Internal Model Validation

Market Workshop

09/05/2018

Contents

Review of 2017/2018 season

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3-year validation plan

Summary

- Last year Lloyd's requested a validation plan submission in June
- Initially, mixed response from the market
  - Some saw it as another Lloyd's requirement, others as an opportunity to improve process
- Resubmissions were requested where insufficient detail was given
- Majority of the agents submitted a plan to adopt a 3-year cycle
  - In some circumstances a full annual validation approach was considered more appropriate e.g. immature syndicates
- Although teething problems may exist, generally positive feedback has been received around the direction of travel
- Aim now is to embed targeted approach into BAU process going forwards

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3-year validation plan

Business as usual

- Validation plans should be reviewed annually, however need **not** be resubmitted to Lloyd's unless it has changed materially
  - E.g. if planning to change from annual to 3-year cycle
  - Any additional feedback from Lloyd's (& other stakeholders) should be incorporated
  - Please get in touch if you have any queries regarding potential submissions
  - Deadline for submission this year is **15th June**
- Validation pack submitted to Lloyd's should outline any deviances to agreed plan
  - Various triggers could result in a re-focussing of validation efforts
- Increases the need for good signposting of previous validation relied upon
  - One approach is to keep a log of relevant testing / documents
- The annual validation pack submitted to Lloyd's should include any deep-dive reviews carried out in the previous year

3-year validation plan

Plan feedback

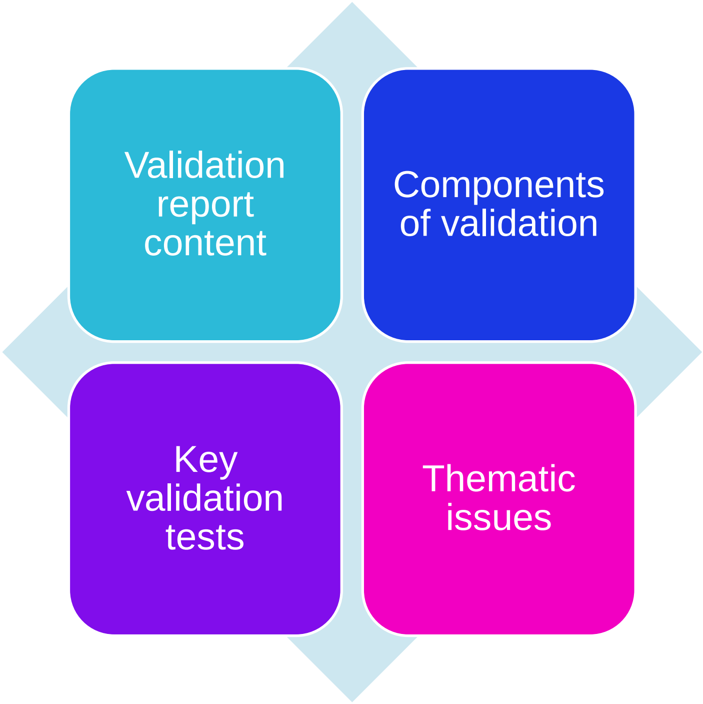
- Make sure all areas are covered, including
  - Model methodology
  - Non-calculation kernel components (data, documentation, governance, systems/IT, use test)
  - Differences between syndicates within a managing agency
- Always explicitly mention the link between focussed validation testing and risk/class materiality criteria
- Planning of deep dive reviews could generally be expanded
  - ‘Deep-dive on reserve risk during 2018’ is ambiguous
  - What is the area of focus/objective of the review?
- A set of validation triggers can also be used to justify not repeating a test annually (similar to falsifiability criteria)
  - E.g. Test to be performed this year if:
    - Test has not been performed for >2 years; or
    - Test resulted in a fail last year; or
    - Risk category has increased/decreased by > x%

"Since this is our first deep dive, maybe we should save the Marianas Trench until we have more experience."

2018 YoA validation report reviews

Process

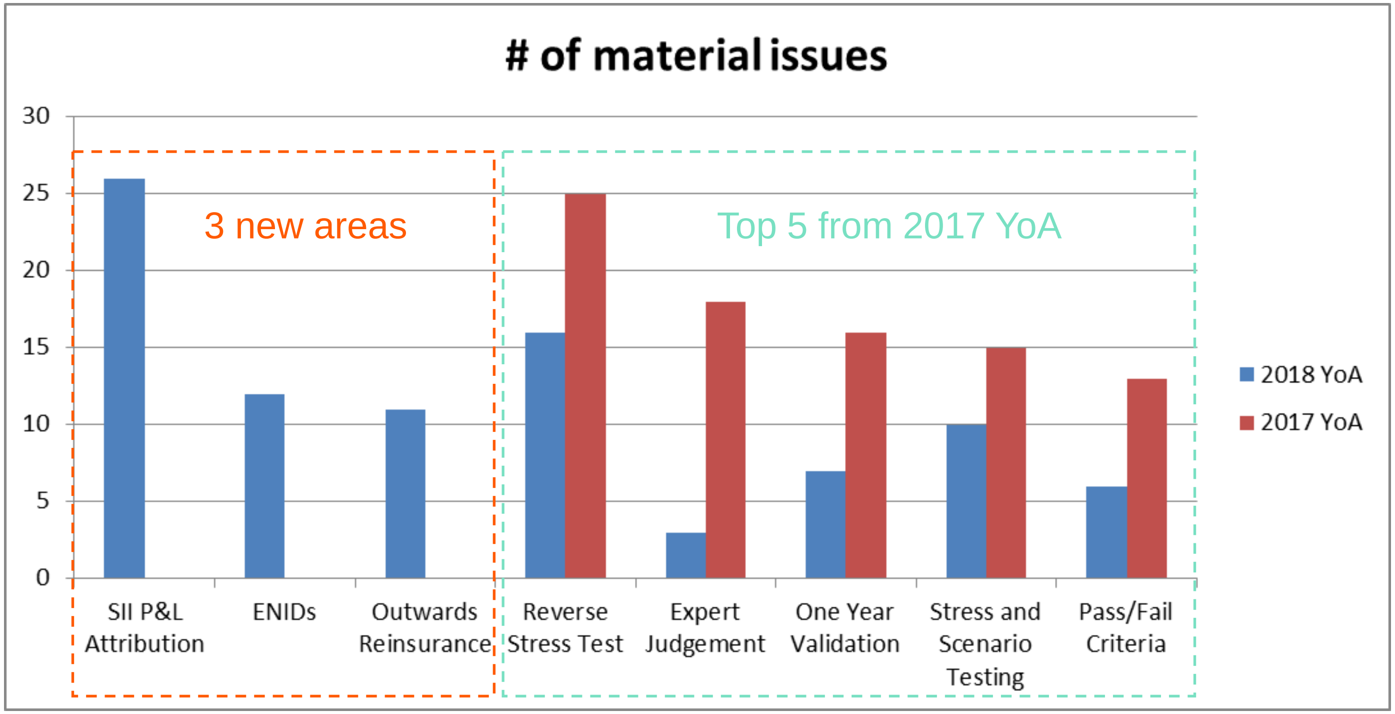
- New review template reflects updated guidance (July 2017)
- Risk based approach taken to reviews
  - 42 managing agents reviewed in detail
- 72 questions covering 4 broad sections
- Aimed to incorporate evolution of validation process and requirements
- However, not intended as a ‘tick-box’ exercise
- Specific sections of validation packs also reviewed as part of SCR reviews
- Some of the deep dive reports were good and added value



2018 YoA validation report reviews

High-level findings

- Significant improvement in key material issues identified last year

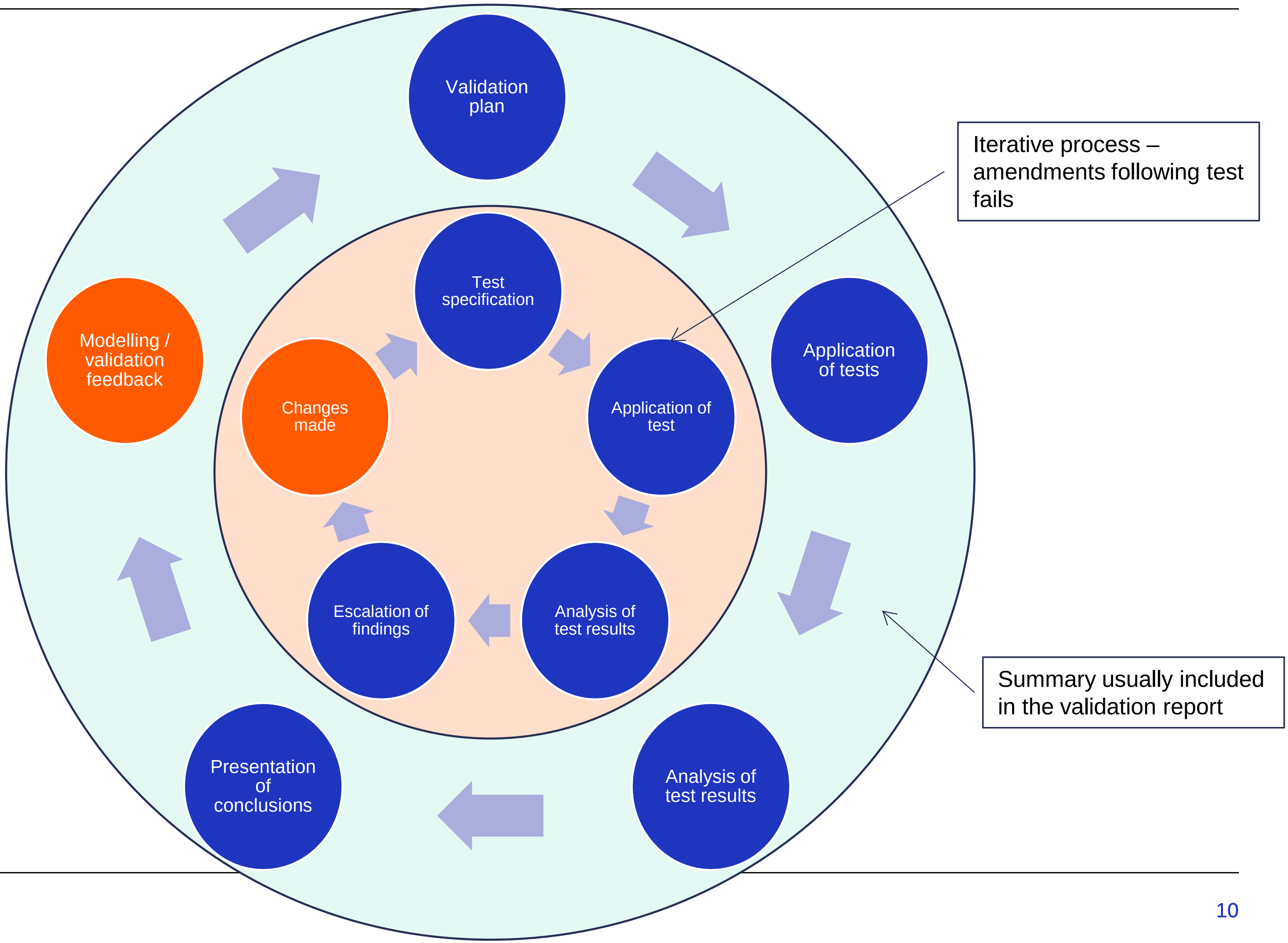


- Note:
  - feedback grouped by category of issue
  - review template has changed since last year, which may influence the comparison
- Themes discussed in more detail later

Validation process

The validation cycle

Value added



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Lloyd's review challenges – market perspective

- Last minute information requests
- New issues identified each year
- Submission deadline not ideal
- Short time to address material issues
- Moving goalposts
- Delay between submission and feedback
- New reviewers
- Prescriptive guidance

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Lloyd's review challenges – Lloyd's perspective

- Lloyd's only sees the final validation pack submission…
  - The process followed is inferred from submitted information
  - The iterative cycle is key to understanding the effectiveness of validation performed
- …But it is not feasible to list every failure/amendment in the validation report
  - A solution could be to include a sample, representative of the robustness of the process, in the validation pack
- Setting appropriate level of capital vs regulatory compliance
  - Validation packs used for both purposes – but different types of review
- There are only two opportunities a year to adjust capital requirements at Lloyd's
  - Results in fairly tight timescales for material issues to be addressed and re-reviewed
- It is not possible to identify all issues in every validation report during one review cycle
  - There is a possibility of new concerns emerging in future
  - Areas of focus are constantly evolving
- Balance between consistency vs fresh pair of eyes for reviewers

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Validation report (conflicting) stakeholders

Recap from previous workshops

- The length of the report is not relevant, however should be appropriate for the intended audience(s) - consider the below examples of submissions to Lloyd's:

20 pg. report + 400 pg. appendices/tech report	70 pg. report + 350 pg. appendices/tech report	200 pg. report
Insufficient information in report for board challenge	Report provides enough information for board challenge	Report provides enough information for board challenge
Concise for board discussion	Length is manageable for board discussion	Report is too long for board discussion
Technical details for regulators provided separately	Technical details for regulators provided separately	May not contain enough technical detail for regulators

- Where necessary, further details are requested to complete our reviews
  - Reduces number of material feedback points issued, but can result in delays
  - The easier validation packs to review include both good sign-posting and the underlying test schedules in the appendices

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Presentation of conclusions

Considerations

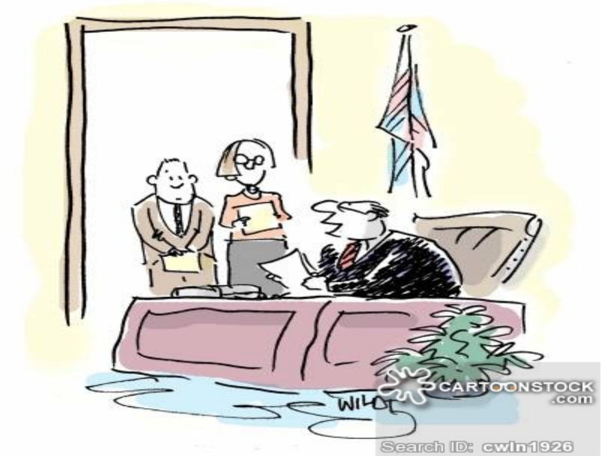
	Sensitivity tests	Stress and scenario tests	Reverse stress test	Backtests	Stability tests
Premium risk	Pass	Pass with limitations		Pass	Fail
Reserve risk	Pass	Pass with limitations		Pass with limitations	Pass with limitations
Market risk	Pass	Pass		Pass	Pass
Credit risk	Pass	Pass		Pass	Pass
Dependencies	Pass	Pass with limitations		Pass	
Overall SCR	Pass	Pass	Pass	Pass with limitations	Fail

Example: This table is presented in the executive summary, without much explanation. Explanation provided in relevant sections.

Risks: The regulator, under time pressure, decides the capital submitted is unstable and requires a loading.

Solution: Provide adequate explanation that justifies the results, especially *pass with limitations* and *fail.*

Discussion on materiality of limitations and accumulation of minors is important too.



"Great speech! But let's cut your carefully reasoned conclusion and insert an uplifting sports metaphor."

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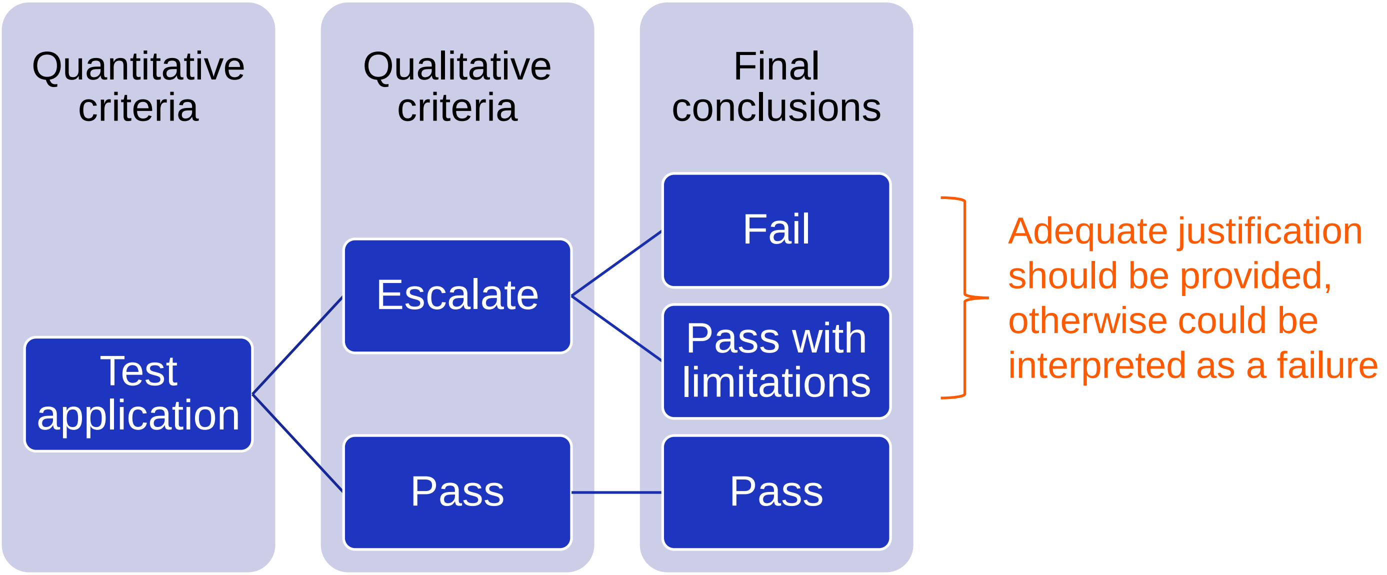
Pass/fail criteria

Tiered criteria

- Clear presentation required to demonstrate why test result was reached
- One possible approach below:



- Test results should be escalated to suitable individuals / committees
- Iterative process, so tests may be repeated

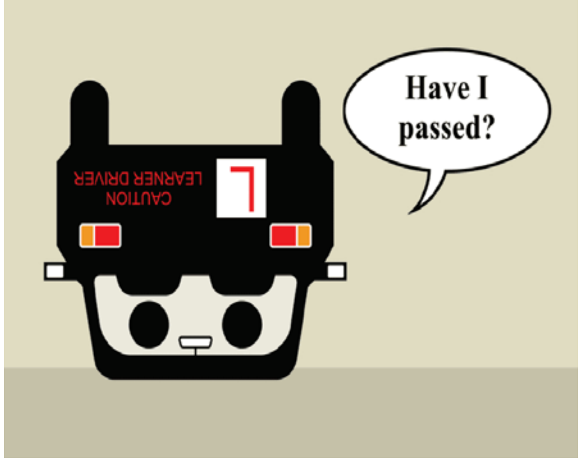
Pass/fail criteria

Example test presentation - backtesting

Result	Criteria
Pass	If all experienced ULRs are less than the 1-in-10 modelled ULR
Pass with limitations	If at least one experienced ULR is greater than the 1-in-10 modelled ULR, with justification.
Fail	If at least one experienced ULR is greater than the 1-in-10 modelled ULR, without justification.

Class	Quantitative Test Result	Qualitative Justification	Final Test Result
Property D&F	Pass	N/A	Pass
Casualty	Pass	N/A	Pass
Marine	Escalate	High ULR in 2011 as a result of large exposure to Costa Concordia loss - this is considered to be beyond a 1-in-20 level loss. In addition, reduced line sizes written subsequently, hence modelled volatility is less than previously experienced.	Pass with limitations

- Additional quantitative criteria can also be added for further robustness
  - E.g. if > 2 experienced ULRs are greater than the 1-in-4 modelled ULR, then escalate



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Top-down challenge

- Capital and validation results should be challenged as part of a managing agent's governance process before the final validation pack is submitted to Lloyd's.
- Challenges should not arise only in the event of a failed test
- This challenge can take many forms:
  - Qualitative validation tests
  - Discussions with internal experts / stakeholders
  - Risk committee / board minutes
- Can be easy for the validator to get lost in the detail
  - Therefore top-down oversight of validation process expected
- Lloyd's may request further evidence of this challenge as part of our reviews
  - Please make sure this is appropriately documented
  - E.g. minutes capturing relevant discussions

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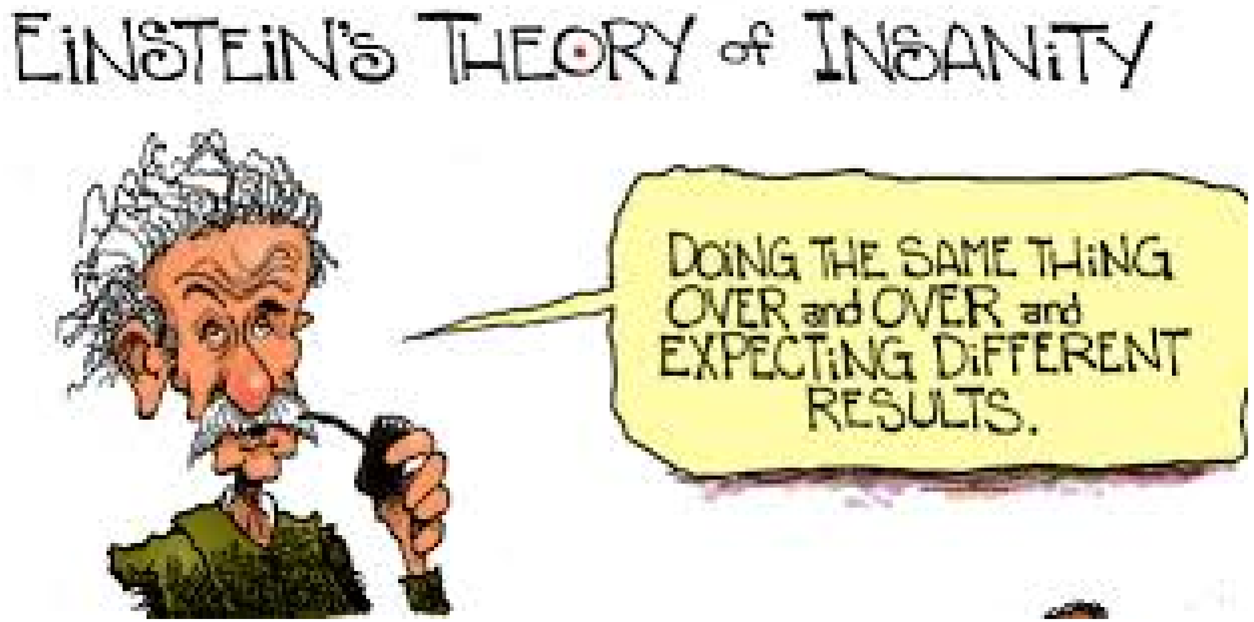
Feedback loop



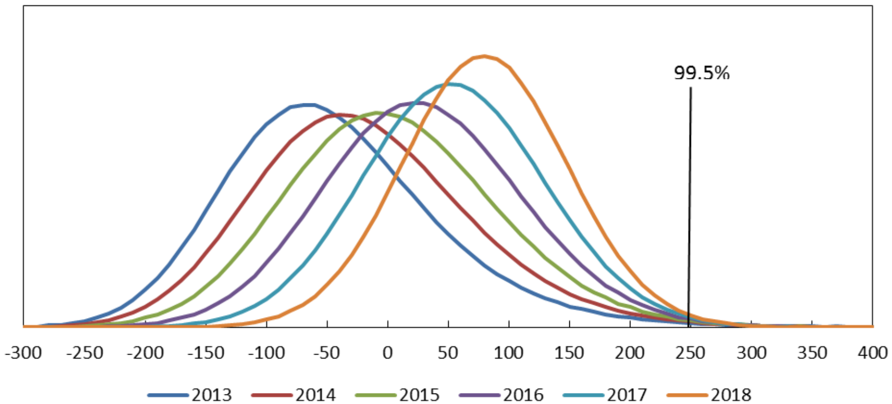
- What tests could be improved/added
- Are any tests not adding value – could use resource more effectively
- What limitations should be addressed – driven by materiality
- Which areas should be reviewed in more detail – e.g. deep-dives

Validating the entire distribution

Analysis of change

99.5% = Mean + ‘Stress’

- Validation should not be restricted to the tail only
- Looking at the 1-in-200 alone can hide true drivers of profitability/risk
- Mean/stress helpful for considering aggregation of risks
  - Means add up
  - Stresses diversify



- Can be extended to look at risk (stress) vs exposure metrics over time
- Also useful to look at movements in post-diversified contributions and the SCR(1)
- Validation performed should be appropriate for any model changes made
  - The model change log can be used as a basis for assessing their impact

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Analysis of change

Example e.g. post-HIM

£m	2017 YoA			2018 YoA			Difference		
	Mean	99.5th %	Stress	Mean	99.5th %	Stress	Mean	99.5th %	Stress
Premium Risk	*-15*	*70*	*85*	*-25*	*60*	*85*	*-10*	*-10*	*0*
Reserve Risk	*-20*	*40*	*60*	*-25*	*55*	*80*	*-5*	*15*	*20*
Insurance Risk	-35	75	110	-50	75	125	-15	0	15
Credit Risk	0	15	15	0	20	20	0	5	5
Market Risk	-10	40	50	-5	30	35	5	-10	-15
Operational Risk	5	20	15	5	20	15	0	0	0
Pre-diversified Total	**-40**	**150**	**190**	**-50**	**145**	**195**	**-10**	**-5**	**5**
Diversification Credit	0	-50	-50	0	-45	-45	0	5	5
SCR(Ult)	**-40**	**100**	**140**	**-50**	**100**	**150**	**-10**	**0**	**10**

Summary Comments

- Improved premium rates expected (reduces mean premium risk)
- Increased reserves due to recent catastrophe losses (also increases risk margin)
- Increased reinsurance recoveries expected (increases credit risk exposure)
- Reduced return/risk on assets (mix changed to improve liquidity)
- Operational risk assumed to be unchanged

- Many moving parts changing the risk profile, but overall SCR(Ult) remains stable
- Reserve risk / market risk / credit risk stress changed by ≥ 30%

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Reconciliation of the mean

- Ensuring the mean model output is accurate is important for capital setting at Lloyd's (with 35% ECU) and for model use
- Need to check that all sources of expected profit (or loss) are consistent with Solvency II principles e.g.
  - Does the initial balance sheet generally reflect the best-estimate of future cash-flows (with a few technical exceptions)?
  - How consistent are the assumptions used for the business plan, technical provisions and the capital model?
- During the capital setting process in March, a few inconsistencies were noted between the QSR and LCR which are used to form the Lloyd's capital stack.
  - Lloyd's relies on the QSR data to make capital adjustments (e.g. RiM & RICB) therefore consistent assumptions expected
- Validation (e.g. back-testing) should also be performed on the projected TPs, to identify whether there are any systematic biases in the roll-forward process.
  - This will be an area of focus by Lloyd's given the implications for the LIM

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P&L attribution

General comments

- Key part of Solvency II Directive (Article 123)
- Aids model use with clear feedback loop between the business and the model
  - A stand-alone P&L attribution report may be produced for internal purposes
- Should start with a top-down assessment of the total P&L
- Then further analysis performed for each risk category
  - Market/Credit/Operational risk should be included
- Further understanding of the P&L drivers gained by performing class level analysis
- Two distinct tests should be performed
  - Test of model design (are material sources of P&L modelled?)
  - Test of model parameterisation (how realistic is the modelled distribution?)

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P&L attribution

Solvency II basis

- Last year, we confirmed that P&L attribution should be extended to a SII basis at an aggregate level
  - Article 240 of the Delegated Acts says *"the specification of profit and loss shall be consistent with the increase and decrease of the monetary amount underlying the probability distribution forecast referred to in Article 228(1)"* i.e. SII basic own funds
- However…
  - Data difficulties exist, for example, in performing a class of business level analysis
  - Boards may gain more value from a UK/US GAAP basis
- Two main approaches to meet the regulatory requirement:
  - Carry out full P&L attribution on SII P&L
  - Perform a bridging analysis from GAAP P&L to SII P&L
- There was commonly misinterpretation of the latter approach
  - Often limited to just a bridging of the actual P&L
  - Comparison between the actual P&L <u>and</u> the modelled P&L still required

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P&L attribution

GAAP - Solvency II bridging example

£m	Actual technical provisions			Modelled technical provisions								
	T=0	T=1	BS to BS Movement	T=0	T=1	BS to BS Movement	Difference	Deterministic / Stochastic	Materiality Assessment	Actual Percentile of Modelled Distribution	Criteria 1	Criteria 2
	A	B	C (B - A)	D	E	F (E - D)	G (C - F)	H	I	J	K	L
GAAP Members' Balance	**-20.0**	**-40.0**	**-20.0**	**-20.0**	**-20.0**	**0.0**	**-20.0**	**S**		**64%**		
Removal of Margins	8.0	6.0	-2.0			0.0	-2.0		Not Material	N/A	Pass	N/A
Expenses Differences	-6.0	-3.0	3.0	-6.0	-5.0	1.0	2.0	D	Material	N/A	Pass	N/A
Additional RI Premium	-12.0	-19.0	-7.0			0.0	-7.0		Material	N/A	Escalate	N/A
UPR Profit	10.0	5.0	-5.0	10.0	7.0	-3.0	-2.0	D	Material	N/A	Pass	N/A
ULO Profit	3.0	6.0	3.0	3.0	4.0	1.0	2.0	D	Material	N/A	Pass	N/A
ENIDs	-2.0	-3.0	-1.0	-2.0	-2.0	0.0	-1.0	S	Not Material	63%	Pass	Pass
RI Bad Debt	-1.0	-4.0	-3.0	-1.0	-1.0	0.0	-3.0	S	Material	87%	Pass	Pass
Effect of Discounting	3.0	5.0	2.0	3.0	4.0	1.0	1.0	S	Not Material	34%	Pass	Pass
Risk Margin	-8.0	-15.0	-7.0	-8.0	-9.0	-1.0	-6.0	S	Material	93%	Pass	Escalate
SII Members' Balance	**-25.0**	**-62.0**	**-37.0**	**-21.0**	**-22.0**	**-1.0**	**-36.0**	**S**		**71%**		**Pass**

Criteria 1	Escalate if material source of actual profit or loss (>£2m) is not captured in the internal model
Criteria 2	Escalate if actual result is outside of percentiles [10%, 90%] for stochastically modelled distribution

Reverse stress test

Specific feedback

- Noted improvement in consistency of approach following numerical examples / FAQs released last year
- More specific feedback provided to improve RST was provided this year
- Pass/fail criteria: what constitutes an ‘approximate’ simulation to the scenario?
  - A pre-defined collar of eligible simulations should be specified around return period
  - Criteria to select suitable simulations can be improved by using objective thresholds for proportion or absolute value of loss associated with each risk category
- How is business unviability defined?
  - 1-in-200 return period commonly used, however link to potential unviability should be described
  - The test can be extended to consider different inflexion points e.g. depletion to MCR

Thematic issues

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Outwards reinsurance

Areas of focus

- Reasonableness of modelled output
  - RI loss ratio distribution
  - Probabilities of attachment and vertical / horizontal exhaustion
- Review of individual contracts
  - Stop-loss / ADC / ILW / shared group covers
  - Are bespoke terms of contract / clash cover modelled accurately?
  - Are recoveries / reinstatements captured in model output where expected e.g. RDSs?
  - Materiality of non-modelled contracts
  - Pre-incepted cover remaining at 1/1 (e.g. reinstatements purchased vs modelled)
  - Reasonableness of renewal assumptions (e.g. inwards vs outwards rate changes)
- Justification of simplifying assumptions (e.g. reserve risk)
  - Reasonableness of net:gross ratio selection (deterministic or stochastic)
  - What remaining RI cover is available for reserve deteriorations
  - Backtesting of actual recoveries against modelled assumption

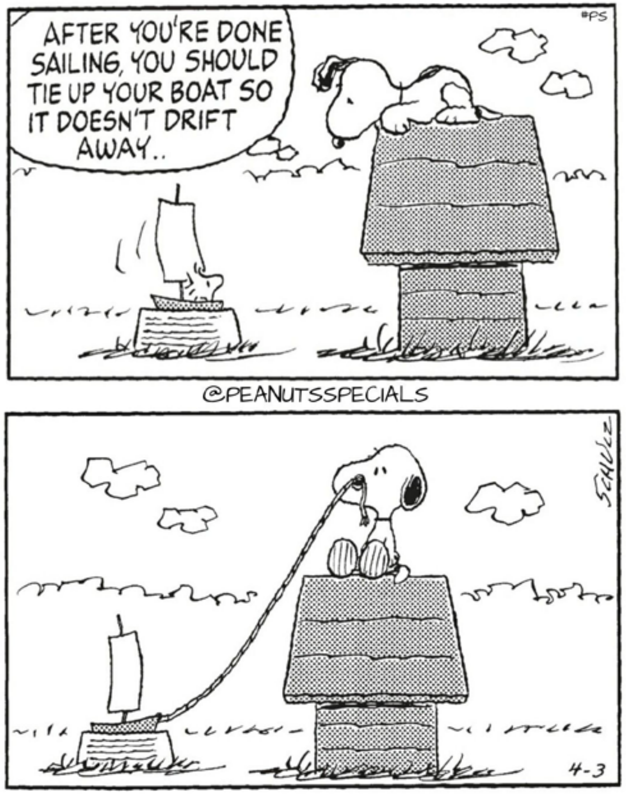
Non-modelled risks

- Particularly relevant given the Harvey flood losses and California wildfires

- Firstly, validation should ensure that all region-perils and secondary perils are adequately allowed for in the model
  - Materiality assessment depending on risk profile may impact the approach taken
  - How relevant / reliable are the data / expert judgements used?
- Secondly, quantitative validation should be performed on the quantum of the allowance
  - E.g. comparison of actual versus expected losses for recent events
  - How are uplift factors or loadings justified as being reasonable?

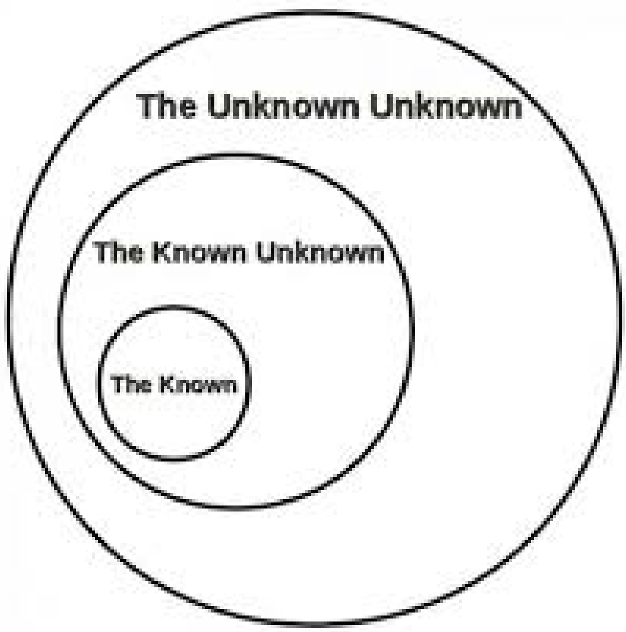
Model drift

- Many incremental model changes in the last two years
  - One syndicate had > 100 minor model changes in a year
- Vendor model version updates
  - Many use outputs without adjusting for risk profile
  - Can result in material movement in numbers
- The validation process should check against model drift
  - E.g. compare SCR for the last 5 years to the standard formula



ENIDs

- Consideration of ENIDs is newly identified limitation in many validation processes
- Many syndicates allow for ENIDs at the mean as part of technical provisions
  - How is comfort gained that the allowance in the tail is appropriate?
  - “Black-swan” events tend to be fat-tailed in nature
- Mixture of quantitative and qualitative testing required



2019 YoA review process

Changes since 2018 YoA process

Capital setting

- Data platform changing from CMR (Core Market Returns) to MDC (Market Data Collections)
- Supplementary Questionnaire and Analysis of Change templates to be embedded into the LCR forms
  - Qualitative information tabs merged and tab naming convention changed
- Testing of MDC to be performed in May/June prior to full roll-out
- Greater engagement regarding comparison between the LIM and syndicate models
  - CALM working party being set up
- Tier 2 capital restrictions being introduced
  - Market Bulletin Y5177
- PMD business planning market briefing on 24 May
  - Details of CPG market messaging for 2019 YoA to be announced

Timetable

Market Bulletin Y5176

- Similarly to last year, there will be split submission deadlines:

<table>
<tr>
<td rowspan="2">Final SBF and LCR returns

Validation report</td>
<td rowspan="2">Final SBF and LCR returns available from 16 July 2018</td>
<td>- Syndicates with spread member capital and Managing Agents with Special Purpose Arrangements (SPA)

- Syndicates with member consolidation requirements

- Managing Agents with multiple syndicates if at least one is required to submit on 6 September</td>
<td>SBF - 6 September 2018 (by 1pm)

LCR - 13 September 2018 (by 1pm)

Validation report – 20 September 2018 (by 1pm)</td>
<td rowspan="2">MDC

Validation report: SCRReturns@lloyds.com</td>
</tr>
<tr>
<td>- Syndicates with members who have Letter(s) of Credit (LoC)

- Syndicates with dedicated single member corporate capital</td>
<td>SBF - 4 October 2018 (by 1pm)

LCR - 4 October 2018 (by 1pm)

Validation report – 11 October 2018 (by 1pm)</td>
</tr>
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Any Questions?

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