**Craig Chupp**

1. How are the jump parameters determined and/or set?  Does the model reflect recent jump data or long-term averages or a combination of both?  Looking at historical data, how does the model determine when a jump has occurred and the magnitude of the jump?  For example, considering the movement in the S&P 500 during the first couple of quarters of 2020, was this considered a jump or multiple jumps?  If so, what was the criteria used to determine if a jump occurred?  Over how many days was the jump considered to occur and what was the magnitude of the jump?
2. How is the value of the mean reversion speed parameter in the Variance Equation determined?

**Vincent Tsang**

1. In the graph “Equity Equation – Impact of Jumps” on page 10 of the ppt slides, the projected cumulative wealth factors from AIRG and GEMS at the end of the 30th year can be approximated by the line

AIGR cumulative wealth factor = 1.3082 (GEMS cumulative wealth factor) +  1.4558

For example, if GEMS cumulative factor is 4500%, the AIRG cumulative factor is approximately 6000%. Please explain the driver(s) which cause AIRG’s cumulative wealth factor being significantly higher than GEMS’s cumulative factor. Given that the title of the slide is “Equity Equation – Impact of  Jumps,” is the difference in wealth factors attributable to the assumed jumps? If not, why?

1. In the first page of the ppt slides “Equity Equation,” the differential equation is listed as follow:

            $\frac{dS\left(t\right)}{S(t)}=\left[\left(r\left(t\right)-D(t)\right)+ μ\_{0 }+μ\_{1 }V\left(t\right)- λmV(t)\right]dt+ \sqrt{V\left(t\right)}dW\_{1}\left(t\right)+γdN(t)$

As the jump parameters l and V(t) are positive and m is negative in page 8, the drifting factor due to the jump parameters is negative. Does it mean that the jump parameters would reduce the drifting factor for the equity return?

**Connie Tang**

1. [Describe] the mechanics of Conning’s calibration.
2. [Discuss] Conning’s model selection decision and recommended calibration, e.g.,
	1. How did they pick this type of equity / rate linkage over other approaches, especially given that the different types can produce very different reserve/capital sensitivities?
	2. How did they get comfortable with the appropriateness of the changes in these sensitivities when certain LATF parameters were incorporated vs. their Standard Calibration?
3. [Describe the] out of the box capabilities in GEMS to allow different relationships (vs. just substituting different parameter values)?
4. [Are there] not out-of-the-box changes that Conning would be willing to consider / implement?

**Connie Tang Section G Questions**

1. What would actually change on a monthly basis?
	1. Is Conning only updating initial conditions (and any LATF-specified formulaic updates – e.g., MRP)?
	2. Are the updates purely mechanical, or are there any subjective tweaks or judgment calls?
2. What is the LATF exposure / testing / approval process for:
	1. Other regularly scheduled / routine updates beyond initial condition or formulaic updates (E.g., bringing an additional year of historical data into the calibration?)
	2. More fundamental model changes (e.g., structural changes, changes in calibration methodology / philosophy)
3. What is the process if something unexpected / unanticipated happens in the monthly updates – e.g., routine (business as usual) updates create scenarios that suddenly don’t make sense, or the calibration produces invalid parameters?
	1. What is the process for reviewing and detecting questionable or inappropriate scenario distribution properties before scenarios are posted?  (There should be checks for reasonability of distribution properties and not just validation that specific targets were reproduced.  The scenarios exposed in Dec. reproduced LATF’s / Conning’s intended targets, but the process should have identified the inappropriate distribution of yield curve shapes.)
	2. What is the escalation process if issues are detected?  (Does Conning make judgments on their own?  Are regulators and industry at risk of being surprised when unusual scenarios produce unusual reported results or changes in reported results that don’t align with prior sensitivities/dynamics?)

**Scott Schneider**

1. Will scenarios be consistent from month to month?  In other words, will new scenario number 1 be comparable to old scenario number 1 or will the scenarios be an entirely new random set?  We would like to see consistency from period to period.
2. When parameters are updated, will Conning provide scenarios as of the valuation date before and after changing each parameter?  Before and after changing all parameters in aggregate?  We would like to be able to assess the impact of the change of each parameter.
3. If 10,000 scenarios are not enough for convergence (particularly for CTE98), what do we do?
4. What time steps will be available (daily, weekly, monthly, quarterly, annual) within the scenarios?  How many years of projection will be provided in each scenario?  We would like the ability to get time steps of any frequency from daily to annual.  We would also like 90 years’ worth of time steps.
5. Will individual states (e.g. New York) have different requirements?  We would like the scenarios to be provided with and without individual state requirements.
6. We believe that Conning has stated that the interest rate generator (GEMS) is arbitrage-free, but the equity return generator appears to add a positive risk premium resulting in scenarios which are not arbitrage-free.  Is our understanding correct?  If so, will there also be an arbitrage-free version of the equity scenarios?

**ACLI**

1. Criteria / stylized facts / distribution properties
	1. What criteria or stylized facts did Conning apply and how did they assess the pros/cons when selecting / developing their ESG model?
	2. How does Conning assess the reasonability of scenario outputs (i.e., in the exposed scenarios and on an ongoing basis)?
	3. What adjustments have been made either in model development or during the generation of scenarios as a result of these considerations?

(Comprehensive information on these items should also be included in Conning’s documentation.)

1. It seems like the selected model and proposed calibration approach may increase procyclicality (and/or create unintuitive relationships).  How did that factor into the model decisions and recommendation?

**Moody’s Analytics**

1. The model seems to support the fitting of the initial yield curve using a shift function. The limitation to 3 points seems to be a particular calibration choice. We are aware that this choice may benefit the stability of the long-term rate distribution, but it would be useful to be clear on the limitation of the model implementation and where calibration choices are chosen to mitigate these constraints in the model.
2. The mechanism to remove the discrepancies [between the actual and modeled starting yield curve] is not clear. Does this mechanism still preserve the arbitrage free properties of the model?
3. The choice of this value 3 [used in the process to fit the initial yield curve] seems to be without any motivation. What impact do these choices have on the scenario produced by the model and their robustness over short term or long-term projection horizons. The NAIC could consider not using this feature at all, i.e. accept the limitation in the model that it will not fit accurately curve or could look to motivate the choice of decay factor based on historical rate behavior/mean reversion speed etc....
4. The parametric fit of the yield curve could lead to very different long-term forward rates driving projected yields on different valuation dates i.e. from month to month. This could mean that analysis sensitive to long term projected rates could be unstable. It could be useful for the NAIC to consider the testing of the model on different valuation dates to understand the stability of the long-term scenarios and related distributions. In particular, looking at historical dates with very different starting curves and long-term forward rates (considering levels and perhaps also different gradients)
5. The model should produce a variety of yield curve shapes, and they should change over time. Is the NAIC setting targets for the correlation between different points on the yield curve or will there be alternative criteria to constrain the behavior of rates across the term-structure? A set of clear quantitative targets for correlation between different points on the yield curve can help validate the model performance objectively in this area.
6. Interest rates can be negative. Will the NAIC consider a test of the scenarios where the curve is initialized using the German or Swiss yield curve to get and understanding of how well the model will handle negative initial starting curves?
7. Is the NAIC constraining the forward expected level of the rates as part of the calibration? If so, it would be useful to understand how the model's distributions are impacted by rate levels that could be lower than current levels. Information from European, Swiss and Japanese yield curves and implied expectations can be a useful stress test to understand how the model might behave in the event the US yields move negative.
8. There are examples of negative rates and dynamics across several developed market. Have the NAIC consider extending the calibration data set beyond just US data to improve and broaden the historical information embedded in the calibrations?
9. Has the NAIC considered how to assess the impact of the frequency and magnitude of negative rates produced by the model?
10. The interest rate generator should be arbitrage free. There are a few variations of the classical CIR type model mentioned in the supplied documentation. It would be good to understand if these model adjustments (floor, decay scaling, term premium assumptions) can break or disrupt the arbitrage free properties of the model. Are the NAIC producing any test of validations to assess these properties in the model?
11. Returns should be provided for funds representative of those offered in U.S. insurance products. How should insurers approach the generation of additional fund returns if the provided return series are not representative of those offered in their particular insurance products?
12. Are the credit spread model and related bond fund returns arbitrage free?
13. The NAIC have not specified any modelling constraints on the credit spread or corporate bond return modelling. Are there any features that are needed from this model? e.g. ability to capture negative spreads, stability of return distributions over long time horizons, relationship between expected defaults and spread levels, nature of the volatility of spread and defaults, volatility of returns etc.
14. If a stochastic spread and ratings-based model is chosen, how should insurers running sensitivities or projections of reserves consider updating the initialization/features of this model?
15. How has the NAIC decided on the relevant number of [corporate bond] rating classes to be modelled?
16. The modelling mentions BB rated bonds, but the model specification only has a generic high yield asset. How will the NAIC ensure this calibration is appropriate and does not understate or overstate risk due to fact the model does not capture B or CCC rated spread/bonds?
17. Is the NAIC specifying any additional criteria on the correlation of transitions/defaults across issuers and how this impact the bonds in the portfolios that are being modelling as part of the bond fund universe?

**Additional Moody’s Analytics Questions**

**Arbitrage Free Nature of the Models**

1. The models discussed are generally considered arbitrage-free pricing models. Is this requirement something that the NAIC wants to be addressed by all risk factors: interest rate, equity returns and credit spread/returns?
2. Is this criterion met for the chosen models? If it is not met, what specific implementation/calibration/configuration decisions have been made to prevent the model from being arbitrage free?
3. If the models are not arbitrage free, what additional validations and testing is being considered to ensure the model produces appropriate behaviour, stable risk premium and reasonable outcomes within each stochastic trial?

**Interest Rate Model**

1. Is the NAIC expecting to produce alternative calibrations with changes to the starting rate levels to help insurers understand the impact of the initial curve on the projected distribution? It would be good to understand the stability of the model/distributions/risk-premia if the model was initialized at a lower (or significantly higher) level than today (e.g. for a realistic example you may consider the current level of German interest rates).

**Corporate Bond and Spread Model**

1. Will further technical documentation on the corporate bond model (including detailed formulas, parameters, and calibration methods) be provided?
2. Can you provide details on the “stochastic modulator μ(t)” process, its parameters and its calibration?
3. The use of the jump in the Equity model is interesting. It can be challenging to calibrate and constrain these types of jump models with historical data. How is this achieved?