

# SOLVENCY II CORE VALIDATION WORKSHOP

9 & 10 May 2011

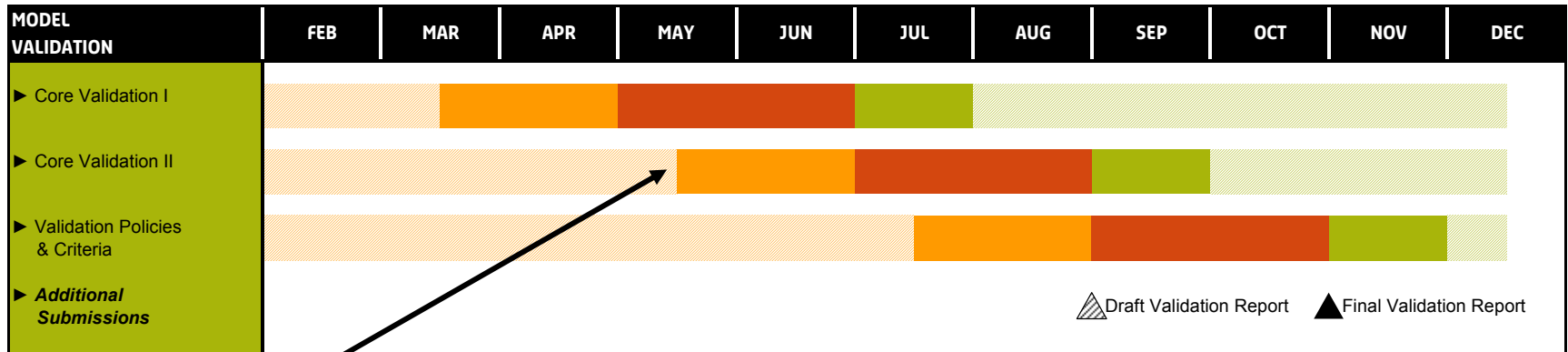
# Agenda

- Introduction
- Calibration
- The Probability Distribution Forecast
- External models and data
- P&L attribution

*Table discussions and play back/Q&A*

- Next Steps and feedback

# Progress to date on workstream



**You are here**

<p><u>Core Validation I</u></p> <ul style="list-style-type: none"> <li>• Assumptions &amp; Expert Judgment</li> <li>• Dependencies</li> <li>• Model robustness</li> <li>• Stress &amp; Scenario testing</li> <li>• Backtesting</li> </ul>	<p><u>Core Validation II</u></p> <ul style="list-style-type: none"> <li>• <b>Calibration</b></li> <li>• <b>Probability distribution forecast</b></li> <li>• <b>P&amp;L attribution</b></li> <li>• <b>External models</b></li> </ul>	<p><u>Policies &amp; Criteria</u></p> <ul style="list-style-type: none"> <li>• Methodologies</li> <li>• Validation policy</li> <li>• Data directory &amp; policy</li> <li>• Risk mitigation</li> <li>• Mgmt actions</li> <li>• Guarantees etc</li> </ul>
<p>Model Demonstrations</p>		

# Today the focus is on model validation workstream ...

## Lloyds

- First validation workshops 15 & 16 March
- Evidence template and scoring expectations issued 31 March
- Guidance on validation report issued 6 May

## Agents

- Scoring updates early March (as at Q4 2010) and 6 May (as at Q1 2011)
- First iteration of evidence templates due 6 May

## ... but strong links with other areas

- Particularly IMSCR workstream
  - SCR will need validation
  - model walkthroughs will inform and prioritise next steps for both workstreams
- However, scope of validation is wider than just the SCR number
  - data, methods and assumptions also apply to TPs
  - governance and use test
  - documentation
  - systems and IT

# **CALIBRATION**

# Calibration: background

- Lloyd's believes that the ultimate horizon is the most appropriate basis for setting member capital.
- The one year SCR is nonetheless a critical number which must be validated.
- Most approaches for deriving the SCR can fall into one of 2 categories:
  1. "Actuary-in-a-box" methods which determine a distribution of one year risk directly from the data
  2. "Recognition pattern" methods which first calculate ultimate risk and then allocate a portion of this to the next year

# Calibration: background

- Lloyd's is not mandating either approach.
- There are no validation loopholes on one year risk methodologies
  - CEIOPS 48/09 chapter 6 “Calibration Standards” applies specifically to methods which require rescaling from a different time horizon/ risk metric
  - Chapter 8 “Validation” and 5.3.2.1 “Adequate actuarial and statistical techniques” apply to all methods
- In the following slides we will look at both approaches with
  - a simple example that illustrates both approaches
  - some examples of validation tools



# Calibration: simple illustration

- Starting point: an increase in the estimate of ultimate claims shows up as an increase in liabilities on the balance sheet

	<b>31.12.2009</b>	<b>31.12.2010 (now)</b>	<b>31.12.2011</b>	<b>31.12.2012</b>	<b>31.12.2013 (ultimate)</b>
<b>Paid-to-date</b>	20	50	?	?	?
<b>Outstanding</b>	80	60	?	?	?
<b>Estimated Ultimate</b>	100	110	?	?	?

# Calibration: simple illustration

- In the second year, the estimated ultimate has increased by  $110 - 100 = 10$  and reserves have deteriorated by  $([50-20]+60) - 80 = 10$
- Our view in 2010 is that we underestimated our liabilities by 10 in 2009.
- That was a retrospective view. What about the future?
  - We will re-estimate our ultimate claims at each future year-end
  - Hit/benefit to 2011 balance sheet =  $110 - (\text{estimated ultimate in 2011})$
  - We can't know today what our **2011 estimated ultimate** will be
  - We can model its possible values with a distribution
- The risk is given by the distribution of  
 $110 - (\text{estimated ultimate in 2011})$

# Calibration: simple illustration

- More generally, risk over a given time horizon is given by the **distribution** of the “claims development result” (see Merz and Wurthrich [2008])

$$\mathbf{CDR} = (\text{today's ultimate}) - (\text{ultimate at end of horizon})$$

$$= (\text{today's reserve}) - [(\text{paid in risk horizon}) + (\text{reserve at end of horizon})]$$

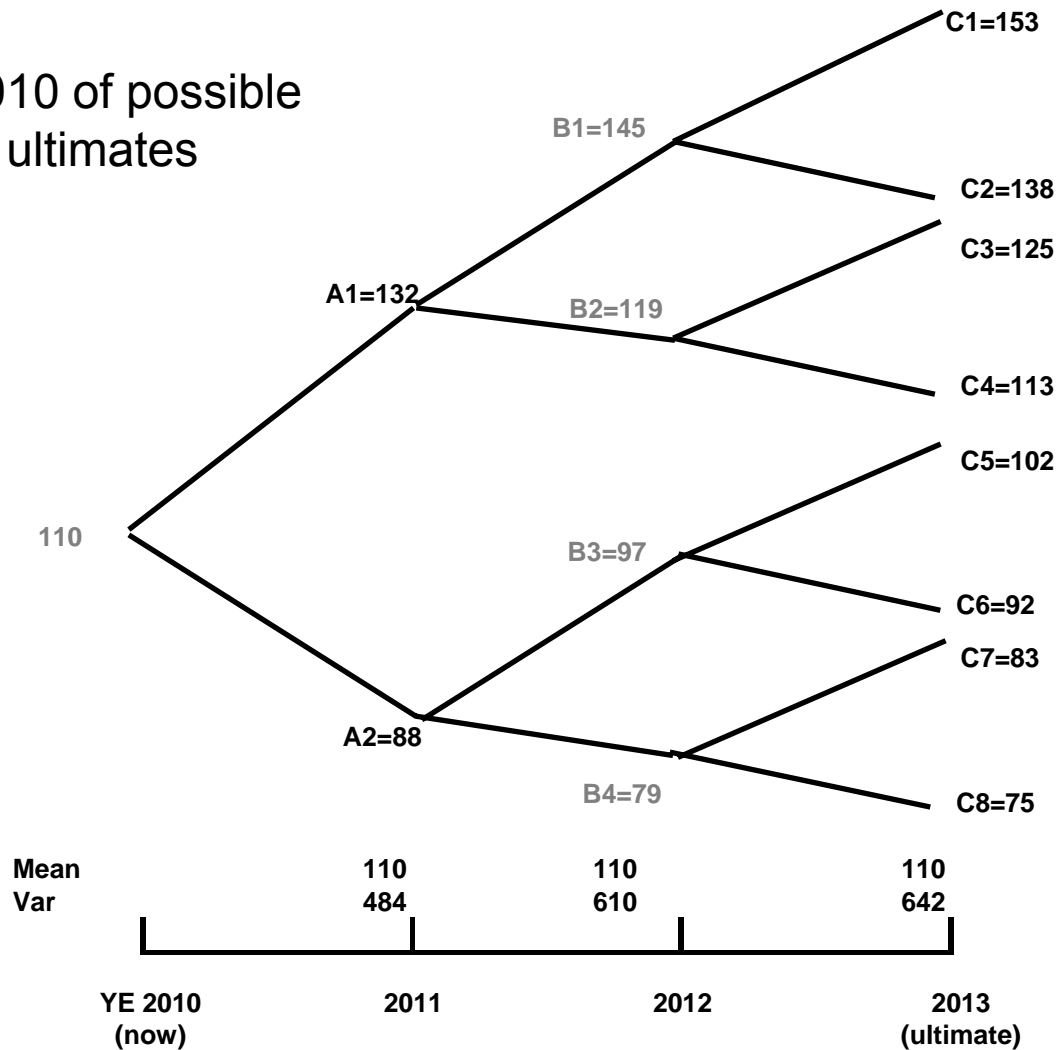
- For the **ultimate** horizon
  - Reserves are nil at the end of the horizon
  - The CDR is a cash-flow view comparing future paids with the reserve
- For the **one year** horizon
  - Reserves are adjusted for paids and favourable/adverse development
  - The CDR is a balance sheet view comparing successive valuations of the liabilities

# Calibration: simple illustration

- The “new” concept here is the distribution of **possible future estimated ultimates** – as opposed to the ultimates themselves
- **Example: Single large claim.** Suppose the actuary looks at the claims history and finds that:
  - The actuarial department revises its estimate of ultimate up or down with equal probability at each year-end
  - The movements are
    - Year 1: +/- 20%
    - Year 2: +/- 10%
    - Year 3: +/- 5%
  - On average they get it right
- Based on the above, the actuary constructs the following tree for **possible ultimates** at future year-ends

# Calibration: simple illustration

Distribution in 2010 of possible future estimated ultimates



# Calibration: simple illustration

- The ultimate horizon is based on our view today of what our possible “estimates” of ultimate could be in 2013

Dist'n point	F(CDR)	CDR
C8	0.125	$110 - 75 = 35$
C7	0.250	27
C6	0.375	18
C5	0.500	8
C4	0.625	-3
C3	0.750	-15
C2	0.850	-28
C1	1.000	$110 - 153 = -43$

- The 1/200 VaR for the ultimate risk horizon is 43
- (Note the drawback of not having enough points in the distribution!)

# Calibration: simple illustration

- Similarly, the one year horizon calculation looks at the distribution of possible ultimates one year from now
- The values are 88 and 132 (points A1 and A2), resulting in the following risk distribution

<b>F(CDR)</b>	<b>CDR</b>
0.500	$110 - 88 = 22$
1.000	$- 22$

- The directly calculated 1/200 VaR for the one year risk horizon is 22

# Calibration: simple illustration

- That was the actuary-in-a box calculation of one year risk
- To illustrate the recognition pattern approach, we will use:

$$\text{Risk}(t) = [\text{expected paid}(t)] / [\text{expected paid}(ult)] * (\text{ultimate risk})$$

- This is an assumption – as are all recognition patterns (more later)

	<b>2011</b>	<b>2012</b>	<b>2013</b>
Payment pattern	50%	30%	20%
99.5 <sup>th</sup> [CDR(t,ultimate)]	43.0		
Implied 99.5 <sup>th</sup> [CDR(t,t+1)]	21.5	12.9	8.6



# Calibration: simple illustration

- That was a simplistic illustration of the actuary-in-a-box and recognition pattern approaches
- The same basic concepts apply to real world data – e.g. a claims triangle
- The following table lists some examples of real world one year risk methodologies
- Next we will look at some **validation** examples that could apply to these methodologies

# Calibration: some methods

Method	Advantages	Limitations	Examples
<b>Actuary-in-a-box</b>	<ul style="list-style-type: none"> <li>• Some fit distribution to one year volatilities, which can help with validation</li> <li>• May have other uses, e.g. actual vs. expected analyses</li> </ul>	<ul style="list-style-type: none"> <li>• Can be complicated and overly reliant on mechanical rules</li> <li>• May be computationally expensive</li> </ul>	<ul style="list-style-type: none"> <li>• Merz &amp; Wuthrich [2008] Mack-type approach</li> <li>• Bootstrap based approach in ResQ</li> <li>• Wacek [2007] “Path of ultimate loss ratio estimate”</li> </ul>
<b>Recognition pattern</b>	<ul style="list-style-type: none"> <li>• Focus is on ultimate – the familiar risk horizon for actuaries</li> <li>• Avoids complicated mathematics</li> </ul>	<ul style="list-style-type: none"> <li>• Based on ultimate not 1 year volatilities</li> <li>• Validation may require comparison with results from AIB methods</li> </ul>	<ul style="list-style-type: none"> <li>• QIS 5 simplification 3 (TP5.32-3)</li> <li>• White and Margetts [2010] “Time-scaling”</li> <li>• Felisky and Wright [2009] “Reduction factor”</li> <li>• ReMetrica component</li> </ul>

# Calibration: validation

- **Example 1:** Testing against experience
  - Compare historical change in ultimates over 12 month period as a percentage of reserves at beginning of period

	Ultimate			Reserve	
UWY	36 mo	48 mo	CDR	36 mo	% Error
2001	86.5	89.1	-2.6	18.0	-14.4%
Etc.					
2007	93.1	91.2	1.9	23.6	8.1%

- The % errors will have an empirical distribution against which the one year calculation can be compared
- This could be done at 12 mo, 24 mo, etc. by UWY or all years
- Reference: Appendix in **Risk Horizon and the Measurement of Economic Capital for General Insurers** by Lowe et. al.

# Calibration: validation

- **Example 2:** Stress and scenario testing
  - Describe extreme scenarios which would result in a significant change in next year's estimated ultimate
    - These may (should) have been developed as part of the validation for the ultimate risk
    - E.g. for reserving risk this could include adverse rulings on known claims and some big IBNR claims
    - The closer the link to actual experience, the more convincing the test
  - How does the change in ultimate compare with the risk indicated by the recognition pattern or actuary in the box?

# Calibration: validation

- **Example 3:** Comparison with alternatives
  - Alternative method (refer to earlier table)
  - Sense check against results from more detailed analysis on larger classes
    - E.g. Long and short-tailed classes on which a actuary-in-a-box method or test against experience has been done
  - Sense check against ultimate analysis
    - Key validation check: Should a recognition pattern allow for one year risk to be greater than ultimate?

# Calibration: one year vs. ultimate risk

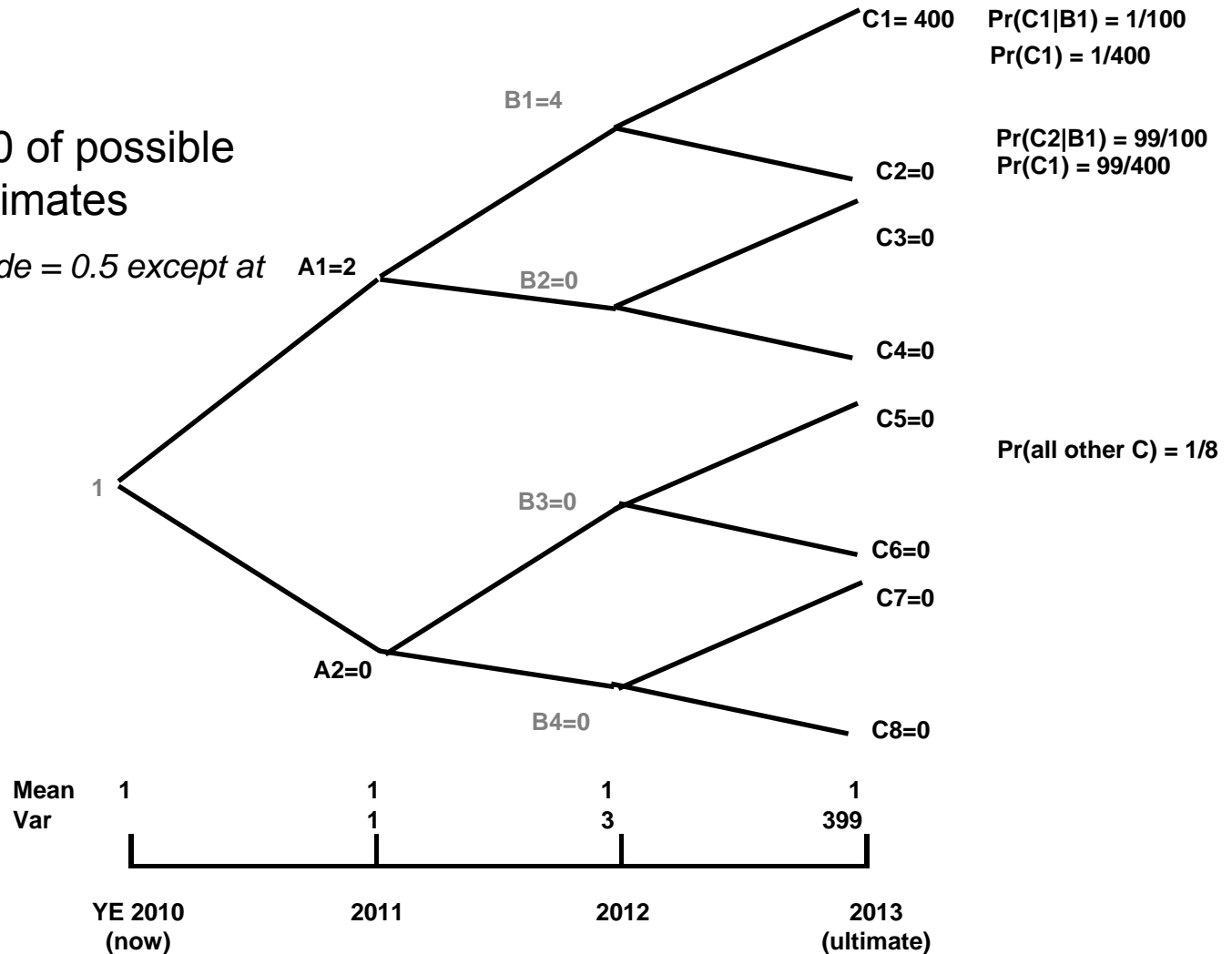
- **No** in the true sense of risk – i.e. all possible outcomes.
- But it **could** arise as a result of the risk metric – i.e. VaR 99.5%.
- Extreme example: our earlier simple illustration re-worked for a binary event claim
  - One very large outcome with probability  $1/400$
  - All other outcomes = 0

# Calibration: one year vs. ultimate risk

## Binary event

Distribution in 2010 of possible future expected ultimates

Probabilities at each node = 0.5 except at C1 and C2



# Calibration: one year vs. ultimate risk

- The one year horizon risk is  $1 - 2 = -1$ .
- The risk on the ultimate horizon is  $1 - 400 = -399$ .
- However using 99.5% VaR gives an ultimate risk of  $1 - 0 = 1$  (i.e. no downside risk).
- So one year risk is greater according to 99.5% VaR.



# Calibration: one year vs. ultimate risk

- Remember that possible ultimates for both horizons are estimated **today** with data available **now**.
- For this reason the one year view must be consistent with the ultimate view – otherwise one would not reflect all the information available.
- Don't confuse the risk horizon with the valuation date.
- The question of whether one year risk can exceed ultimate is contentious! You may have a different view.
- **Short answer** for validation: have a clear justification for how your one year risk compares to ultimate.

# **PROBABILITY DISTRIBUTION FORECAST**

# PD forecast: background

- The key statistical quality issue is the “richness of the probability distribution forecast” for the SCR
- A distribution for Basic Own Funds based on a limited number of data points will provide a less reliable SCR
- Two ways this could occur:
  - Underlying component distributions (e.g. op risk, reserving risk) are based on a few key points, first two moments, etc.
  - An insufficient number of simulations for a stable SCR
- No new validation techniques are required, but the Advice expects agents “to make extensive use of validation techniques (stress-testing, scenario analysis, etc.)” (5.45)

# PD forecast: validation

- **Example 1.** Reserve risk modelled with lognormal parameterised from mean and CoV
  - Ensure that all relevant information has been included – e.g. maximum deterioration on key claims
  - Sensitivity test for parameter uncertainty in mean and CoV
  - Impact of alternative distribution, particularly in the tail
  - Comparison with other classes for which more detailed analysis has been done

# PD forecast: validation

- **Example 2.** Test of stability of model for which cat is the material fat tailed risk
  - Build a simple sub-model for gross cat risk only
  - Run different seeds at different numbers of simulations (specifically mentioned in (8.87) – (8.89))
  - Convergence in sub-model at given number of simulations is **not** proof of convergence of CK at that number of simulations
  - However lack of convergence implies lack of convergence of CK
  - Faster to test than running the full model (the brute force option)
  - Can also compare outputs with analytical calculation from ELT
  - Agent determines **criteria** for stability

# PD forecast: validation

Test of model stability using 1 in 200 Year OEP					
	Simulations		Calculation (from ELT)	% Difference with calculation	
Seed	10k	100k		10k	100k
0	456.8	459.3	457.5	-0.2%	0.4%
1	453.3	456.9		-0.9%	-0.1%
...					
8	497.7	455.0		8.8%	-0.5%
9	436.1	460.6		-4.7%	0.7%
Mean	452.9	458.1		-1.0%	0.1%
Std dev	19.5	2.2		4.1%	0.5%
CoV	4.3%	0.5%			

# **EXTERNAL MODELS AND DATA**

# EMD: Key themes from the guidance

- The standard for validation is the same, whether a component of the internal model is developed in house or outsourced
  - *“The use of a model or data from a third party shall not be considered justification for exemption from any of the requirements for the internal model set out in Articles 120 to 125” (Article 126, Solvency II Directive)*
- Agents must be able to clearly identify the places in the model where they have outsourced expertise
  - *“...undertakings must be able to document and explain the role of any External Models or Data, and the extent to which they are used within the internal model” (DOC48/09 10.19)*
- Agents need a clear rationale for using external models
  - *“Undertakings shall be able to explain the reasons for preferring external models or data to internal ones. They shall be able to list the alternatives considered and explain the decision [...]” (DOC48/09 10.20)*



# EMD: Key themes from the guidance

- There are a number of ways for agents to demonstrate ownership of external model and data
  - *“...in-house knowledge of the EMD may be demonstrated by:*
    - *Detailed understanding of the methodology [...], capabilities, limitations and appropriateness for the SCR*
    - *...full understanding of the effect and significance of proprietary elements*
    - *...detailed validation of EM output*
    - *...documentation of the rationale behind judgmental over-rides*
    - *Retention of in-house expertise” (DOC48/09 10.20)*
- The more material an external model is as a part of your internal model, the higher the bar will be
  - *“...expectations of external models or data should be appropriate to their nature, scale and complexity. This recognises the principal of proportionality” (DOC48/09 10.25)*

# EMD: Examples of evidence

- The requirements and detailed guidance notes on 'External Models and Data' lay out some of the ways in which the in-house knowledge and ownership of the external models can be demonstrated
- We will give some high level examples on how this could be met for:
  - A bootstrapping module
  - ESG model output
  - Catastrophe models & data
- These are just examples, and are not the required or complete list of methodologies

# EMD: Examples of evidence

- Recap of requirement of in-house ownership (from *DOC48/09 10.20*):  
“In-house knowledge of the EMD may be demonstrated by:
  - 1) Detailed knowledge of the methodological underpinnings and basic construction of External models and data, including an understanding of the models’ capabilities, limitations, and appropriateness for use in deriving the SCR
  - 2) Demonstration of a full understanding of the effect and significance of the proprietary elements in the external models;
  - 3) Performing detailed validation of external model output;
  - 4) Documentation of the rationale behind any judgment-based overrides or any other adjustments made to external data sets or external model outputs; and
  - 5) Retention of in-house expertise on the External models and data for as long as these are used to derive the SCR”

# EMD examples: Bootstrapping module

Item	Example of evidence
1) Detailed knowledge of the methodological underpinnings	<ul style="list-style-type: none"><li>• A description of the approach underlying the bootstrap implementation, underlying implicit assumptions and appropriateness to the data triangle used and purpose</li><li>• A document following the bootstrap of a triangle, with results at all intermediate steps, describing the methodology for each step</li></ul>
2) Understanding of the effect and significance	<ul style="list-style-type: none"><li>• Comparison of capital for reserving risk to capital for total risk</li><li>• Comparison of capital under the bootstrap module to “blind” bootstrap in Excel, or other reserving risk methodologies.</li><li>• Comparison of capital under the bootstrap implementation to capital under the bootstrap with alternative parameters</li></ul>

# EMD examples: Bootstrapping module

Item	Example of evidence
3) Performing detailed validation of output	<ul style="list-style-type: none"><li>• Sense checks on the more obvious or intuitive outputs such as graphs of residuals, mean of distribution compared to best estimate, sense checks on link ratios</li><li>• For a single line of business comparing the results of the bootstrap to those of a side bootstrap model built in Excel</li></ul>
4) Rationale behind any judgment-based overrides	<ul style="list-style-type: none"><li>• Documentation of initial assumption, revised assumption, reason for change, consistency of assumptions, and impact</li></ul>
5) Retention of in-house expertise	<ul style="list-style-type: none"><li>• Evidence of training in the module, and of general bootstrapping.</li></ul>

# EMD examples: ESG output

Item	Example of evidence
1) Detailed knowledge of the methodological underpinnings	<ul style="list-style-type: none"><li>• Description of the approach underlying the ESG, with the underlying statistical basis and assumptions and why it is appropriate to use for the assets modelled</li></ul>
2) Understanding of the effect and significance	<ul style="list-style-type: none"><li>• Capital evaluation on deterministic ESG scenarios (a “mean” scenario, a “99.5th” scenario, etc) with the difference giving a sense of the significance</li><li>• Turning all volatility in the insurance risk model off (e.g. using “mean” scenario’s for all premium, catastrophe and reserving risk), so approximately evaluate the capital requirement driven by the ESG</li></ul>

# EMD examples: ESG output

Item	Example of evidence
3) Performing detailed validation of output	<ul style="list-style-type: none"><li data-bbox="643 462 1725 753">• Back-testing: Economic events appearing in historical data but on model assumptions are comparatively rare could indicate inconsistencies or inappropriate models. Frequent events in modelled data which are rare in historical data may indicate the same inconsistency</li><li data-bbox="643 808 1725 972">• Portfolio scenarios: Sense checking scenarios of asset portfolio deteriorations outside of the calculation kernel against modelled output.</li></ul>
4) Rationale for overrides 5) In-house expertise	<ul style="list-style-type: none"><li data-bbox="643 1090 1049 1125">• See previous example</li></ul>

# Catastrophe models & data

Evidence reviewed to date:

- Reaffirmed the diversity of approach across the market in regard to the use of catastrophe models & data
- Highlighted that the level and completeness of documented evidence varied significantly across the market
- Identified common gaps in the documentation the areas that needed expansion varied greatly by Managing Agent
- General feedback; much more to be done in regard to documenting current processes
- General suggestion that Managing Agents were planning to make most progress in EMD documentation during in H1 2011



# Catastrophe models & data

Section 6 of the Detailed Guidance Note issued for External Models & Data in March 2010 provides a list of examples relating to documenting validation procedures

The Lloyd's Exposure Management team are available to:

- provide input and assistance to the refinement of current Cat Models & Data documentation
- Assist in identifying gaps between current documentation and section 6 guidance

This can take the form of:

- Direct feedback to completed EMD questionnaires and evidence templates
- Direct feedback following walkthrough meetings
- Ongoing dialogue with Managing Agents

# EMD examples: Cat models & data

Item	Example of evidence
1) Detailed knowledge of the methodological underpinnings	<ul style="list-style-type: none"><li>• Internal summaries of documentation / presentations covering e.g. event generation, vulnerability, hazard and financial loss modules</li><li>• External education through seminars, conferences</li><li>• Adjustments for known exclusions / limitations of model</li><li>• Explanation / rationale for why the data or models are appropriate for the classes of business</li></ul>
2) Understanding of the effect and significance of proprietary elements	<ul style="list-style-type: none"><li>• Sensitivity testing of outputs with and without various modelling options</li><li>• Model change management processes</li><li>• Comparison with outputs from other vendor models</li></ul>

# EMD examples: Cat models & data

Item	Example of evidence
3) Performing detailed validation of output	<ul style="list-style-type: none"><li>• Ensuring that the modelled portfolio is complete<ul style="list-style-type: none"><li>◦...that insured values are reflective of the risk</li><li>◦...that the contract terms are modelled correctly</li></ul></li><li>• Sense checking - comparison of modelled output with alternative methodologies e.g. PML method</li><li>• Compare model output with actual experience</li><li>• Documenting frequency of validation and evidence of challenges made</li><li>• Independent review and challenge</li></ul>
4) Rationale for overrides 5) In-house expertise	<ul style="list-style-type: none"><li>• See previous example</li></ul>

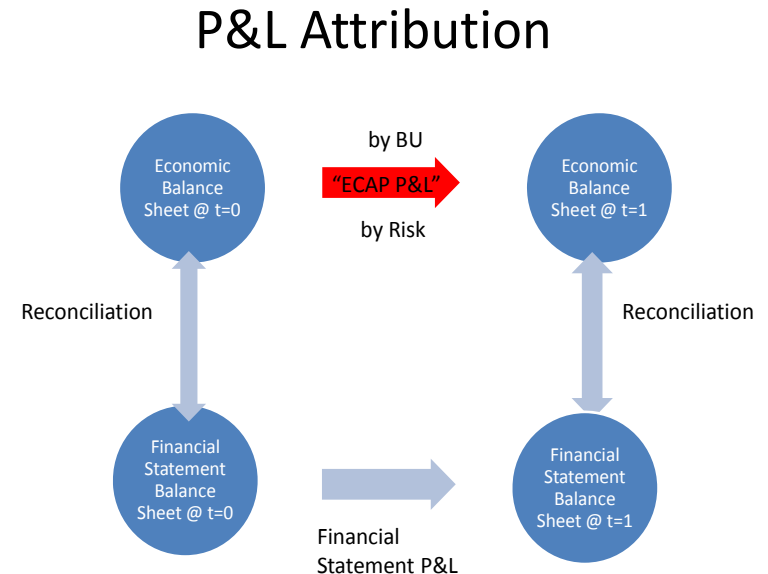
# **PROFIT & LOSS ATTRIBUTION**

# P&L - Themes from guidance

- This is a test of the categorisation used within your internal model...
  - *“...[undertakings] shall demonstrate how the categorisation of risk chosen in the internal model explains the causes and sources of profits and losses...”*  
(Article 213, Level 1 text)
- ...but also a test of business planning analysis and financial reporting
  - *“...undertakings shall review at least annually the causes and sources of profits and losses for each major business unit”* (Article 213, Level 1 text)
- Reconciliation between different bases will be important
- It's also about embedding the analysis
  - *“The categorisation of risks chosen in the internal model shall be adequate, and sufficiently granular, for the purpose of risk-management and decision-making”* (commission draft L2 advice)

# What is profit / loss?

- P&L attribution focuses on the movement in the Economic Balance Sheet (red arrow in diagram)....
- ...so agents will need to construct a historical P&L on this economic basis
- However, alternatives to this may be appropriate where they better fit an agent's economic view
  - E.g. if planning is on an alternative basis
  - Agents should note that this may make the model's "explanation" more challenging
- Reconciliations between the economic (model) basis and the Financial Statement basis will be required



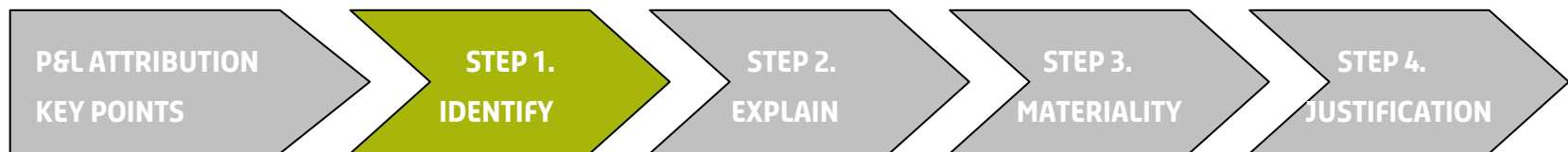
Source: EIPOA pre-consultation draft  
"Level 3 Guidelines on Profit & Loss Attribution"

# What do we need to attribute to?

- Lloyd's is not mandating a specific set of classes to attribute to.
  - Agents will have to make their own decisions, and the selected grouping will vary by agent...
  - ...however, this must be sufficiently granular to meet the spirit of the test
- Profit and loss should be attributed to “Major Business Units”.
  - On the underwriting side, Lloyd's would expect this to correspond broadly to modelled lines of business / groups
  - Other “units” to consider could include specific underwriters, geographical areas, reinsurance treaties / collections of contracts, investment portfolios / investment managers
- Profit and loss should further be attributed to “Risk Drivers”.
  - Materiality is the most important consideration here
  - There is no unique definition of what “risk drivers” are – The risk driver structure in agents' models are a sensible starting point...
  - ...but this should be supplemented with common sense and analysis of drivers of variation in past performance
  - Continue to refine the allocation until there is only one material risk driver in each allocated bucket

# What do we need to do?

- There are three parts to identification for P&L attribution:
  - Identify the “causes and sources” of P&L in actual historical performance – include potential material
  - Identify the drivers in the model & attribute P&L variability to them
  - Reconcile to show that the model can explain the causes and sources
- Syndicate 999 has performed a detailed P&L attribution exercise on its Property Treaty line of business
  - This is a major contributor to planned profit, and has therefore been defined as a major “business unit” for syndicate 999
  - 2010 saw an economic basis loss of £52m, compared to a planned profit of £30m
  - This material variation arose from a variety of sources – the test now checks that these reasons are appropriately reflected as drivers of P&L in the model
  - The next step is to identify and explain these reasons at an appropriate level of granularity
  - Note the P&L categorisation here is an example only – agents should use a categorisation that works for their business and model





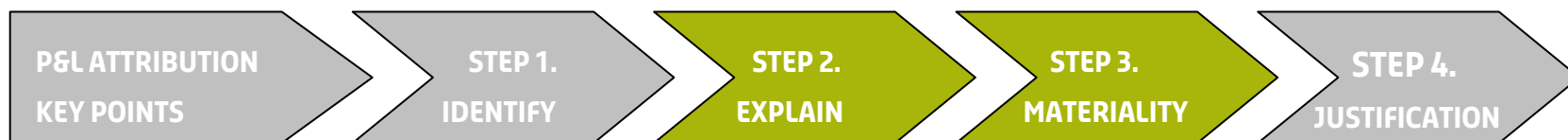
# Break down historical performance on an economic basis...

	£m	2010		Variance	Driver of variance
		Plan	Actual		
Current year	1 Gross Premium	250.0	275.0	25.0	Exposure higher than planned
	2 Acqn Expenses	- 50.0	- 55.0	- 5.0	Higher in line with higher premium income
	3 <b>Gross Net Premium Earned (1+2)</b>	<b>200.0</b>	<b>220.0</b>	<b>20.0</b>	
	4 Reinsurance premium	- 50.0	- 100.0	- 50.0	More RI purchased than plan, rates substantially higher than expected, reinstatement premiums due on cat cover
	5 <b>Net Premium Earned (3+4)</b>	<b>150.0</b>	<b>120.0</b>	<b>- 30.0</b>	
	6 Gross Claims (BEL)	- 119.0	- 210.0	- 91.0	Cat events and unusually high attritional claims
	7 New Gross Risk Margin	- 21.0	- 21.0	-	
	8 <i>Gross ULR ((6+7)/3)</i>	70%	105%	35%	
	9 RI share claims (BEL)	15.0	55.0	40.0	RI responded partially to cat losses
	10 Net Claims (BEL) (6+7+9)	- 104.0	- 155.0	- 51.0	Higher gross claims partially offset by higher RI recovery
	11 New Net Risk Margin	- 21.0	- 21.0	-	
	12 <i>Net ULR ((10+11)/5)</i>	83%	147%	63%	
	13 <b>Underwriting Result (5+10+11)</b>	<b>25.0</b>	<b>- 56.0</b>	<b>- 81.0</b>	
Prior years	14 Gross Claims development	-	15.0	15.0	Favourable development in prior years
	15 RI claims development	-	- 1.0	- 1.0	Corresponding reduction in RI recoveries
	16 Unwinding of discount	- 15.0	- 15.0	-	
	17 Unwinding of risk margin	10.0	5.0	- 5.0	Change in risk emergence assumptions
	18 Change in discount rate	-	4.0	4.0	Higher interest rates gave a profit on reserve discounting
19 <b>Insurance Result (13+14+15+16+17+18)</b>	<b>20.0</b>	<b>- 48.0</b>	<b>- 68.0</b>	<i>Reserve release partially offsets adverse underwriting experience</i>	
All years	20 Allocated Expenses	- 5.0	- 12.0	- 7.0	One-off costs for mid-year restructuring
	21 Allocated Investment Income	15.0	25.0	10.0	Gains on equity portfolio and greater than expected cash returns more than offset a loss on FI portfolio
	22 Movement in FX	-	- 5.0	- 5.0	Slight adverse movement in US\$
	23 Change in RI bad debt	-	- 12.0	- 12.0	Arbitration lost, leading to reduction in RI on run-off
	24 <b>Non-Insurance Result (20+21+22+23)</b>	<b>10.0</b>	<b>- 4.0</b>	<b>- 14.0</b>	
	25 Other	-	- 2.0	- 2.0	Slight loss attributed to other factors, including changes in reserving assumptions
26 <b>Economic Profit / (Loss) (19+24+25)</b>	<b>30.0</b>	<b>- 52.0</b>	<b>- 82.0</b>	Performance substantially worse than plan	

The variance column identifies where economic performance was different from plan.

The purpose of the P&L attribution test is to ensure that the internal model appropriately captures all of the material sources of deviation from plan that have been observed in historical performance

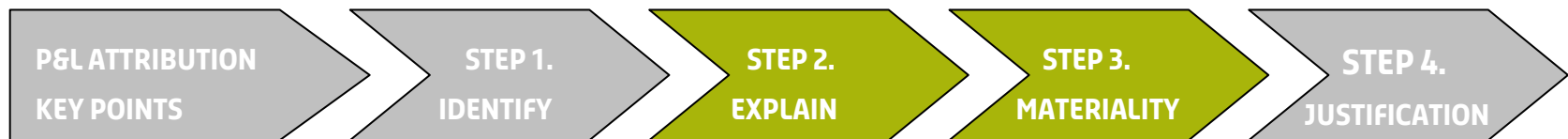
Note that this P&L is on an economic basis – it will typically look very different to current GAAP, and is likely to require additional work to create



# Identify the drivers in the corresponding model P&L...

£m	2010 Variance	Captured	Modelling Approach
1 Gross Premium	25.0	x	Modelled as fixed - equal to plan
2 Acqn Expenses	- 5.0	x	Modelled as fixed % gross
<b>3 Gross Net Premium Earned (1+2)</b>	<b>20.0</b>		
<b>Current year</b>			
4 Reinsurance premium	- 50.0	p	Modelled as a fixed component (equal to plan) plus reinstatements due on risk XL and Cat programmes
<b>5 Net Premium Earned (3+4)</b>	<b>- 30.0</b>		
6 Gross Claims (BEL)	- 91.0	✓	Modelled stochastically as the sum of attritional, large and cat claim
7 New Gross Risk Margin	-	p	Modelled as a fixed % of BEL
8 <i>Gross ULR ((6+7)/3)</i>	35%		
9 RI share claims (BEL)	40.0	✓	Cat and large loss XL recoveries modelled directly from gross losses. QS recoveries modelled directly
10 Net Claims (BEL) (6+7+9)	- 51.0	✓	Modelled as (Gross - RI)
11 New Net Risk Margin	-	p	Approximated as equal to gross
12 <i>Net ULR ((10+11)/5)</i>	63%		
<b>13 Underwriting Result (5+10+11)</b>	<b>- 81.0</b>		
<b>Prior years</b>			
14 Gross Claims development	15.0	✓	Reserve development modelled using a lognormal distribution with COV based on a bootstrapping exercise
15 RI claims development	- 1.0	p	Uses net to gross ratio
16 Unwinding of discount	-	✓	Average payment patterns used to discount BEL at time 1
17 Unwinding of risk margin	- 5.0	x	Not modelled explicitly
18 Change in discount rate	4.0	✓	Discount rate from ESG used in explicit discounting
<b>19 Insurance Result (13+14+15+16+17+18)</b>	<b>- 68.0</b>		
<b>All years</b>			
20 Allocated Expenses	- 7.0	x	Underwriting expenses modelled as fixed
21 Allocated Investment Income	10.0	✓	Investment income modelled using a stochastic ESG
22 Movement in FX	- 5.0	✓	Modelled in 2 currencies
23 Change in RI bad debt	- 12.0	✓	Modelled stochastically as % recovery
<b>24 Non-Insurance Result (20+21+22+23)</b>	<b>- 14.0</b>		
25 Other	- 2.0	x	No other drivers modelled
<b>26 Economic Profit / (Loss) (19+24+25)</b>	<b>- 82.0</b>		

This column describes whether the source of variation is adequately captured within the model, with "p" indicating that the variation is partially captured by the modelling approach

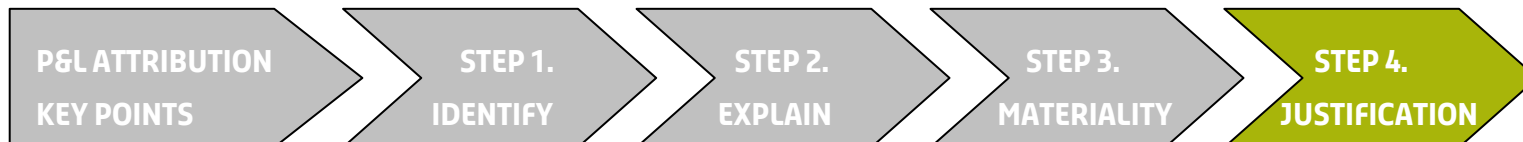


# Which areas does the model struggle to “explain”?

Explain why the modelling approach does not capture the identified driver of variation, and justify why the approach is still appropriate for the business

Capture any actions required to improve the model’s ability to explain sources of profit and loss

£m	Captured	Model limitations	Action
1	×	Modelled as fixed - equal to plan	No action
2	×	This approach is consistent with the above	No action
4	p	Modelled as a fixed component (equal to plan) plus reinstatements due on risk XL and Cat programmes	Update process to ensure model gets latest RI plan
7	p	A simplified approach has been taken that reflects the broad dynamics of the gross risk margin behaviour	Review the approach taken to risk margin in light of market best practice
11	p	Approximated as equal to gross	
15	p	The simplified ratio approach is thought to be adequate given the limited materiality of movements experienced	No action
17	×	Not modelled explicitly - approximated as the balancing item on the movement in the risk margins between T0 and T1	Review risk margin approach
20	×	Underwriting expenses are set fixed, equal to plan for the year, so the model does not include any variability arising from this source	Investigate using a stochastic approach to expenses
24	×	Drivers of "other", such as changes to valuation assumptions, are not thought to be appropriate for modelling. They are also low materiality	No action, given limited materiality



# Guidance also expects P&L Attribution to be applied within businesses

- Lloyd's will expect agents to be able to evidence that P&L attribution is embedded in their business
  - It can't just be a model compliance exercise
- The analysis of historical performance could be used, for example, to provide insights for future strategy and risk management:
  - Evaluating the operation of controls
  - Updating the risk register / identifying new sources of risk
  - Reviewing the risk strategy
  - Evaluating risk budgets / verifying that risk limits are effective
  - Identifying risk drivers that require further analysis / different controls
- Lots of this will already be done within agent review and planning processes

# P&L Attribution should be a key validation tool

- Agents should ensure that P&L attribution analysis is used to support their model validation:
  - Are all material risks covered?
  - Are risk drivers granular enough to represent the business?
  - What is the potential impact of non-modelled / qualitatively assessed risks?
  - Was last year a realistic outcome within the model (a back-test with a single point of data)?

# So, is P&L attribution the same as backtesting?

- No – although the concepts are linked, they require separate analysis and come to distinct conclusions
- Consider an example where a cat writer combines a number of EP curves within their model:
  - P&L attribution is a test that you have in your model all of the EP curves that you should have, i.e. is a completeness check for the number of EP curves against the risk drivers in your business
  - Backtesting compares the shape of each individual EP curve against the range of outcomes for the given risk driver over many years
- P&L attribution is to ensure that your model overall has all the right moving parts...
- ...Backtesting is to ensure that any given moving part moves in the right way

# **TABLE DISCUSSIONS**

# Suggested topics for discussion

- Do you have other examples of how you are performing validation on any of these areas?
  - alternative approaches
- What resources are you using to obtain independence in validation?
  - balance between internal vs external
  - what areas are you focusing on?



# **ROUND UP AND QUESTIONS**

**NEXT STEPS**

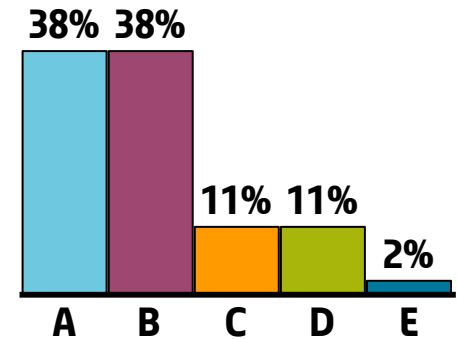
# What happens next?

- Slides will be made available on [lloyds.com](https://lloyds.com) after both workshops
- Validation report guidance now available on website
- Evidence templates and updated scores will be reviewed and questions raised with agents together with any request for supporting evidence
- Initial model walkthroughs to be completed by end May
  - second tranche will begin mid June – booking to start soon
- Next workshops on validation – 4 & 5 July
- Other upcoming sessions:
  - Governance, Risk Management & Use – 17 & 18 May
  - IMSCR & TPs – 13 & 17 June
- Finally, before you go, a request for feedback ...

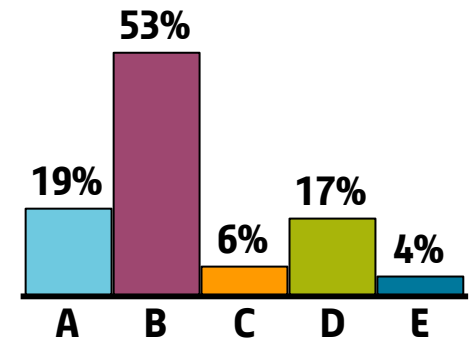
# How useful have you found today's session?

- A. Very useful and provided helpful practical guidance and clarification
- B. More detailed guidance and worked examples would have been helpful
- C. We have clear views on Lloyd's expectations for validation
- D. Greater detail needed on format and timing of Lloyd's reviews
- E. I'm too polite to say!

9 MAY RESULTS



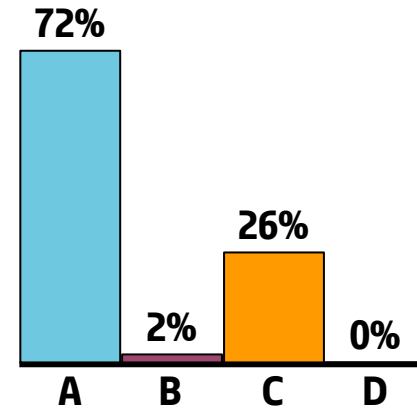
10 MAY RESULTS



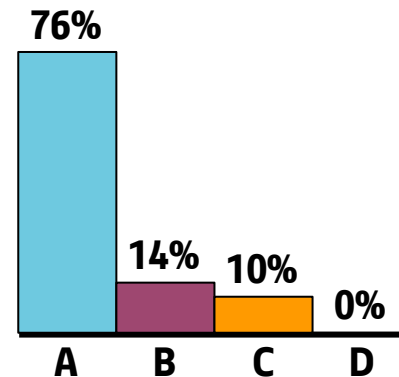
# How have you found format of today's workshop?

- A. It was a good balance between presentation and discussion
- B. Would prefer less presentation and more discussion
- C. Would prefer less discussion and more presentation
- D. Other.

9 MAY RESULTS



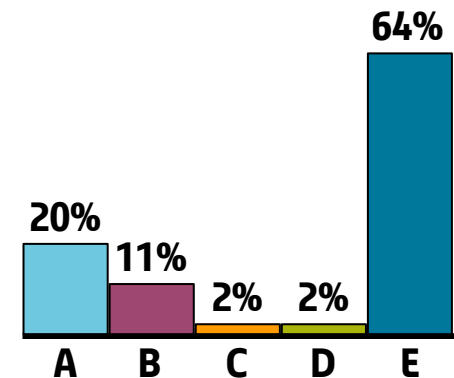
10 MAY RESULTS



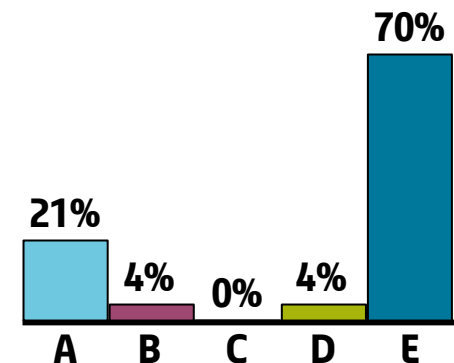
# How have you found the initial model walkthrough session?

- A. Structure, timing and attendance of session worked well
- B. Would expect more detailed questions at this stage
- C. Would expect less detailed questions at this stage
- D. Too many attendees to have proper walkthrough
- E. Still have this excitement to come!

9 MAY RESULTS



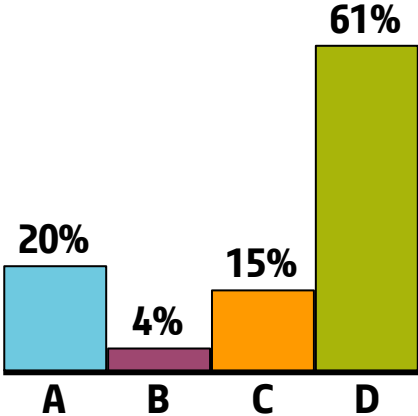
10 MAY RESULTS



# Did you find model validation guidance useful?

- A. Guidance is useful and provides clarification on requirements
- B. We have clear views on Lloyd's expectations for validation report
- C. More detailed guidance was expected
- D. I haven't had the chance to read it yet

9 MAY RESULTS



10 MAY RESULTS

