

Session RR3: Allocating Capital - A Hands-on Case Study

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Agenda

- What capital allocation is and why we do it
- Key considerations in allocating capital
- The Ruhm-Mango-Kreps algorithm
- Representative methodologies
- Case study on allocating capital using the Ruhm-Mango-Kreps algorithm
- Additional considerations in allocating capital

Capital Allocation

- Capital allocation is a theoretical exercise
- Any business segment has access to the entire available capital of the firm
- For some lines capital consumption is more likely
 - Property insurance subject to catastrophic loss
 - Workers compensation in areas with concentration of employees
- Object is to reflect the likelihood of a business segment needing to utilize corporate capital

No method yet developed is ideal for this purpose

Reasons for Allocating Capital

- Pricing
 - Use the capital allocation to determine the investment income generated for rate calculations
- Risk management
 - Determine the risk adjusted rate of return as expected return divided by capital allocation
 - Use the risk adjusted return to decide if a business segment (line or investment) is worth continuing
- Performance evaluation
 - Reward performance based on risk adjusted returns

Key Considerations in Allocating Capital

- Must be accepted within the organization
- Sums to the total capital of the organization
- Stable over time
- Allocation not affected by other business segments
- No negative allocations
- Appropriate for particular application
- Coherent

No single method meets all these considerations

Ruhm-Mango-Kreps Algorithm

- Based on conditional probability
- Incorporates a riskiness leverage factor (RLF)
- Application of Ruhm-Mango-Kreps
 - Simulate a large number of potential outcomes
 - Rank the iterations by aggregate results
 - Determine an RLF for each aggregate outcome
 - Apply corresponding RLF to each segment's result whether it consumes or supplies capital
 - Allocate capital based on total capital charges
- Advantage/disadvantage of Ruhm-Mango-Kreps
 - Flexible enough by choice of RLF to duplicate any other capital allocation method

Ruhm-Mango-Kreps Algorithm

TVaR Example (based on 80% VaR)

Scenario	U/W Prop	U/W Cas	Invest	Total	Risk Wt.
1	-1200	-500	650	-1050	1
2	-700	200	-500	-1000	1
3	-600	-200	700	-100	0
4	100	900	300	1300	0
5	-100	-200	1900	1600	0
6	500	-200	1400	1700	0
7	200	-500	2100	1800	0
8	100	-600	2500	2000	0
9	1200	800	700	2700	0
10	1100	700	2200	4000	0
					2
Exp. Val.	60	40	1195	1295	
Risk-W EV	-950	-150	75	-1025	
Risk Mea	-1010	-190	-1120	-2320	
Cap. All	0.435345	0.081897	0.482759		

Capital Allocation Methods to be Considered

- Semi-variance
- Value-at-Risk (VaR)
- Tail Value-at-Risk (TVaR)
- Marginal capital - Myers-Read

Semi-variance

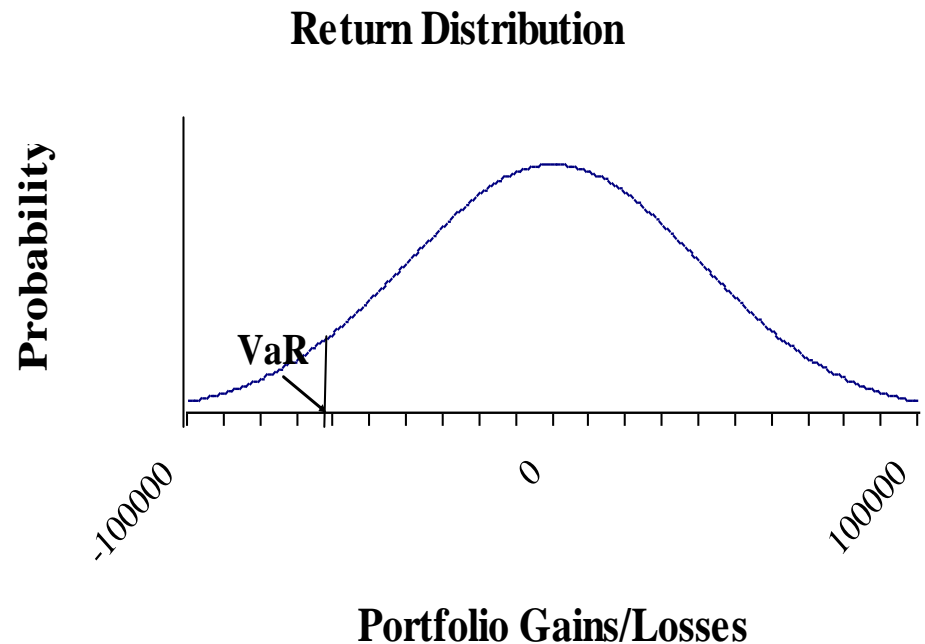
- Only considers downside variance
- Impact of risk is proportional to the square of the difference from the mean
- For RMK approach, $RLF = \mu - X$ if $\mu > X$, otherwise 0

Value-at-Risk - A Definition

- Value-at-Risk (VaR) is a statistical measure of possible portfolio losses
 - A percentile of the distribution of outcomes
- VaR is the amount of loss that a portfolio will experience over a set period of time with a specified probability
- Thus, VaR depends on some time horizon and a desired level of confidence

Value-at-Risk - An Example

- 95% probability and one-day holding period
- VaR is the one-day loss that will be exceeded only 5% of the time
- In the example, the VaR is about \$60,000
- For the RMK approach, the RLF is 1 if the cumulative probability is within ϵ of the selected VaR probability level, 0 otherwise



Tail Value-at-Risk

- Tail VaR considers the average loss in iterations that exceed the selected VaR level
 - This gives equal weight to all outcomes in the tail
- For RMK approach, $RLF = 1$ if cumulative probability is above the selected VaR, otherwise 0

Marginal Models for Capital Allocation

- Marginal models recognize diversification benefits within an organization when allocating capital
- Marginal methodologies (e.g. Myers-Read) rely on option pricing theory to derive the marginal impact of a line on capital
- Marginal models view the equity holders of the insurance company as investors who have a contingent claim (call option) on the firm's assets
 - As liabilities mature, equity holders have a claim on the residual (e.g., $\text{Assets} - \text{Liabilities}$)
 - If liabilities exceed assets, the equity holders lose their stake, but no more; this return profile is similar to a call option on the assets

Myers - Read

- Given the firm's assets and the present value of the losses by line, option pricing methods are used to calculate the firm's default value
 - Default value is the premium the company would have to pay to guarantee payment of the losses if the company defaults
- Surplus is then allocated to each line so that the marginal default value is the same in all lines.
- M-R evaluates incremental changes
- For RMK approach, $RLF = 1$ if cumulative probability is within ε of the ruin probability, otherwise 0

Choice of Method

- Reason for capital allocation should drive the choice of method
- Ease of application
- Ease of interpretation

Applying Capital Allocation to Performance Evaluation

- Dividing actual returns by allocated capital provides a risk adjusted rate of return
- Base performance evaluation on risk adjusted returns
- Compare this approach to having a different hurdle rate for each area

Case Study: Capital allocation for performance evaluation

- Five roles to play
 - VP-Homeowners
 - VP-Auto
 - VP-Investments
 - CRO
 - CEO
- Excel file with 10,000 iterations of economic capital model
- Capital allocation methods
 - TVaR
 - 95%
 - 99%
 - 99.9%
 - VaR
 - 95%
 - 99%
 - Semi-variance
 - Myers-Read
 - $\varepsilon = 1.0\%$
 - $\varepsilon = 0.5\%$
 - $\varepsilon = 0.1\%$

Case Study- Developed by Steve D'arcy (30 minutes)

- Form groups of 5
- Read Case Study
- Download Excel file RPM Case Study Data
- Perform capital allocation calculations
- For your role, select one of the capital allocation methods to use for performance evaluations
- Be prepared to justify your choice when the group reconvenes

Case Study Discussion

Which method did each role select?

- VP-Homeowners
- VP-Auto
- VP-Investments
- CRO
- CEO

Other Methods:

- See RR-1 Presentation

Capital Allocation References

- D. Ruhm and D. Mango, 2003, “A Method of Implementing Myers-Read Capital Allocation in Simulation,” *Casualty Actuarial Society Forum*, Fall, 451-458.
<http://www.casact.org/pubs/forum/03fforum/03ff451.pdf>
- R. Kreps, 2005. “Riskiness Leverage Models,” *Proceedings of the Casualty Actuarial Society* 91: 31-60.
<http://www.casact.org/pubs/proceed/proceed05/05041.pdf>.
- D. Mango, 2006, “Insurance Capital as a Shared Asset,” *Casualty Actuarial Society Forum*, Fall, 573-586.
<http://www.casact.org/pubs/forum/06fforum/577.pdf>
- S. P. D’Arcy, 2011, “Capital Allocation in the Property-Liability Insurance Industry,” *Variance*, 5(2):141-157.
<http://www.variancejournal.org/issues/05-02/141.pdf>
- D. Ruhm, D. Mango and R. Kreps, “A General Additive Method for Portfolio Risk Analysis.” Forthcoming, *ASTIN Bulletin*.