

Based on suggestions from students like you, we are reorganizing the card deck this year to highlight certain topics that are covered in multiple items on the syllabus. For example, we combined the two study notes that deal with General American's default into a single card. We also collected all the fair value topic cards and put them together in the deck at the first occurrence of fair value in the syllabus. In every instance, we underlined the broad topic on the first card in the series. While this may result in less flow in the cards when compared to the source material, it allows for mastery of important topics over the whole syllabus.

As always, we appreciate your feedback.

## **Examples of Embedded Options Written by Insurance Companies**

- Risk options embedded in term life, disability, LTC, cancer
  - Guaranteed renewable premiums
    - Call on the value of future benefit payments
- Investment options embedded in fixed and variable annuities
  - Right to deposit additional premiums into a fixed rate annuity
    - Call on value of future annuity payments
  - Withdrawal, GMIB, GMDB options
    - Put on policy value
  - Guaranteed minimum return
    - Interest rate floor
- Hybrid options in permanent, whole and variable life
  - Option to convert to cash
    - Put on policy value
  - Option to borrow cash at pre-determined interest rates
    - Series of puts on fixed rate bonds

Source: *ALM of Fin'l Institutions*, Chapter 16

## **Steps in Generating the Stock Price Process (RSLN-2 model)**

1. Generate a uniform random number  $u \sim U(0,1)$
2. If  $u \leq \pi_1$ , assume  $\rho_0 = 1$  (starting in first regime), and otherwise assume  $\rho_0 = 2$
3. Generate  $z \sim N(0,1)$
4. Calculate the return as  $Y_1 = \mu_{\rho_0} + \sigma_{\rho_0} \cdot z$  and so the stock price at time 1 is  $S_1 = S_0 \exp(Y_1)$
5. Generate a new  $u \sim U(0,1)$
6. If  $u \leq p_{\rho_0,1}$  then  $\rho_1 = 1$  otherwise  $\rho_1 = 2$
7. Repeat (3) to (6) for as many steps are required for one scenario
8. Repeat (1) to (7) for  $N$  total scenarios, where  $N$  is large enough to produce the desired degree of accuracy

Source: *Investment Guarantees* Ch. 6 pg 98

## **Mapping of Life Insurance Risks**

(Note: repeating risks are shown only once.)

<b>Risk Type</b>	<b>Specific Risks</b>		
<b>Credit</b>	Business credit risk Invested asset credit risk	Political risk Concentration risk	
<b>Market</b>	Interest rate risk Basis risk Reinvestment risk	Currency risk Asset concentration risk A/L matching	Asset market value Political Sovereign
<b>Liquidity</b>	Liquidity risk Asset affiliates risk	Capital markets risk Catastrophe risk	
<b>Operational</b>	Human capital Operational risk Start-up risk	Distribution channel risk Fraud risk Strategic risk	Stress testing Business continuation Business acquisition
<b>Legal</b>	Political risk	Regulatory risk	Legal risk
<b>Reputation</b>	Reputation risk	Quality risk	
<b>Other</b>	Pricing risks Reserve adequacy Rapid growth New company	Economic environment Net retention Mortality/morbidity Claim frequency/severity	Sales/lapses Underwriting risk Inflation risk

Source: FE-C106-07 “AAA Report to NAIC: Mapping of Life Insurance Risks”

## **'Greeks'**

- Design of hedging program is a function of the measurement of risk in the liability structure, driven by the assumptions used to determine embedded options
- Greeks show the capital market sensitivities of the value of the option held by VA PHs
  - Delta is the change in value of what is hedged per unit of change in the VA account value
  - Gamma is the rate of change of delta w.r.t. the price of the underlying asset
  - Rho is the change in the option price w.r.t. the change in the risk-free rate
  - Vega is the change in the option price w.r.t. a change in volatility of the underlying asset
    - Rho and Vega do not change much when hedging profits vs. claims
    - Increase in the discount rate is offset by increase in expected market returns (remember CAPM!)
    - Lapse assumptions are drivers of Vega and Rho

*Source: SN FE-C167-09 “Hedging the Bet – VA Bells and Whistles”*

## Insurance Operational Risk

<b>Risks of Acquiring Business</b>	<b>Personnel Risks</b>
<ul style="list-style-type: none"> <li>• Market conduct</li> </ul>	<ul style="list-style-type: none"> <li>• Fraud</li> </ul>
<ul style="list-style-type: none"> <li>• Managing general agents</li> </ul>	<ul style="list-style-type: none"> <li>• Faulty processes that produce administrative errors</li> </ul>
<ul style="list-style-type: none"> <li>• Growth strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Behavior</li> </ul>
<ul style="list-style-type: none"> <li>• Knowledge of product</li> </ul>	<b>Events Beyond Company Control</b>
<b>Reinsurance</b>	<ul style="list-style-type: none"> <li>• Terrorism</li> </ul>
<ul style="list-style-type: none"> <li>• Counterparty risks</li> </ul>	<ul style="list-style-type: none"> <li>• Avian Flu</li> </ul>
<ul style="list-style-type: none"> <li>• Reinsurance chains</li> </ul>	<b>Legal risks</b>
<b>Ratings risks</b>	<ul style="list-style-type: none"> <li>• Class action lawsuits</li> </ul>
	<ul style="list-style-type: none"> <li>• Legal interpretation</li> </ul>
	<ul style="list-style-type: none"> <li>• Regulatory Fines</li> </ul>

Sources: FE-C104-07 “Insurance Op Risk – The Big Unknown”;  
Operational & Reputational Risks

## **Steps to Credit Rating**

## COMPANY SPECIFIC

### 1. Financial assessment

E – earnings	AV – asset values	FS – financial size
CF – cashflow	LIQ – liquidity	F – flexibility
	LEV – leverage	DC – debt capacity

### 2. Management & qualitative factors

#### 3A. Industry ratings summary

Competitiveness	Restructuring	Demand changes
Trade environment	Technological change	Macroeconomic vulnerability
Regulatory framework	Financial performance	

#### 3B. Tier assessment

#### 3C. Industry / tier position

### 4. Financial statement quality

### 5. Country risk

## OFFERING SPECIFIC

### 6. Third party support

### 7. Term

### 8. Structure

### 9. Collateral

Source: *Risk Management*, Chapter 7, pages 282, 290, 292, 295