American Academy *of* Actuaries

Status of American Academy of Actuaries' Economic Scenario Work Group (ESWG)

NAIC LHATF Winter Meeting
December 4, 2008

ESWG Chair
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GOALS FOR THIS SESSION

1. Review the mandate of the Economic Scenario Work Group
2. Summarize recommendations
3. Highlight ongoing challenges and discuss next steps

ESWG GOALS (SET BY STANDARDS FOR STOCHASTIC METHODS WORK GROUP (SSMWG) FALL 2006) AND STATUS

1. The ESWG will recommend a prescribed generator containing updated parameters
   - Minor changes from Fall 2007 report
   - Full scenario set and subset have been provided to Academy work groups and SOA Research team for testing
2. The ESWG will recommend calibration criteria so companies can use their own generator
   - Provide to NAIC at winter meeting
3. Generators will <u>not</u> use pre-selected criteria to approximate specific blocks of business
   - Different methodology from C-3 Phase 1

UPDATES FROM C-3 PHASE I ADOPTED IN 1999

- ESWG chose to continue with Stochastic Log Volatility model used for C-3 Phase I adopted in 1999
- Refreshed some parameters using Treasury data from 1953 – 2008
- Prepared a Microsoft Excel generator for broad distribution to the industry
- Documented the model, data sources, key decisions and parameters

ASSUMPTION UPDATES FROM C-3 PHASE I ADOPTED IN 1999

- Soft cap of 18% limits the maximum long rate
  - reduces maximum rates with minimal impact on overall results
- Yield curve interpolation uses historical curves
- Established processes (formulas) for automatically updating Mean Reversion Parameter (MRP) for target long interest rate
  - Long rate is the 20-year US Treasury rate
    - Current MRP, 5.50%
    - C-3 Phase I MRP, 6.55%

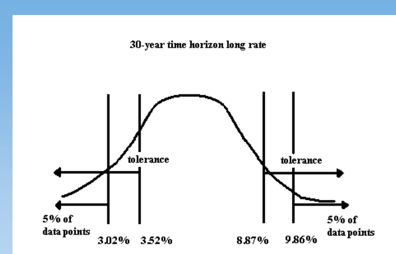
CALIBRATION GOALS

- Subject to calibration requirements, companies should be able to use their preferred interest rate generator
- Objective – allow models with results similar to the Academy model with Academy parameterization to “pass”
- Criteria should be dynamic and not require frequent revision by the Academy
- Standards will include qualitative and quantitative requirements
  - Qualitative means documentation supporting choices made

CALIBRATION CRITERIA

- By definition, the 10,000 scenarios of the SLV model are “calibrated”
  - Subsets of this scenario set must pass the calibration criteria
- Key idea is to develop “acceptable tolerances” around the SLV statistics
- ESWG recommends the following statistics:
  - Distribution results at the 5% and 95% point-in-time percentiles for long rate and short rate distributions at 1, 5, 10, and 30 year horizons
    - Relaxed tolerances at 1 year time horizon
  - Distribution results at the 5% and 95% cumulative percentiles for the spread distribution at the 30-year time horizon

Football goal posts analogy for tolerances



MEAN REVERSION PARAMETER (MRP)

- Mean reversion parameter will adjust over time to better reflect current conditions. The reversion rate is a simple average of the
  - Long rate (median over most recent 50 years adjusted down by 25 bp)
  - Long rate (mean over the most recent 36 months)
  - Rounded to near 25 basis points

STOCHASTIC COMPANY GENERATOR WITH CALIBRATION CRITERIA VS. REGULATORY PRESCRIBED DETERMINISTIC SCENARIOS

- Stochastic company generator
  - Captures uniqueness of Asset/Liability portfolio risk
  - Evolution to best practice
  - Consistent with internal risk assessment
  - Peer review allows companies to better understand their situation in order to defend it
  - Allows modeling of other factors (e.g., hedging, currency, equity, credit spreads)
  - Some interest rate scenarios move between high and low
- Prescribed deterministic
  - Standard scenario set provides consistency between companies
  - Fewer scenarios require less effort
  - Regulator needs less expertise to peer review

NEXT STEPS

- MRP update frequency
  - Ad hoc with NAIC approval
  - Annually using formula
    - Recommendation is to refresh early in calendar year and use until following calendar year
  - Quarterly using formula
- Company generators must calibrate each time scenarios are built
- Release current versions of models, scenarios, and scenario picking tool

Description of the Stochastic Log Volatility (SLV) Model

The SLV model simulates the following three (3) correlated stochastic processes in discrete monthly time:

1.	${}_1i_t$	The natural logarithm of the long maturity interest rate
2.	α_t	The nominal spread between the long and short maturity rates
3.	ν_t	The natural logarithm of the volatility of the long maturity rate process

The SLV discrete time equations are:

$$
\begin{aligned}
{}_1i_t &= Max\left\langle {}_1\lambda_L, Min\left[{}_1\lambda_U, (1-\beta_1)\cdot {}_1i_{t-1} + \beta_1 \cdot \ln\tau_1 + \psi\cdot\left({}_2\tau_t - \alpha_{t-1}\right)\right]\right\rangle + {}_1\sigma_t \cdot {}_1Z_t \\
\alpha_t &= (1-\beta_2)\cdot\alpha_{t-1} + \beta_2 \cdot {}_2\tau_t + \phi\cdot\left({}_1i_{t-1} - \ln\tau_1\right) + \sigma_2 \cdot {}_2Z_t \cdot \left({}_1r_{t-1}\right)^{\theta} \\
\nu_t &= (1-\beta_3)\cdot\nu_{t-1} + \beta_3 \cdot \ln\tau_3 + \sigma_3 \cdot {}_3Z_t
\end{aligned}
$$

where

$$
\begin{aligned}
{}_1i_t &= \ln\left({}_1r_t\right) \\
{}_1\lambda_U &= \ln\left({}_1r_{Max}\right) \\
{}_1\lambda_L &= \ln\left({}_1r_{Min}\right) \\
{}_2r_t &= \exp\left({}_1i_t\right) - \alpha_t \\
\text{If } {}_2r_t < {}_2r_{Min}, &\text{ then } {}_2r_t = \kappa \cdot {}_1r_t \\
{}_1\sigma_t &= \exp\left(\nu_t\right)
\end{aligned}
$$

${}_1Z_t, {}_2Z_t, {}_3Z_t \sim N(0,1)$ with constant correlation matrix ρ