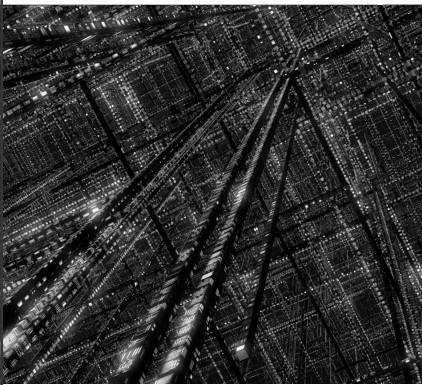


**GUY CARPENTER**



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**Beyond the (Correlation) Matrix**  
*Risk Driver Modeling*

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## **Agenda**

### *Do You Feel Lucky?*

- Describe limitations of Correlation Matrices
- Describe the alternative: Risk Driver Modeling
- Explain why it is better
- Show who else is using it
- Demonstrate how it will help
- Q&A

## Current Practice: Correlation Matrices

- Correlation matrix among risk sources
  - Loss ratios by line of business
  - Currencies
  - Underwriting or Accident years
  - Large losses...
- Widely used because of familiarity—actuaries “know”
  - Meaning of the term correlation
  - Range of correlation values (-1 to +1), and
  - What different values mean (e.g., “50% correlated”).
- A correlation matrix represents one specific form—linear correlation—of the more general concept of statistical dependence.
- Unless otherwise specified, corresponds to the normal copula based upon the multi-variate normal distribution

## Limitations of Correlation Matrices

- As the number of variables increases, the normal copula becomes mathematically incapable of generating correlation in the tail (see Embrechts)
- Some actuaries get around this by using other copulas (e.g., T, Gumbel, Frank, HRT)
  - Careful though – now we lose the “familiarity” benefit
- Issues with clarity, transparency and manageability in large capital models
  - Maintaining internal consistency – and correcting inconsistency – is problematic
  - Combining many dimensions of modeling with compounding matrices—e.g., currencies, underwriting years
  - Documenting rationale

## Limitations of Correlation Matrices

- Biggest limitation is lack of ***explanatory information*** around simulated outcomes
  - Cross your fingers and hope something realistic turns up
  - Run enough simulations...an issue for another day
  - Difficult to get senior management understanding and buy-in as required by the Solvency II Use Test
- That is because its input—the correlations—are actually observed results of the effects of underlying causes—the risk drivers
  - Symptoms not root causes
  - Top-down not bottom-up

## **Risk Driver Modeling**

### **1) *What it is***

- A.k.a. structural or factor or causal modeling
- Implement distinct types of risk drivers for distinct types of dependence:
  - Clash (simultaneous events)
  - Time series or common shock factors (accident year basis), and
  - Calendar year effects.
- Volatility and accumulation occurs through degree of influence or impact of driver on risk sources (lines of business)
- Requires specificity and deliberateness in modeling

## Risk Driver Modeling

### 2) *Why it is better*

- Explanatory
  - Forces explicitness regarding nature of the impact of key factors on company results
  - **Operating hypothesis of the company**
  - What does it say about your firm if you cannot even speculate about these factors or their effect?
- Scientific basis
  - Scaling for the future
  - As our learning advances, we have a structure capable of adapting and admitting new information in a clear manner
- Clarity
  - Engage key opinion leaders directly in the process without statistical double-speak

## **Risk Driver Modeling**

### **3) *Who else does it***

- Dr. Glenn Meyers  
common shock  
modeling
- Catastrophe modelers
- Credit risk modelers
- Economic scenario  
generators (cascade  
models)
- GLM and predictive  
modeling in pricing and  
reserving



## **Risk Driver Modeling**

### ***4) How it will help***

- Transparency
- Sensitivity testing
- Stress testing
- Scenario analysis
- The ORSA

**Risk Driver Modeling**  
*Demonstration*

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