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Central Bank of Ireland

Eurosystem



# Internal Models

A Presentation to Society of Actuaries in Ireland

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31<sup>st</sup> May 2011



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## Disclaimer

- The views expressed are personal and are not necessarily that of our employer, the Central Bank of Ireland
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## Background

Ireland is Second Largest in Europe

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## Agenda

- Approval Process
- Validation
- Aggregation

**Tony Jeffery**  
**Dermot Marron**  
**Niamh Gaudin**

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# Approval Process

## Tony Jeffery

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## Basic principles

- When used properly as a tool within a firm's risk management system, internal models are desirable
  - But only if the model is adequate for the assessment of risk
  - As always in Solvency II proportionality must be applied
  - Our aim is to be practical and risk focused
  - Approval must be based on controlled and thorough consideration of all material risks
  - The Group Supervisor's role is key
  - Approval of an IM is to be led by the relevant Examination team with support by the IM and Actuarial Teams and ultimately to be decided upon by Senior Management.
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## Group Models

- Approval of Models for Groups largely falls on the Group Supervisor
  - It is a collaborative process
  - Our Prime Concerns are
    - Local Use
    - Local Governance
    - Local Calibration
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## Group Models

- We need to understand your model, so we can test your understanding
  - We will communicate any areas where we have doubts
    - Observation
    - Concern
    - Major Issue
  - VA's we expect substantial technical involvement.
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## Approval Process

1. Readiness Assessment Request
  2. Assessment by CBoI of Readiness
  3. Request for Status of Evidence and Pre-Application Submission
  4. Walkthrough
  5. Decision on assessment Levels
  6. Completion of Model Overview and Work Plan (“MOWP”)
  7. Detailed Work based on MOWP
  8. Approval and confirmation of no further questions (“NFQ”) for each Criteria
  9. Formal Submission and Approval
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## Levels of Consideration

- Conceptual
  - Detailed
  - Very detailed
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# Validation

## Dermot Marron

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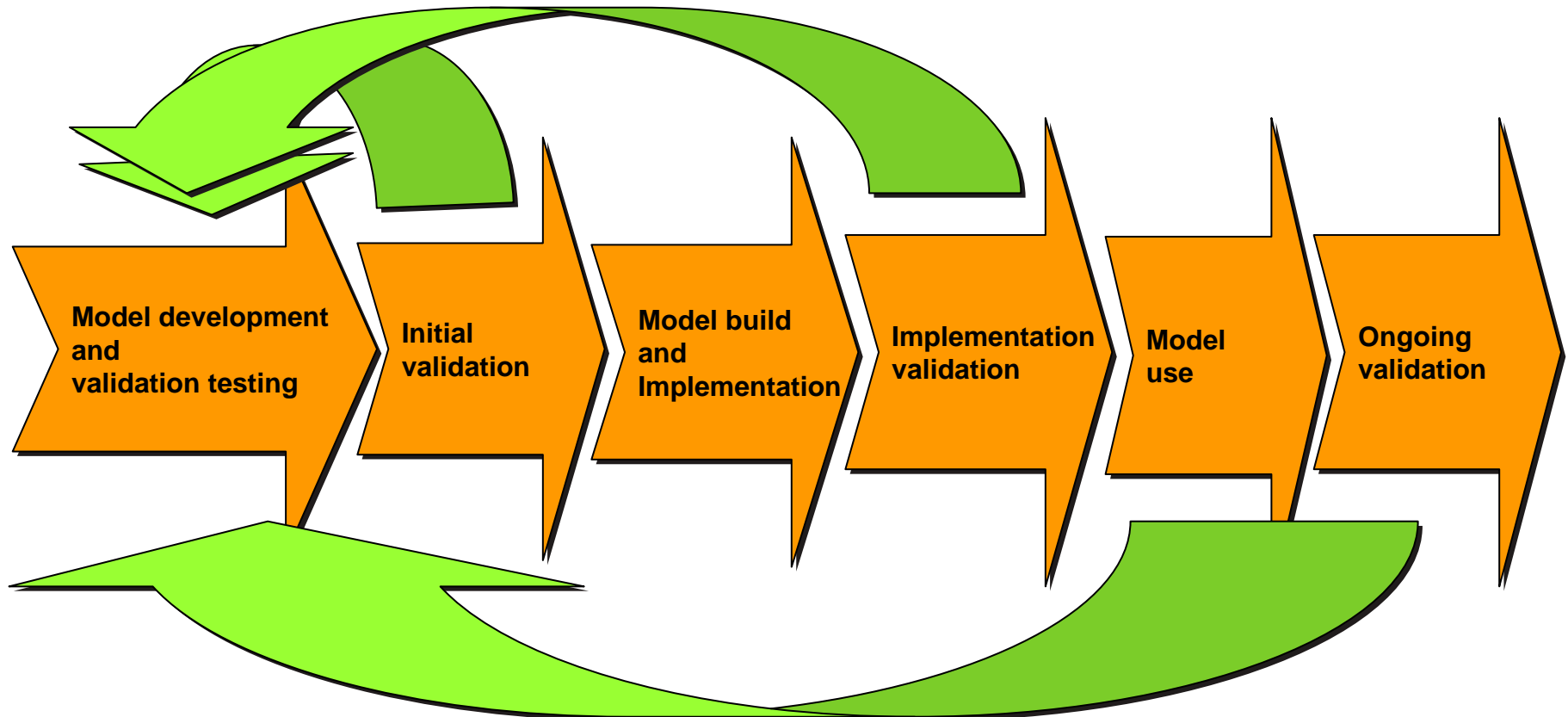
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## Validation

- Informal Supervisory Meeting of Supervisors on 28 April to discuss Validation
  - Comments informed by
    - Central Bank of Ireland experience to date
    - Experience of other Supervisors to date
    - Experience of other Supervisors with Basel II
  - Not high on agenda for Internal Model companies to date – suggest that it moves up in priority!
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## Stages of Validation





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## Development

- Planning and design
  - Validate theoretical basis – weak?
  - Market practice does not relieve companies of the requirement to validate the theoretical basis
  - Independence a challenge – development team will defend to the death!
  - Need to “retrovalidate”
  - Link to documentation standards
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## Implementation

- Not well recognised, often overlooked
  - Real-life examples
    - Sovereign debt model
    - Negative interest rates
    - Hard-coded commission rates
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## Ongoing validation

- Generally well recognised
  - Link to ORSA and Use Test
    - Scenario testing
    - Stress testing
    - Reverse stress testing
    - Back-testing
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## Elements of Validation

- Qualitative
    - E.g. governance of process
    - Internal Audit can have a function here
  - Theory and Concept
  - Statistical
  
  - Level 3 paper forthcoming on validation tools
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## Independence

*Article 229 TSIM18*

### **Validation process**

*The validation process shall be independent from the development and operation of the internal model.*

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## Independence

- Very important
    - Reporting lines very important in ensuring independence
    - Example of Head of Validation reporting to CRO who was ultimately responsible for the Risk Model – took 2 years for changes to be implemented
  - External  $\neq$  Independent
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## Outsourcing

- Terms of engagement should match Validation Policy
    - Share with Central Bank of Ireland
  - Clear criteria
  - External  $\neq$  Independent
  - Negative Assurance v Positive Confirmation
  - Accountancy (Audit) firms v Actuarial firms
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## Challenge and Escalation

- Need Senior Management “buy-in”
  - Challenge can be career-ending!
  - Not in guidelines – ‘cultural’ issue
  - Reporting lines very important – direct line, no filter
  - Status and salary – validation not sexy!
  - Use Test should evidence challenge of the model
  - Central bank of Ireland will challenge Validation work
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# Aggregation

## Niamh Gaudin

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## Aggregation

### Article 121 (5)

As regards diversification effects, insurance and reinsurance undertakings may take account in their internal model of dependencies within and across risk categories, provided that supervisory authorities are satisfied that the system used for measuring those diversification effects is adequate.

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## Aggregation

- Extract from CP 56 Tests and Standards for Internal Model Approval
  - “EIOPA concludes that modelling of dependencies and the aggregation mechanism requires special attention by the supervisory authority”
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## Measurement and Modelling of Dependencies in Economic Capital – Institute discussion paper

- Diversification benefits can amount to anything in the region of up to 50% of an insurance company's undiversified total economic capital, assuming a ground up approach
  - The diversification benefit depends, among other things, on the level from which we started aggregating.
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## *Article 223 TSIM13* - shall meet at least

- The system used for measuring diversification effects shall **identify** the key variables driving dependencies.
  - Insurance and reinsurance undertakings shall be able to **justify** the assumptions underlying the system used for measuring diversification effects on an **empirical basis**.
  - The system used for measuring diversification effects shall take into account any **non-linear** dependence and any material lack of diversification under **extreme** scenarios.
  - The system used for measuring diversification effects shall take into account the characteristics of the risk measure used in the internal model.
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## *Article 120* - Use Test

- Understanding of the internal model
    - Overall understanding of the internal model shall mean: knowledge about the diversification effects taken into account in the internal model
  - Integration with risk management
    - Insurance and reinsurance undertakings shall demonstrate that the internal model is widely integrated in their risk-management system in the following manner: the outputs of the internal model, including the measurement of diversification effects, are taken into account in formulating risk strategies, including the development of risk tolerance limits and risk mitigation strategies
  - Takes diversification effects actively into account in business decisions
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## Aggregation

- The difference between correlation & dependence is that a strong correlation only indicates that two (or more) data sets move together but (unlike dependence) does not establish any causal relationship.
  - For example, IQ of a child & size of his shoe will show a strong positive correlation but this does not mean that children with larger feet have greater IQ. Both these variables however 'depend' on a third factor i.e. age of the child.
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## Options available 1

- Covariance Matrix

- Instead of calculating the full distribution of your losses, you come up with an assumption for the 99.5% instantaneous shock for each individual risk driver
  - Assumptions
    - Dependence between economic risks can be summarized by the linear Pearson correlation coefficient
    - Variance of the random variables are finite
    - Losses are a linear function of your risks
    - Assume that the economic risks follow a multivariate normal distribution (normal used as a approximation to elliptical)
    - Linear correlation is a natural dependency ratio for elliptically distributed risks – what about CAT events?
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## Options available 2

- Covariance Matrix with additional stresses overlaid
    - Attempt to compensate for the deficiencies but no way to estimate how accurate or inaccurate they are
    - Other Dependency Ratios
      - Spearman's rank correlation
      - Kendall's rank correlation  $\tau$ 
        - Both are more sensitive to non linear relationships
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## Options available 3

- Coefficient of Tail Dependence
    - Describes the likelihood of random variable A taking an extreme value on condition that random variable B also takes an extreme value
    - This does not provide full information of the dependence structure between random variables
  - Curve fitting
    - Idea is to accelerate the nested stochastic calculation by using interpolation
  - Least Squares Monte Carlo
    - Increases the speed and accuracy of calculation over Curve Fitting, run a significant number of real-world (outer) simulations for one year with one market consistent (inner) simulation, then use regression
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## Options available 4

- Copulas – Difficult to select and fit
  1. Determine the marginal distribution of every single risk component
  2. Determine the dependence structure between these risk components via the copula function

Gaussian copula – problem in allowing for the correlation in the tail

Student copula – tail dependent

Gumbel copula – Tail dependent in the upper one, in the lower tail they feature independency making them inadequate for modelling extreme events

Clayton copula – Tail dependent in the lower one, making them good for modelling yields on shares, for example

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# Conclusion

60% of CFO forum companies use the variance covariance matrix approach to aggregate capital (study by Oliver Wyman Jan 2009)

- Irish experience to date shows that Internal Models use copulas or variance covariance matrices for aggregation purposes with some use of stress tests overlaid
  - Is the data available to meet the requirements under both the SQS and the Use Test?
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Thank you

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