SEAC | Southeastern Actuaries Conference

Being Part of Something that Counts

Reporting and Auditing Requirements Under VM-20/VM-21

1. Vendor Perspective - Steve Krupa – FSA, MAAA
2. Auditor Perspective – Elizabeth Walsh – FSA, MAAA
3. Regulator Perspective– Rachel Hemphill – FSA, MAAA, FCAS

Moody's Analytics

Better Faster Decisions

Reporting & Auditing Requirements for VM20/VM21

Vendor Perspective – Steve Krupa, FSA, MAAA

November 19, 2020

Vendor Perspective Agenda

1. Reporting and Auditing Challenges for VM-20
2. Reporting and Auditing Challenges for VM-21
3. Model Governance Considerations in Practice
4. Approaches to Building Comfort with Models

Reporting and Auditing Challenges for VM-20

Post Level Term Profit Testing	2 % Collar Test	IUL DR Interest Crediting	Model Simplification
Exclude post level term profits from seriatim Term Deterministic Reserve (DR) and test direction of lapse margin on modeled reserve	98% Modeled Reserve < Starting assets less PIMR < MAX (102% Modeled Reserve, NPR, 0) Modeled Reserve = MAX (DR, SR)	IUL DR interest credit at 100% spent on options for 1st 20 years and 108% thereafter, accumulated at 1 year treasury from Scenario #12	Demonstrate reserve not understated when compared to reserve with no simplification
» Leverage CALM +/- lapse margin at every duration » 100% lapse (only with post level term profits) at end of initial term period for Term DR » Seriatim comparison of PV post level term in-flows and outflows	» Incrementally improve runtime with solver efficiencies to limit number of iterations to meet 2% collar	» Leverage CALM seriatim reserve reconciliation report to improve auditability	» Compression via clustering » Neural Network aided clustering » Improve bursting offerings and runtime grid monitoring tools on the Public cloud

Reporting and Auditing Challenges for VM-21

Standard Projection Amount	Stochastic Reserve	VM-31 PBR Report Disclosures	Allocation of Aggregate Reserve to Contract Level
CTE with prescribed assumptions vs Company Specific Market Path (CSMP)	Scenario Reserve method Direct Iteration vs GPVAD discounting additional assets at NAER	Cumulative Decrement Analysis (CDA) and Impact of Aggregation	Allocate excess reserve to seriatim records
» CSMP may not enclose CTE 70 (adjusted) with 40 prescribed paths » Prescribed assumptions for GMWB with no previous withdrawals requires withdrawal delay cohort method splitting contract into cohorts with different initial withdrawal periods	» Direct iteration – no deficiency at end of any projection year (leverage CALM – no deficiency at end of coverage period) » Discount accumulated deficiencies at NAER on additional assets	» Project along scenario closest to CTE70 (adjusted) express as total % of account value at end of projection year by decrement » Impact of aggregation at contract level = sum absolute value of negative Accum Deficiencies (AD) discount at NAER of CDA scenario from time of CDA duration	» Contract level reserve = CSV + allocated portion of excess aggregate res over aggregate CSV » Excess of aggregate reserve over aggregate CSV is allocated based on contracts relative risk to its CSV » May use relative risk measure like Standard Scenario (AG43 or NY Reg 213) or other

Model Governance Checklist Categories

1. Version Control Flow

   A - Governance Standards

   B – Modeling Process

   G – Model Selecting/ Versioning
2. Automation and Other Assumption Updates

   C – Assumption Setting
3. Actuarial Modeling Flow for Valuation Results

   D – Input Data/Tables/ Mapping

   H – Reporting

   I – Analysis/Validation
4. Model Governance in Practice

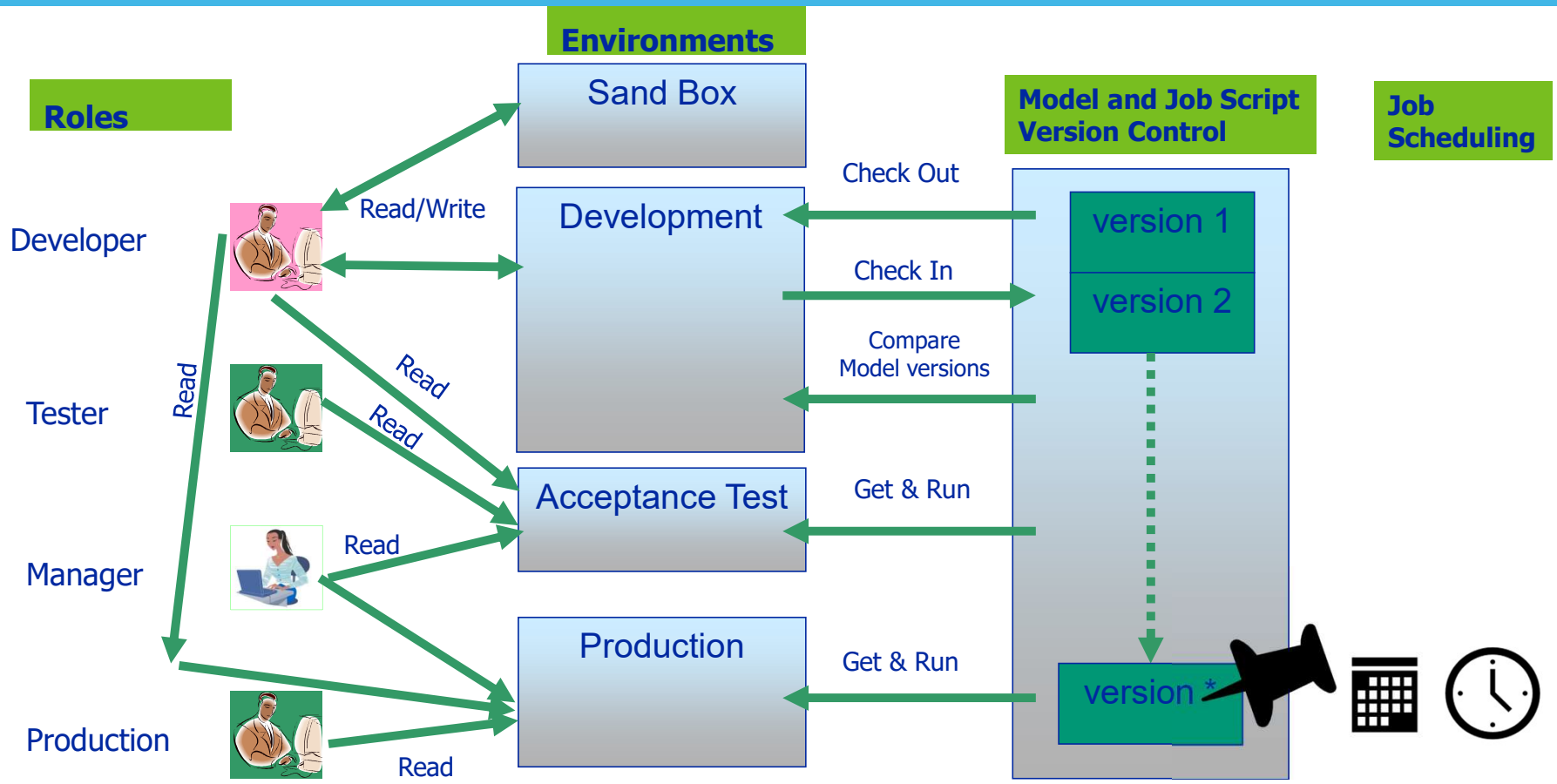
   E – Access Controls

   F – System/ Model Changes
5. Hierarchy for Aggregating VM-20 Results

   H – Consolidation of Results

www.actuary.org/sites/default/files/files/publications/PBRChecklist_Final.pdf

Version Control Flow



Automated Model Assumption Updates
(Calendar Year Cadence)

Day	Month-End
T+0	Auto Download Historic Treasury Rates (EOD 6PM) (FRB_H15.csv) https://www.federalreserve.gov/datadownload/Output.aspx?rel=H15&series=bf17364827e38702b42a58cf8eaa3f78&lastobs=&from=&to=&filetype=csv&label=include&layout=seriescolumn&type=package
T+1	Table F&G Current Spreads - https://content.naic.org/sites/default/files/pbr_data_2020_vm-20_table_f_%26_g_current_spreads.xlsx
T+1	Table J Current and Long Term Swap Spreads - https://content.naic.org/sites/default/files/pbr_data_2020_vm-20_table_j_swaps.xlsx

Day	Quarter-End
T+1	Table H&I Long Term Spreads - https://content.naic.org/sites/default/files/pbr_data_2020_vm-20_table_h_%26_i_long_term_spreads.xlsx

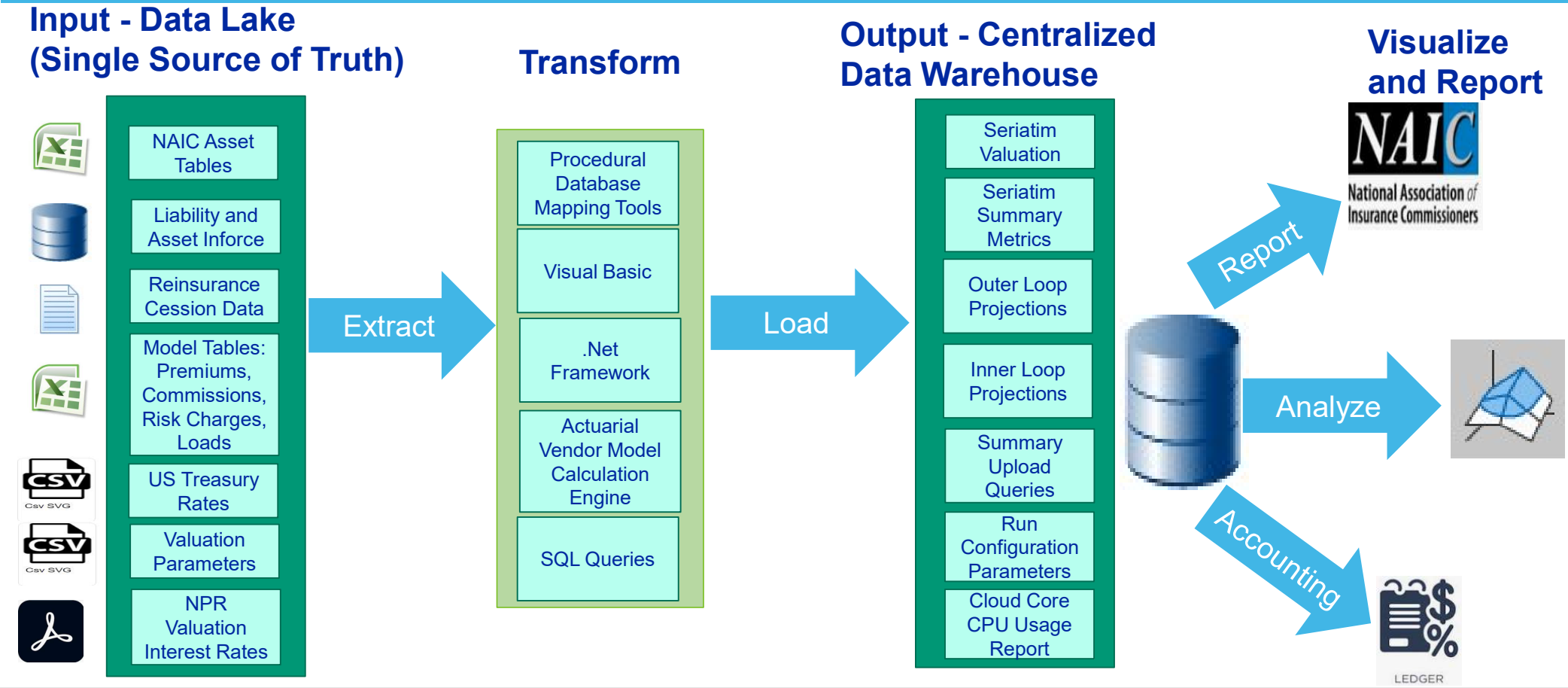
Day	Annually
End of Jun	Table A Default Costs – https://content.naic.org/sites/default/files/pbr_data_2019_vm-20_table_a_baseline_annual_default_costs.xlsx
End of Sept	VM-20 Mortality Improvement - https://www.soa.org/globalassets/assets/files/resources/experience-studies/2019/mortality-improvement-smoothed-rates-2019-final.xlsx

Other Model Assumption Updates

Frequency	Assumption	Data Source
Monthly	Historic Equity Returns, Dividends, & Volatility	Company Investment Dept
Quarterly	Company Liability Inforce Extract	Company Admin System
Quarterly	Company Asset CUSIP Inforce Extract - Investment Expense, OAS, WAL	Company Investment Dept
September	VM-20 Net Premium Reserve Interest Rate Assumptions (maxrate_tbla_tblh_rates202008.pdf) – https://www.dfs.ny.gov/apps_and_licensing/life_insurers/max_reserve_life/rates	NY DFS Website
September	Company Policyholder Behavior – Withdrawal, Flexible Premium, Conversions, Lapse, Surrender, GMxB, Net Revenue Share, NGE, …	Company Assumption Committee
September	Asset and Reinvestment Strategy Assumptions	Company Investment Committee
December	Company Expense Inflation	Company Finance Dept
December	Company Fully Allocated Expense and Pre-Tax IMR Allocation	Company Finance Dept
Every 3 yrs	Company Mortality Experience and Mortality Improvement	Company Mortality Study
Every 3 yrs	Company Credibility and Sufficient Data Period	Company Mortality Study

Actuarial Modeling Flow for Valuation Results

(Extract-Transform-Load (ETL))



Model Governance Framework in Practice

User Group (Unique by User)	User1 (VAL)	User2 (VAL)	Test Service Account	Manager (VAL)	Prod Service Account	Model Steward
User Role (Define Permissions)	Developer	Developer	Tester	Manager	Production	Model Steward
Role Specifics	-Make Ord Life model changes -Test changes and new vendor versions -Checkin/out changes to version control	-Make Annuity model changes -Test changes and new vendor versions -Checkin/out changes to version control	-Run/checkout/bkup last developed version -Validate results	-Review test results -Pin version for production -Review production results	-Schedule automated run to checkout pinned version, run and bkup	-Install vendor versions -Assign version to users -Add/ Delete users -Create new work areas -Manage user roles, job queues, and run priority
Work Area (Environment/ Function - VAL/PRC/ALM)	USER1_Sandbox (R/W) DEV_VAL (R/W) TEST_VAL (RO) PROD_VAL (RO) PROD_ALM (RO) PROD_PRC (RO)	USER2_Sandbox (R/W) DEV_VAL (R/W) TEST_VAL (RO) PROD_VAL (RO) PROD_ALM (RO) PROD_PRC (RO)	TEST_VAL (R/W)	TEST_VAL (RO) PROD_VAL (RO) PROD_ALM (RO) PROD_PRC (RO)	PROD_VAL (R/W)	
Dataset Model (Regulatory/LOB/ Report Basis/ Project)	ORD_BASIS_YYYY_QN	ANN_BASIS_YYYY_QN	ANN_BASIS_YYYY_QN ORD_BASIS_YYYY_QN	ANN_BASIS_YYYY_QN ORD_BASIS_YYYY_QN	ANN_BASIS_YYYY_QN ORD_BASIS_YYYY_QN	
Version Control Repository (PROD Only by Function)	VCP_PROD_VAL (R/W) VCP_PROD_PRC (RO) VCP_PROD_ALM (RO)	VCP_PROD_VAL (R/W) VCP_PROD_PRC (RO) VCP_PROD_ALM (RO)	VCP_PROD_VAL (RO)	VCP_PROD_VAL (RO/PIN)	VCP_PROD_VAL (RO PIN/W)	
Backup Repository (Environment/ Function)	BKUP_DEV_VAL (R/W) BKUP_DEV_PRC (RO) BKUP_DEV_ALM (RO)	BKUP_DEV_VAL (R/W) BKUP_DEV_PRC (RO) BKUP_DEV_ALM (RO)	BKUP_TEST_VAL (R/W)	BKUP_DEV_VAL (RO) BKUP_TEST_VAL (RO)	BKUP_PROD_VAL (R/W)	

Model System Deployment Options in the Cloud

All On-premise:

- All infrastructure (Front-end & Back-End (grids)) is on-premise
- Fixed grid processing capacity
- Native connectivity to data storage for inputs and outputs
- DR on-premise or in the cloud
- All managed by client IT

Hybrid (with PaaS):

- Static capacity (Front-end & Back-End (grids)) is on-premise
- Use PaaS (Platform-as-a-Service) for on-demand computing in public cloud at peak periods
- Native connectivity to data storage for inputs
- Automated data transfer to and from PaaS
- DR on-premise or in the cloud
- On-premise part is managed by client IT
- PaaS is fully managed by vendor (including DR)

Fully in the Cloud (hosted):

- All infrastructure (Front-end & Back-End (grids)) is in public cloud
- All grid processing capacity is on-demand (PaaS)
- Need to implement data transfer to and from cloud
- DR in the cloud
- All managed by Vendor
- Vendor cloud subscription (Fixed bulk cost, pay-as-go, or hybrid)

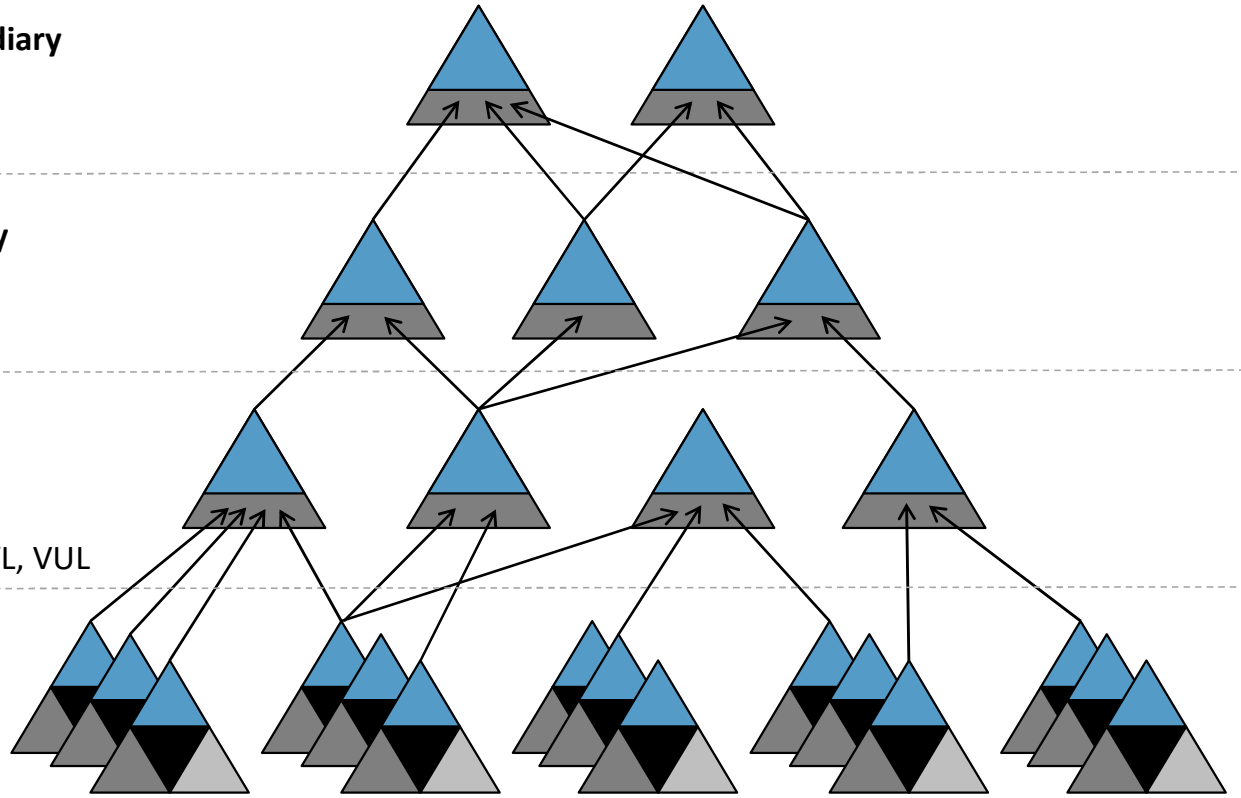
Hierarchy for Aggregating VM-20 Results

Foreign Exchange Subsidiary
USD, JPY, EUR, CAD, AUD

VM-20 Reserve Category
Term, ULSG, Other

VM-20 Line of Business
Term: 10yr, 20yr, 30yr
ULSG: Var, Index, Fixed
Other: Par/NP Life, UL, VL, VUL

Plan
Risk Attribute



4

3

2

1

Approaches to Building Comfort with VM-20 Models

Static Validation (admin system recon)

- Policy Count/ CUSIP Count
- Face Amount
- Premium
- Cash Surrender Value
- Policy Loan
- Account Value
- Shadow Account Value
- Pre-Tax IMR
- Asset Book Value/ Market Value
- General/ Investment Expenses

Dynamic Validation (back testing)

- Premium
- Commission
- Death Benefit
- Surrender/Withdrawal Benefit
- Net Asset Earned Rate (NAER)
- General Insurance Expense
- Premium tax
- Dividend
- Reinsurance claim recovery and premium payments

Monitor Key Metrics (trend analysis)

- Net Premium Reserve
- Due and Deferred Premium
- Deterministic Reserve
- Stochastic Reserve
- VM-20 Reserve (Net/Gross)
- Starting Assets
- Required Surplus
- Total Profit

Approaches to Building Comfort with VM-21 Models

Static Validation (admin system recon)

- Policy Count/CUSIP Count
- Guaranteed Death Benefit Base
- Guaranteed Living Benefit Base
- Net Amount at Risk (Death Ben)
- Net Amount at Risk (Living Ben)
- Cash Surrender Value
- General/Separate Account Value
- General/Investment Expenses
- Pre-Tax IMR
- Book Values/Market Values
- General Account Hedge Assets

Dynamic Validation (back testing)

- Deposits
- Commission
- Death Benefit
- Surrender/ Withdrawal Benefit
- Annuitization Benefit
- Net Asset Earned Rate (NAER)
- General Insurance Expense
- Hedge gains/losses
- Net Revenue Share
- Reinsurance claim recovery and premium payments

Monitor Key Metrics (trend analysis)

- CTE70 (adjusted)
- CTE70 (best efforts)
- CTEPA
- Standard Projection Amounts
- Stochastic Reserve/ E Factor
- VM-21 Reserve (Net/Gross)
- Starting Assets
- RBC Amount CTE98 (pre-tax)
- Total Profit

Additional Model Control Techniques

- Test bed with Independent Spreadsheet Calculations for NPR and DR (GPV)
- Compare Results of Multiple Reserve Methods
  - VM-20 Deterministic Reserve – Gross Premium Valuation (GPV) vs Direct Iteration
  - VM-21 Stochastic Reserve – Greatest PV Accumulated Deficiencies vs Direct Iteration
- VM-21 Disclosures
  - Scenario Reserve Comparison of CTE 70 (best efforts), CTE 70 (adjusted) and CTEPA by scenario
  - Cumulative Decrement Analysis (using company experience and prescribed assumptions)
  - Impact of Aggregation
  - Back Testing Hedge Error factor (E)
- Sensitivity Testing and Margin Analysis (Aggregate and Individual)
- Actual vs Expected – Mortality, Lapse, Change in Value of Hedges
- Attribution Analysis - www.soa.org/globalassets/assets/Files/Research/Projects/2017-understand-vm-20-results.pdf
- Reserve Roll-forward
- Independent Peer Review

© 2020 Moody's Corporation, Moody's Investors Service, Inc., Moody's Analytics, Inc. and/or their licensors and affiliates (collectively, "MOODY'S"). All rights reserved.

CREDIT RATINGS ISSUED BY MOODY'S INVESTORS SERVICE, INC. AND ITS RATINGS AFFILIATES ("MIS") ARE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES, AND MOODY'S PUBLICATIONS MAY INCLUDE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES. MOODY'S DEFINES CREDIT RISK AS THE RISK THAT AN ENTITY MAY NOT MEET ITS CONTRACTUAL, FINANCIAL OBLIGATIONS AS THEY COME DUE AND ANY ESTIMATED FINANCIAL LOSS IN THE EVENT OF DEFAULT. CREDIT RATINGS DO NOT ADDRESS ANY OTHER RISK, INCLUDING BUT NOT LIMITED TO: LIQUIDITY RISK, MARKET VALUE RISK, OR PRICE VOLATILITY. CREDIT RATINGS AND MOODY'S OPINIONS INCLUDED IN MOODY'S PUBLICATIONS ARE NOT STATEMENTS OF CURRENT OR HISTORICAL FACT. MOODY'S PUBLICATIONS MAY ALSO INCLUDE QUANTITATIVE MODEL-BASED ESTIMATES OF CREDIT RISK AND RELATED OPINIONS OR COMMENTARY PUBLISHED BY MOODY'S ANALYTICS, INC. CREDIT RATINGS AND MOODY'S PUBLICATIONS DO NOT CONSTITUTE OR PROVIDE INVESTMENT OR FINANCIAL ADVICE, AND CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT AND DO NOT PROVIDE RECOMMENDATIONS TO PURCHASE, SELL, OR HOLD PARTICULAR SECURITIES. NEITHER CREDIT RATINGS NOR MOODY'S PUBLICATIONS COMMENT ON THE SUITABILITY OF AN INVESTMENT FOR ANY PARTICULAR INVESTOR. MOODY'S ISSUES ITS CREDIT RATINGS AND PUBLISHES MOODY'S PUBLICATIONS WITH THE EXPECTATION AND UNDERSTANDING THAT EACH INVESTOR WILL, WITH DUE CARE, MAKE ITS OWN STUDY AND EVALUATION OF EACH SECURITY THAT IS UNDER CONSIDERATION FOR PURCHASE, HOLDING, OR SALE.

MOODY'S CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT INTENDED FOR USE BY RETAIL INVESTORS AND IT WOULD BE RECKLESS AND INAPPROPRIATE FOR RETAIL INVESTORS TO USE MOODY'S CREDIT RATINGS OR MOODY'S PUBLICATIONS WHEN MAKING AN INVESTMENT DECISION. IF IN DOUBT YOU SHOULD CONTACT YOUR FINANCIAL OR OTHER PROFESSIONAL ADVISER.

ALL INFORMATION CONTAINED HEREIN IS PROTECTED BY LAW, INCLUDING BUT NOT LIMITED TO, COPYRIGHT LAW, AND NONE OF SUCH INFORMATION MAY BE COPIED OR OTHERWISE REPRODUCED, REPACKAGED, FURTHER TRANSMITTED, TRANSFERRED, DISSEMINATED, REDISTRIBUTED OR RESOLD, OR STORED FOR SUBSEQUENT USE FOR ANY SUCH PURPOSE, IN WHOLE OR IN PART, IN ANY FORM OR MANNER OR BY ANY MEANS WHATSOEVER, BY ANY PERSON WITHOUT MOODY'S PRIOR WRITTEN CONSENT.

All information contained herein is obtained by MOODY'S from sources believed by it to be accurate and reliable. Because of the possibility of human or mechanical error as well as other factors, however, all information contained herein is provided "AS IS" without warranty of any kind. MOODY'S adopts all necessary measures so that the information it uses in assigning a credit rating is of sufficient quality and from sources MOODY'S considers to be reliable including, when appropriate, independent third-party sources. However, MOODY'S is not an auditor and cannot in every instance independently verify or validate information received in the rating process or in preparing the Moody's publications.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability to any person or entity for any indirect, special, consequential, or incidental losses or damages whatsoever arising from or in connection with the information contained herein or the use of or inability to use any such information, even if MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers is advised in advance of the possibility of such losses or damages, including but not limited to: (a) any loss of present or prospective profits or (b) any loss or damage arising where the relevant financial instrument is not the subject of a particular credit rating assigned by MOODY'S.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability for any direct or compensatory losses or damages caused to any person or entity, including but not limited to by any negligence (but excluding fraud, willful misconduct or any other type of liability that, for the avoidance of doubt, by law cannot be excluded) on the part of, or any contingency within or beyond the control of, MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers, arising from or in connection with the information contained herein or the use of or inability to use any such information.

NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE ACCURACY, TIMELINESS, COMPLETENESS, MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF ANY SUCH RATING OR OTHER OPINION OR INFORMATION IS GIVEN OR MADE BY MOODY'S IN ANY FORM OR MANNER WHATSOEVER.

Moody's Investors Service, Inc., a wholly-owned credit rating agency subsidiary of Moody's Corporation ("MCO"), hereby discloses that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by Moody's Investors Service, Inc. have, prior to assignment of any rating, agreed to pay to Moody's Investors Service, Inc. for appraisal and rating services rendered by it fees ranging from $1,500 to approximately $2,500,000. MCO and MIS also maintain policies and procedures to address the independence of MIS's ratings and rating processes. Information regarding certain affiliations that may exist between directors of MCO and rated entities, and between entities who hold ratings from MIS and have also publicly reported to the SEC an ownership interest in MCO of more than 5%, is posted annually at www.moodys.com under the heading "Investor Relations — Corporate Governance — Director and Shareholder Affiliation Policy."

Additional terms for Australia only: Any publication into Australia of this document is pursuant to the Australian Financial Services License of MOODY'S affiliate, Moody's Investors Service Pty Limited ABN 61 003 399 657AFSL 336969 and/or Moody's Analytics Australia Pty Ltd ABN 94 105 136 972 AFSL 383569 (as applicable). This document is intended to be provided only to "wholesale clients" within the meaning of section 761G of the Corporations Act 2001. By continuing to access this document from within Australia, you represent to MOODY'S that you are, or are accessing the document as a representative of, a "wholesale client" and that neither you nor the entity you represent will directly or indirectly disseminate this document or its contents to "retail clients" within the meaning of section 761G of the Corporations Act 2001. MOODY'S credit rating is an opinion as to the creditworthiness of a debt obligation of the issuer, not on the equity securities of the issuer or any form of security that is available to retail investors. It would be reckless and inappropriate for retail investors to use MOODY'S credit ratings or publications when making an investment decision. If in doubt you should contact your financial or other professional adviser.

Additional terms for Japan only: Moody's Japan K.K. ("MJKK") is a wholly-owned credit rating agency subsidiary of Moody's Group Japan G.K., which is wholly-owned by Moody's Overseas Holdings Inc., a wholly-owned subsidiary of MCO. Moody's SF Japan K.K. ("MSFJ") is a wholly-owned credit rating agency subsidiary of MJKK. MSFJ is not a Nationally Recognized Statistical Rating Organization ("NRSRO"). Therefore, credit ratings assigned by MSFJ are Non-NRSRO Credit Ratings. Non-NRSRO Credit Ratings are assigned by an entity that is not a NRSRO and, consequently, the rated obligation will not qualify for certain types of treatment under U.S. laws. MJKK and MSFJ are credit rating agencies registered with the Japan Financial Services Agency and their registration numbers are FSA Commissioner (Ratings) No. 2 and 3 respectively.

MJKK or MSFJ (as applicable) hereby disclose that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by MJKK or MSFJ (as applicable) have, prior to assignment of any rating, agreed to pay to MJKK or MSFJ (as applicable) for appraisal and rating services rendered by it fees ranging from JPY200,000 to approximately JPY350,000,000.

MJKK and MSFJ also maintain policies and procedures to address Japanese regulatory requirements.