multivariate Normal, true correlation is 50%, sample of 15 pairs of points

### 3c. Estimation: using expert judgement

Due to large statistical error the use of expert judgement is often unavoidable

- Justification of expert judgement in dependencies is often not thorough enough or well documented

**The PRA finds it useful when firms explain how they have considered underlying drivers, scenarios, historical data and uncertainty in parameters**

### 3c. Estimation: using expert judgement

The PRA has seen H/M/L expert judgement converted into some correlation parameters without justification.

- **Correlation is not intuitive concept**
  - What does H/M/L mean?
  - Use of algorithms?
- If a Positive Semi-Definite (PSD) algorithm alters the input matrix significantly it suggests the implementation of expert judgement is inconsistent.

**Firms are required to justify and explain appropriateness of the input parameters**



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### 3d. Estimation: one year

- The same input correlations are often used for both the one-year and ultimate view with little justification
- In some instances firms' one-year methodology is reducing the output dependency

**Firms should consider whether their chosen structures are appropriate at both the one-year and ultimate view and justify accordingly**



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## 4. Scenario testing

### A well constructed scenario test will consider:

- how adverse events could lead to multiple strains
- how dependence on common factors can lead to increased risk of combinations of losses

**Firms should consider stress and scenario testing as part of validating the appropriateness of the overall dependency structure**



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## 5a. Tail dependencies

Capital requirements are sensitive to tail dependencies, but it is acknowledged that they are hard to estimate

**Firms should consider scenarios that may affect tail dependency**

**The weaker the tail dependency the more likely that it will attract attention from the PRA**



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## 5b. Tail dependencies: an example of measurement

There are several ways of looking at tail dependencies

An example is using conditional probabilities

$$S(a) = \text{Prob}[Y > F_2^{-1}(a) | X > F_1^{-1}(a)] = \frac{\text{Prob}[Y > F_2^{-1}(a) \text{ and } X > F_1^{-1}(a)]}{1-a} = \frac{1-2a+C(a,a)}{1-a}$$

- Comparisons of tail dependencies become easier, but it ignores the marginal distributions

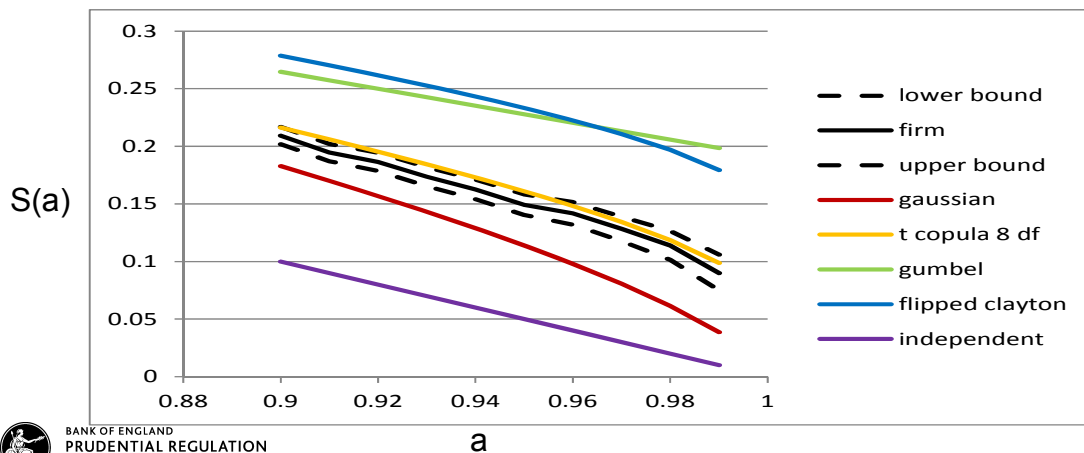


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## 5b. Tail dependencies: an example of measurement

This type of curve facilitates easily comparisons of tail dependencies



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## 6. Summary

- It is useful to consider dependencies at different points in the pdf and in extreme scenarios
- **Important points:**
  - Clear justification
  - Allowance for statistical errors
  - Avoid looking at dependency parameters in isolation
  - Useful to explain how underlying drivers, scenarios, historical data and uncertainty in parameters have been considered



## Questions?





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## **One-year insurance risk**

Keith Tomkins  
Jack Smith-Keegin

1 May 2014



## Objectives

### To provide insight into:

- What the PRA has seen across the industry
- What the PRA thinks of it



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## Agenda

1. Introduction
2. Methodology firms are using
3. Some things the PRA has seen...  
...and some observations
4. Summary



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## 1. Introduction

### A definition of one-year risk:

Risk of adverse movements in basic own funds  
over the next 12 months  
due to new information emerging

This includes:  
**All** of the balance sheet  
**All** sources of information



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## 2. Methodology firms are using

- Merz-Wuthrich
- Re-reserving (Actuary-in-the-box)
- Rehman-Klugman
- Ultimo
- Timescaling
- Emergence factors
- Expert judgement



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## 2. Methodology firms are using

### Article 121 of the Directive:

*“...undertakings shall be able to justify the assumptions underlying their internal model...”*

- Many firms haven't even set out assumptions, let alone justified them
- The PRA is particularly interested in appropriateness in the tail

**The PRA does not want reams of documentation...  
...but if a material limitation isn't mentioned this is a concern!**



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## 3. What the PRA has seen

- a. Emergence factors
- b. Simplifications
- c. Examples of good practice



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### Question 3

What is the *highest* emergence factor you would expect to see for a GI line of business?

- a) 95%
- b) 100%
- c) 110%



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### Question 4

What is the *lowest* emergence factor you would expect to see for a GI line of business?

- a) < 20%
- b) 20 - 40%
- c) > 40%



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### 3a. What the PRA has seen: emergence factors

- Emergence factors as high as 140%
- Emergence factors as low as 15%
- Emergence factors = 100%

### Reminder...

#### A definition of one-year risk:

Risk of adverse movements in basic own funds  
over the next 12 months  
due to new information emerging

This includes:  
**All** of the balance sheet  
**All** sources of information

### 3b. What the PRA has seen: simplifications

**Discussion:** What might you expect to change the premium provisions between  $t=0$  and  $t=1$ ?



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### Question 5

Suppose the risk margin is currently £100m. Should it be different a year from now?

- a) Definitely
- b) Maybe
- c) Definitely not



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### **3b. What the PRA has seen: simplifications**

- Firms assuming that premium provisions are unchanged between  $t=0$  and  $t=1$
- Firms assuming that risk margin is unchanged between  $t=0$  and  $t=1$
- Firms implicitly assuming that claims reports or payments are the only source of information

### **3c. What the PRA has seen: examples of good practice**

- A range of methods being compared, with the results presented in the documentation
- Where emergence factors aren't used, a comparison with ultimate figures
- Application of expert judgement, such as stress and scenario tests, to check output of theoretical analysis

## 4. Summary

- This is a new and unfamiliar area for the UK GI industry
- The PRA has been surprised by the quantitative impact
- All of the methods have limitations and justification has often been weak

### The PRA has seen:

- Emergence factors ranging from well-justified to inexplicable
- Simplifications being used with little or no justification
- Some really good work trying to get to grips with the new issues

**One-year insurance risk will remain a key area  
of focus in the PRA's review work**



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# PRA's assessment of insurance risk

Elena Papastylianou  
Laurence Thompson

1 May 2014



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## Objectives

- To share examples from the PRA's review work
- Insights from the PRA's use of data requests



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## Agenda

1. Insurance Risk Review
2. Data Requests
3. Conclusions
4. Questions?



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## 1. Insurance risk review

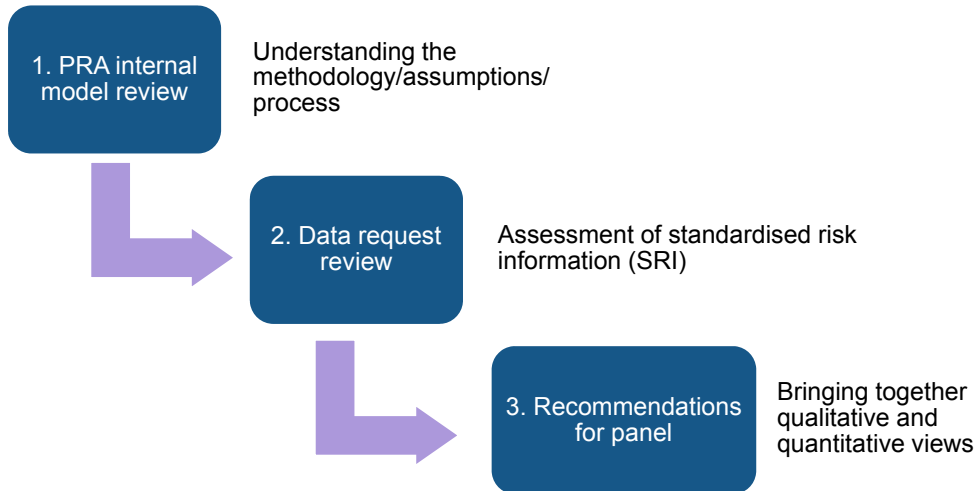
- a. Model review process
- b. What the PRA has seen: issues firms are considering
- c. What the PRA has seen: useful documentation



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## 1a. Internal model review process



## 1b. What the PRA has seen: issues firms are considering

Data appropriateness, e.g. how many years of history is sufficient

Events not in the data (ENIDs), e.g. liability catastrophes

Potential optimism in the business plan

These issues are covered in more detail in Supervisory Statement SS5/14 'Solvency II: Calculation of technical provisions and the use of internal models for general insurers' published in April 2014.

## 1b. What the PRA has seen: issues firms are considering

Allowance for calendar year effects, e.g. claims inflation

Treatment of “outlying” data points

Possible reinsurance exhaustion

These issues are covered in more detail in Supervisory Statement SS5/14 ‘Solvency II: Calculation of technical provisions and the use of internal models for general insurers’ published in April 2014.



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## 1b. What the PRA has seen: issues firms are considering

Appropriateness of the methodology to a firm’s data and portfolio

Allowance for parameter uncertainty

**Firms should consider all eight issues**

These issues are covered in more detail in Supervisory Statement SS5/14 ‘Solvency II: Calculation of technical provisions and the use of internal models for general insurers’ published in April 2014.



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## 1c. What the PRA has seen: useful documentation

- Articulation and justification of *all* assumptions and parameters
- Evidencing of stress and scenario testing
  - How do scenarios of foreseeable loss compare to percentiles of model output?
  - Separate scenarios useful for ultimate and one-year time horizons
- Results from more than one method tested and presented
- All of this presented in one concise document.

**It is useful to present justification and results in a way that's easily accessible to reviewers**

## 2. Data collection exercises

- a. Findings from the 2013 standardised risk information (SRI) data collection exercise
- b. Insights from the 2013 SRI data collection exercise
- c. Future data collection exercises

## 2a. Findings from the 2013 SRI data collection exercise

Internal inconsistencies  
in firms' parameters

Some low levels of  
volatility

Significant spread of  
one-year risk  
emergence results

Suggestions of weak tail  
dependencies between  
lines of business

Feedback was published on the PRA website in February 2014, [www.bankofengland.co.uk/solvency2](http://www.bankofengland.co.uk/solvency2)  
and available on the 'Preparing for Solvency II' page in Key Resources

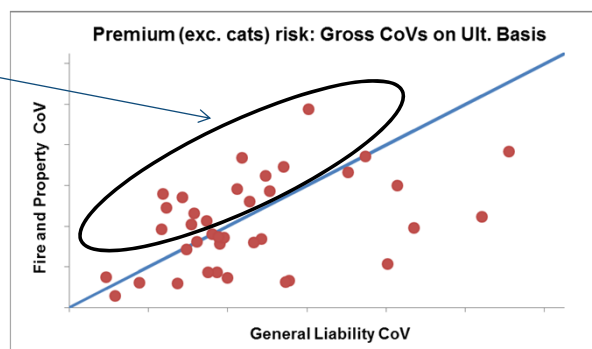


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## 2b. Insights from the 2013 SRI data collection exercise

Area of focus



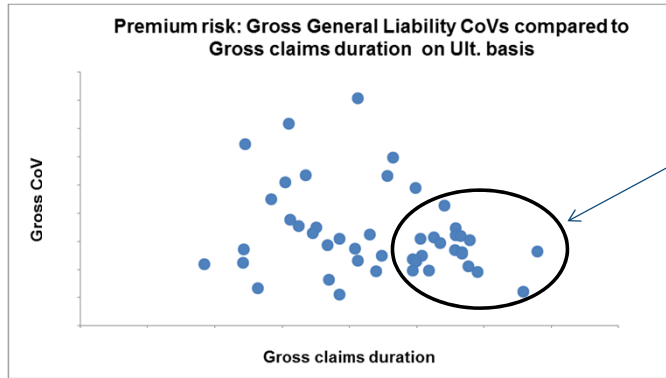
It is useful when firms explain model output with reference to the underlying  
risk profile of their different lines of business



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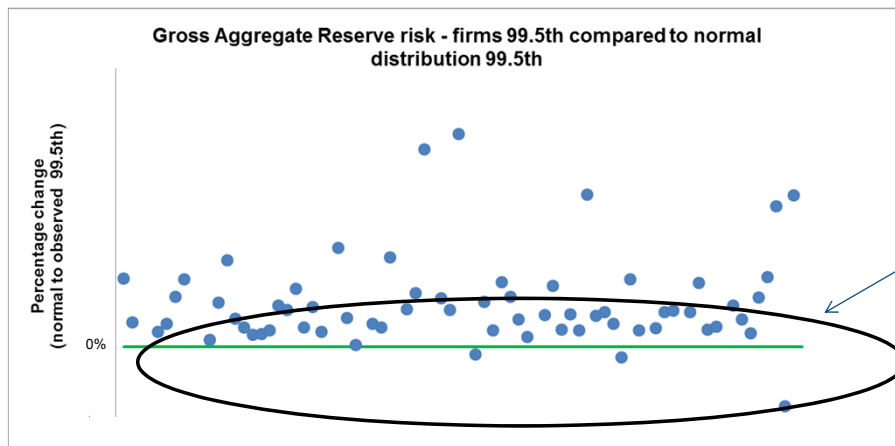
## 2b. SRI data request insights



It is useful when firms explain model output with reference to the underlying risk profile of their different lines of business



## 2b. SRI data request insights



Why do these firms have a distribution that does not exhibit skewness / a fat tail?



## 2c. Future data collection exercises

- The PRA will continue to use thematic data collection exercises as part of its preparations for Solvency II
- Standardised data aids consistent review work and feedback
- On 14 April the PRA published a summary of data collection exercises that will be requested during 2014:

[www.bankofengland.co.uk/solvency2](http://www.bankofengland.co.uk/solvency2)

**Due to the reliance placed on this data it is important to ensure a good quality submission**



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## 3. Conclusions

- a. Bringing it all together for the assessment of internal model approval
- b. Final thoughts



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### 3a. Bringing it all together for the assessment of internal model approval



### 3b. Final thoughts

1. There are some issues that are consistently poorly addressed in firms' models
2. The PRA has seen a number of interesting / strange / inexplicable features in the data
3. SRI data gives the PRA valuable quantitative insight into firms' models, so data quality is important!

## 4. Questions?



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## Plenary four

James Orr  
Chris Moulder

1 May 2014

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## Agenda

1. Thoughts on model approval
2. Panel discussion
3. Closing remarks



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## 1. Thoughts on model approval

- a. Themes from the day
- b. Approval is binary
- c. Reasons for loading in the current regime



### 1a. Themes from the day

- **Justification**
  - Key decisions often explained poorly
  - In some cases, key decisions not even identified
- **Validation**
  - Not the same thing as justification
  - Often fails to test whether the model reflects the risk profile
- **Documentation**
  - Quality not quantity



## 1b. Approval is binary

- The decision that the PRA will make on a model is simple



**Internal model meets tests and standards**

**Internal model fails to meet tests and standards**



- Very different to ICAS, where the PRA sets ICG having reviewed the ICA submission



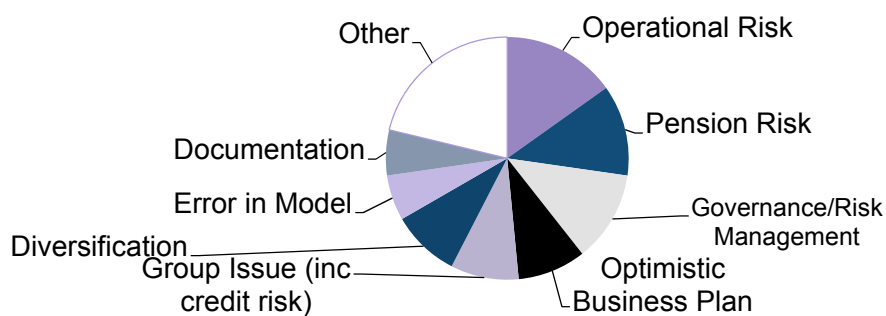
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**Model approved**

**Model not approved**

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## 1c. Reasons for loadings in the ICAS regime



**While ICAS is not the same as Solvency II, loadings applied indicate where firms have failed to justify their assumptions under the current regime**



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## 2. Panel discussion and Q&A



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## 3. Closing remarks



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## Objectives for today

- a. Assist firms in improving the quality (not quantity) of submissions
- b. Discuss methods by which work done and judgements made can be effectively justified and communicated
- c. Provide insight into the PRA's review process and thoughts on review work to date

The PRA wants to help general insurers improve the quality of their internal model submissions

## QR code and website details



[www.bankofengland.co.uk/solvency2](http://www.bankofengland.co.uk/solvency2)