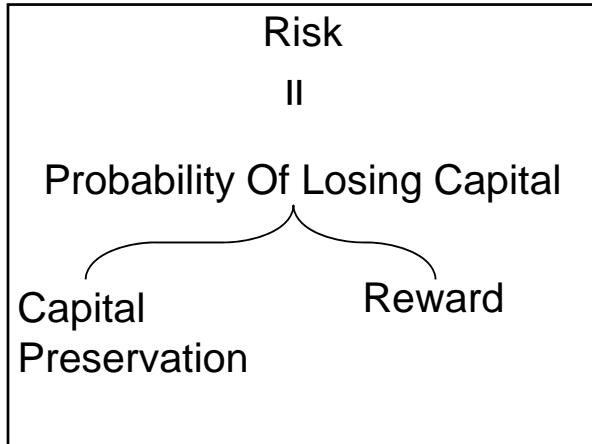


**Implementing A VA Risk
Appetite Statement**

Agenda

- **What is risk?**
- **Risk Appetite Implementation**
- **Risk Appetite & EC Sensitivity**

What is risk?



Capital Preservation

What % of your capital do you want to lose on a given transaction?

What Capital Do You Want to Preserve?

“Don’t want to risk more than X% of my capital with Y% probability”

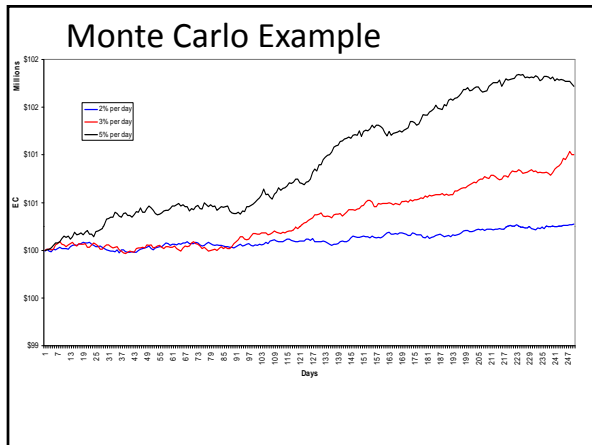
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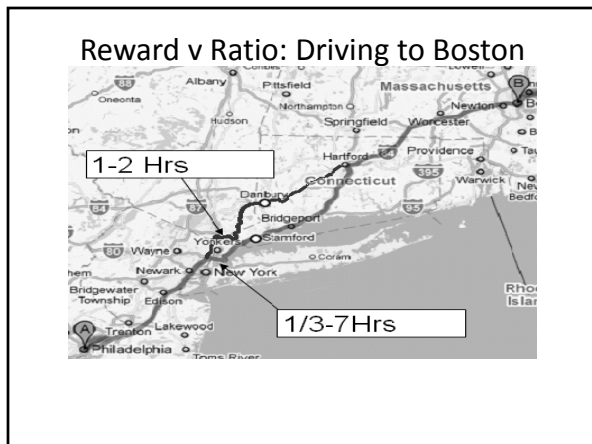
Economic Capital

Monte Carlo Example

Assume a company starts with \$100M in capital

- Willing to risk a certain % of its capital each day.
- How will capital change if 1,000 transactions are simulated each day?





Companies Have Unique Risk Profiles

ABC Life

Operational

Market

Credit

XYZ Re

Business

Financial

Hazard

Q: When Does Risk Change?

A: Every Transaction

Risk Is Aggregated

```
graph LR; A["Jane Doe Underprices A Sale"] --> B["Mispricing Risk"]; B --> C["Underwriting Risk"]
```

Risk Appetite Implementation

Risk Appetite Statements

Company XYZ
• Company Risk Assessment
• Company Targets, Capital Ratios
• For Each Line of Business:
• Regulatory Restrictions
• Economic Capital Limits
• Best Practices

Given:

You can only control certain aspects of the business

- Crediting Rates
- Surrender/Annuitization Charges
- Transfer Fees
- Etc

Implementing EC Limits

1. Map EC by risk class to EC by controllable item

Hazard Risk	➔	GMWB rollup
\$1 B		\$300M
		GMDB Type
		\$700M

Implementing EC Limits

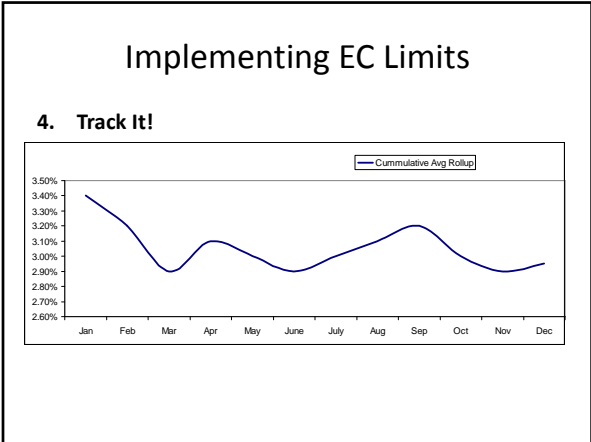
2. Determine sensitivity of EC by controllable item

GMWB Rollup Rate Sensitivity:
10M increase in EC per 10bps Rollup Rate Increase

Implementing EC Limits

3. Limit That Item
GMWB Rollup Rate

- EC Allocation: 300M
- Sensitivity: 10M per 10bps
- Limit: $300(0.1\%/10) = 3\%$



Risk Appetite & EC Sensitivity

- ### Risk Implementation Steps
1. Map EC by risk class to EC by controllable item
 - 2. Determine sensitivity of EC by controllable item**
 3. Limit That Item
 4. Track It

Definition Of Economic Capital

$$EC = \int_{\mu}^p c(x - \mu) f(x) dx$$

f(x) distribution

- Represents the company loss model
- We will explore the EC sensitivity under two
 - Normal Distribution
 - Gamma Distribution

Normal Distribution

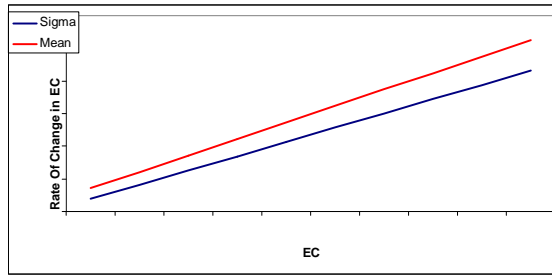
$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Normal Distribution – EC Sensitivities

$$\frac{\partial}{\partial \mu} EC = \frac{c(\mu - p)}{\sigma^2} EC + \frac{c^2(\mu - p)}{\sqrt{2\pi\pi}}$$

$$\frac{\partial}{\partial \sigma} EC = c \frac{2p\mu + 2\sigma^2 - p^2 - \mu^2}{\sigma^3} EC + c \frac{2p\mu - p^2 - \mu^2}{\sqrt{2\pi\pi}}$$

Normal Distribution – EC Sensitivities



Gamma Distribution

$$f(x) = x^{\alpha-1} e^{-\beta x} \frac{\beta^\alpha}{\Gamma(\alpha)}$$

α = Shape

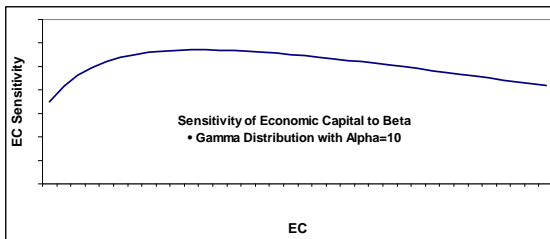
β = Scale

$\alpha\beta$ = mean

Sensitivity of the Beta Parameter

$$\frac{\partial}{\partial \beta} EC = \frac{1}{\beta} \frac{e^\alpha p^\alpha (1 + p\beta - \alpha) - e^{p\beta} \left(\frac{\alpha}{\beta}\right)^\alpha}{e^{p\beta} \left(\frac{\alpha}{\beta}\right)^\alpha - e^\alpha p^\alpha} EC$$

Sensitivity of the Beta Parameter



Summary

- Define Your Risks Clearly
- **Find EC Sensitivities**
- Set Your Business Limits
- Track Results
