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PROPERTY AND CASUALTY: SEPARATED AT BIRTH

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Agenda

1. Introduction: Property and Casualty wear different masks
2. Demonstration of the correlation between Property and Casualty
3. Modelling the correlation in ERM

Separated at Birth

Property and Casualty lines of business are often sold together and are subject to similar market forces. However, published results do not always show a strong correlation.

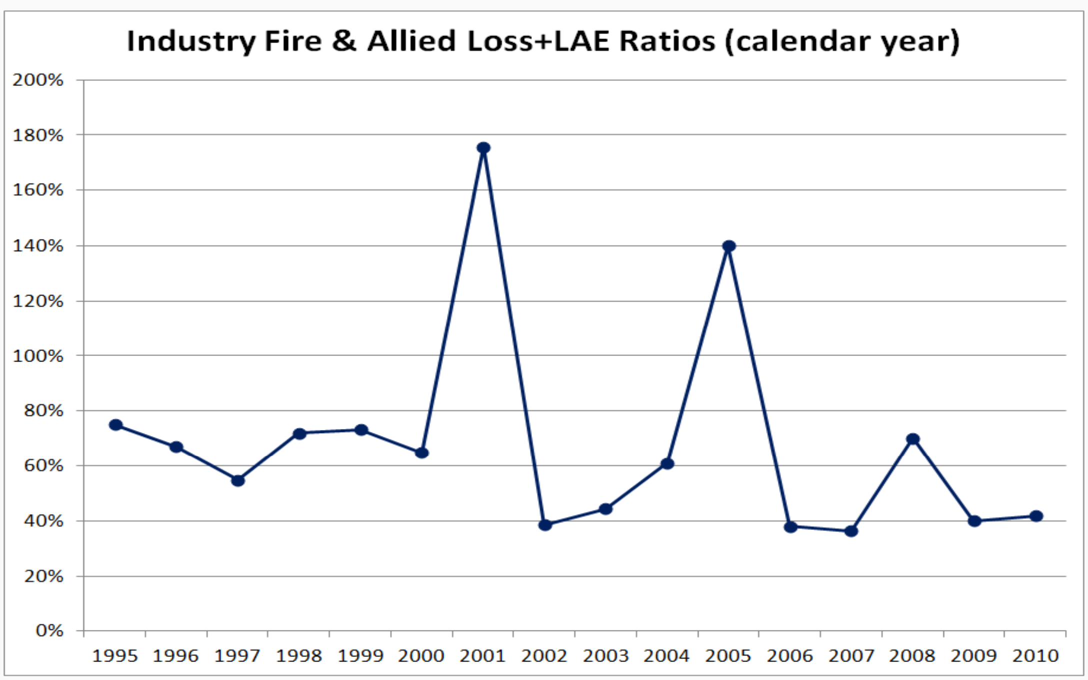
- Small commercial insurance is often explicitly "packaged" as BOP or CMP
- Large account businesses purchase separate policies, but often involve the same buyers, sellers and intermediaries.
- For (re)insurers, we often hear "*you need to think about the whole account*"

Separated at Birth

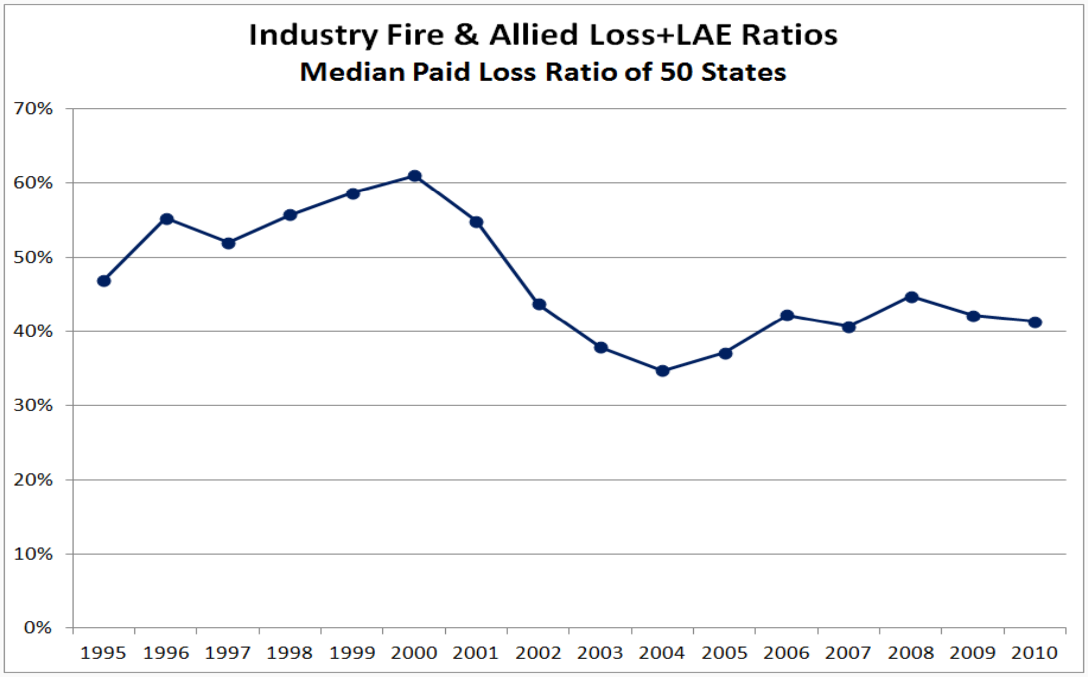
- Property results are subject to the market cycle, but this is masked by catastrophes and other large loss events.
- Casualty results are subject to the market cycle, but this is masked by the very slow recognition of ultimate results in the reserving process.

Similar patterns – covered by different masks.

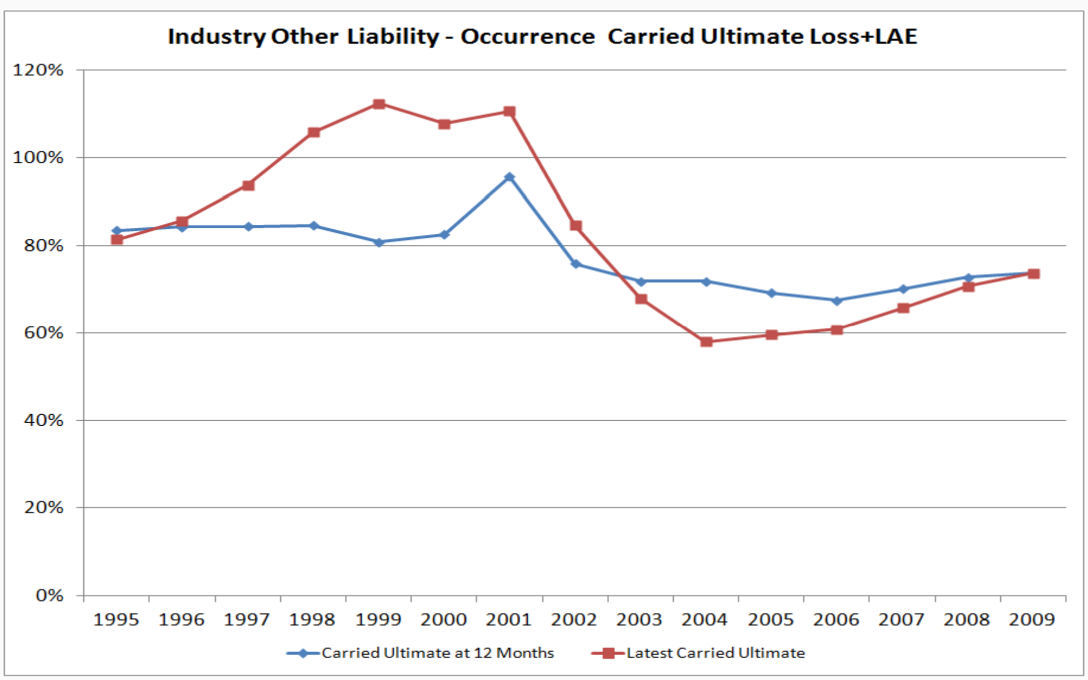
Separated at Birth - Property Loss Ratios including catastrophes



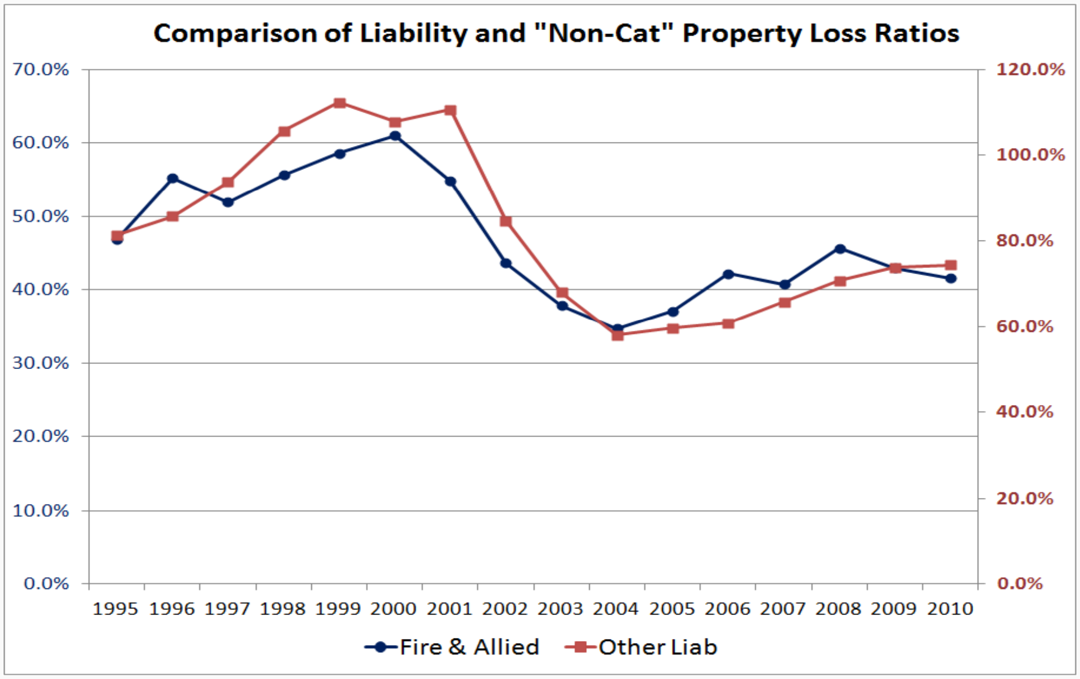
Separated at Birth - Property Loss Ratios excluding catastrophes (via median)



Separated at Birth – Casualty Loss Ratios



Separated at Birth – Liability and Property Loss Ratios

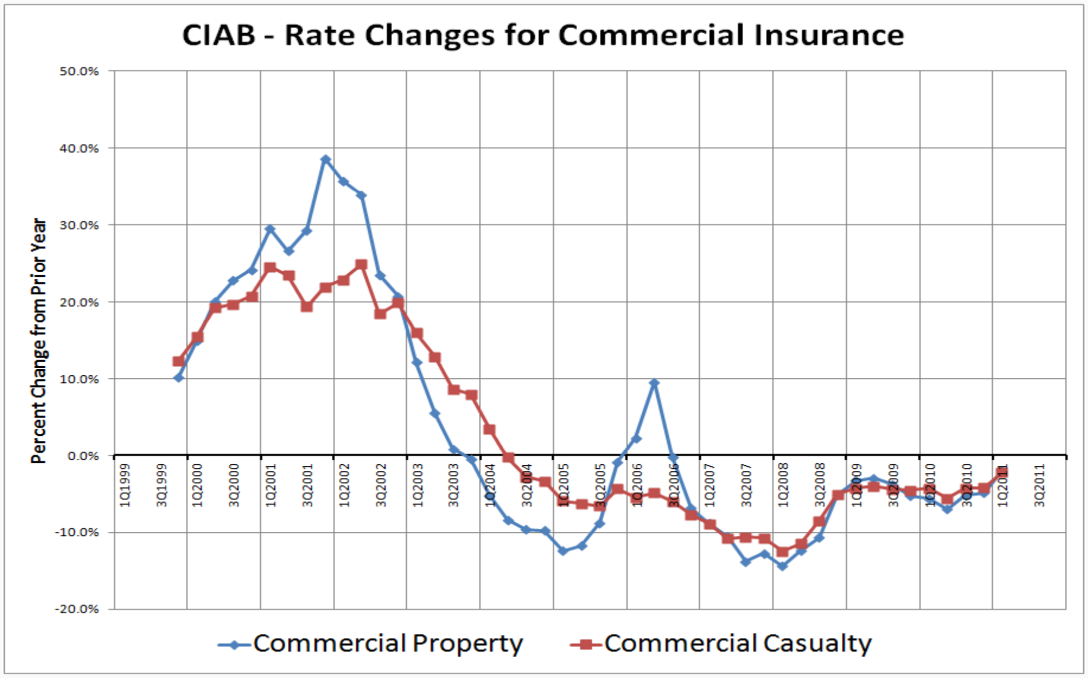


Separated at Birth

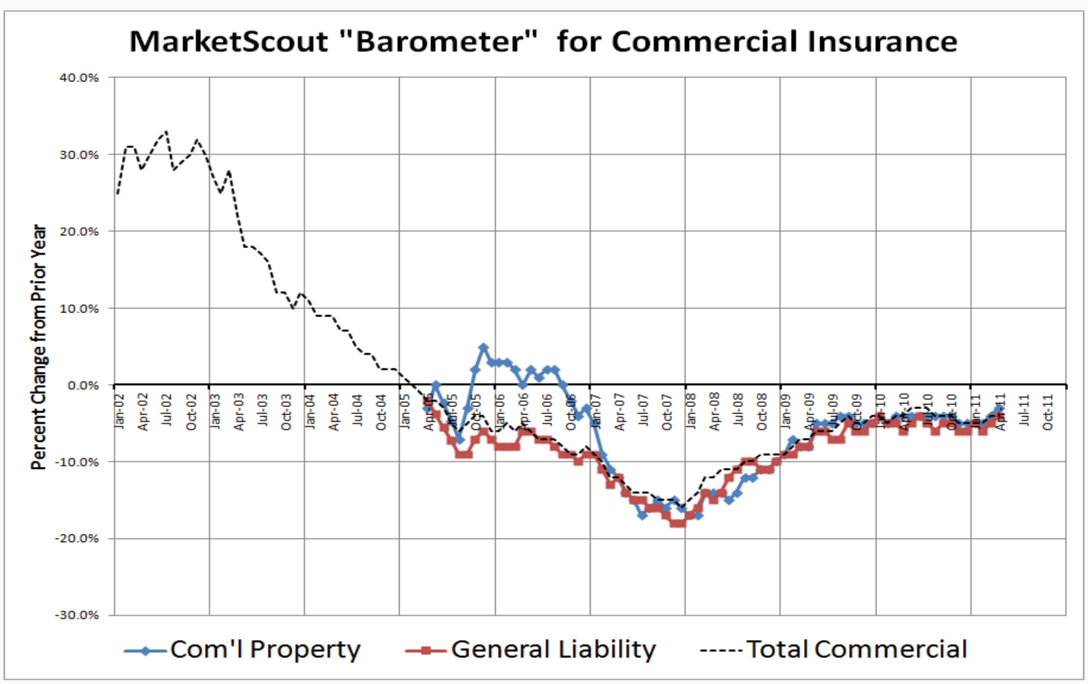
- Correlation coefficient for the “true” ultimate loss ratio for Other Liability with the non-catastrophe portion of Fire & Allied is **about .926**. Other lines of business show similarly strong correlation.

- The primary reason for this correlation is the common market cycle affecting all lines of business.
- A secondary reason for the correlation may be that economic costs will be co-integrated over the long term.

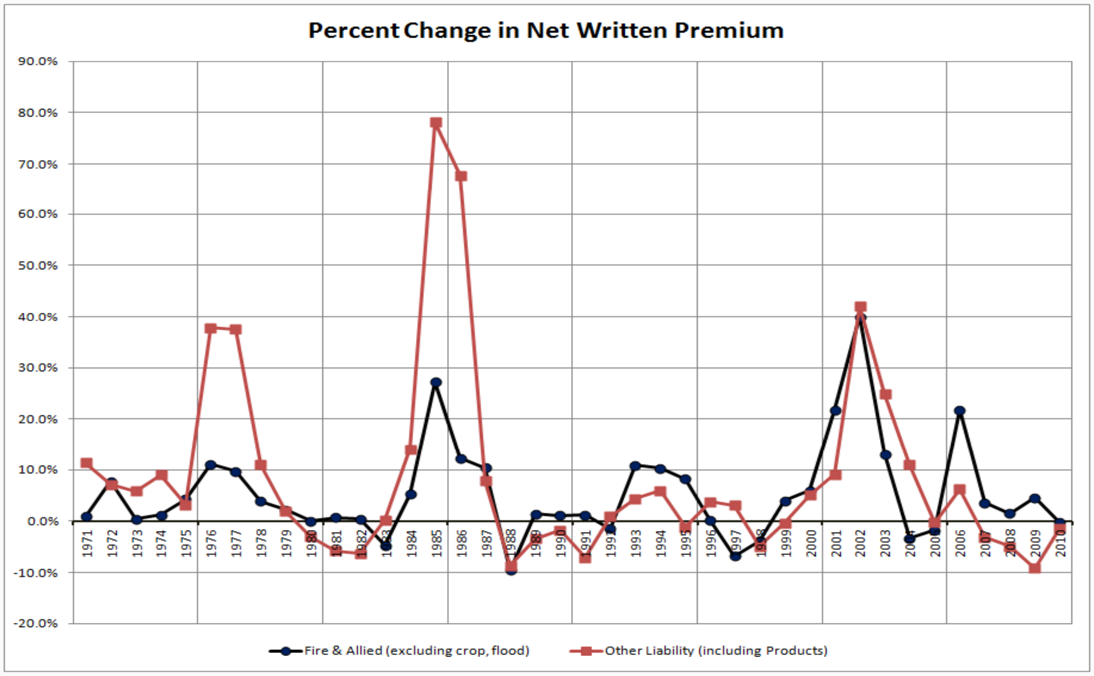
Separated at Birth – CIAB Rate Changes



Separated at Birth – MarketScout Rate Changes



Separated at Birth – Percent Change in NWP



Separated at Birth - Two Methods for including LOB Correlation in Enterprise Risk Models

Implicit:

- Do not adjust historical results to current level
- Estimate correlations based on historical loss ratios
- Model correlation via copula

Explicit:

- Adjust historical results to current cost and rate level
- Explicitly model market cycle and economic forces
- Apply the market cycle and economic forces as separate level of simulation, applicable to all lines of business
- Scatter Plot of results can be used to show the dependence (copula is output, not input)

Separated at Birth - Modelling Correlation

In an explicit model of market cycle, rate/price movement is treated as a secondary random variable. This is sometimes described as a "mixing" variable or a "common shock" model.

The form of this secondary variable creates a copula.

X_1 and X_2 are random variables for two lines of business

Y is a random variable for the market cycle (affecting premium)

If X_1, X_2 are lognormal and Y is also lognormal, then

$F(X_1/Y, X_2/Y)$ follows a Gaussian (bivariate normal) copula

If X_1, X_2 are exponential and Y is gamma, then

$F(X_1/Y, X_2/Y)$ follows a Heavy-Right-Tailed (bivariate Pareto) copula

Separated at Birth - Copulas

A copula is a function that defines a bivariate (or multivariate) distribution in terms of the marginal distributions.

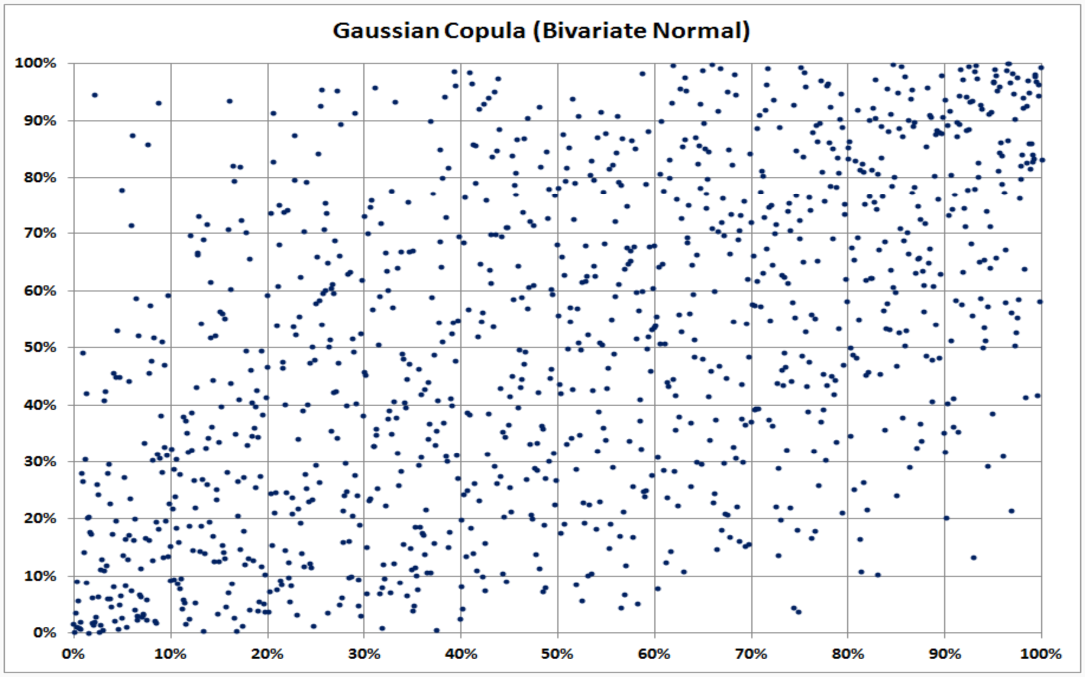
$$F(X_1,X_2) = C[F_1(X_1), F_2(X_2)]$$

For example, the Clayton copula is written as:

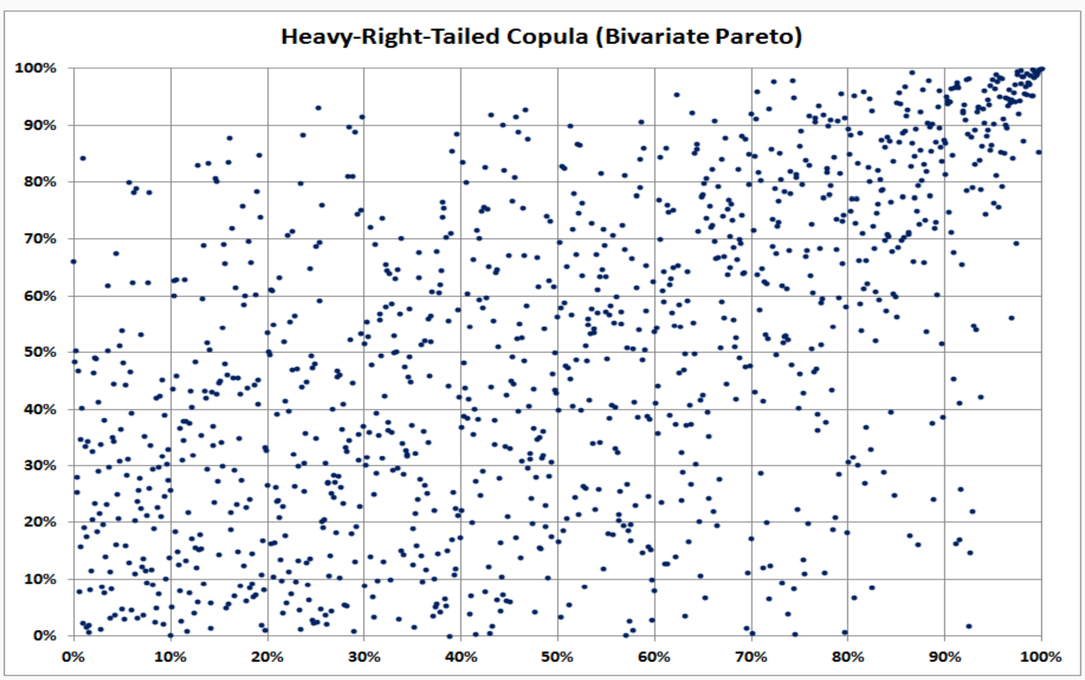
$$C[F_1(X_1), F_2(X_2)] = [F_1(X_1)^{-\beta} + F_2(X_2)^{-\beta} -1]^{-1/\beta}$$

The copula parameter, β, controls the strength of the dependence between the variables.

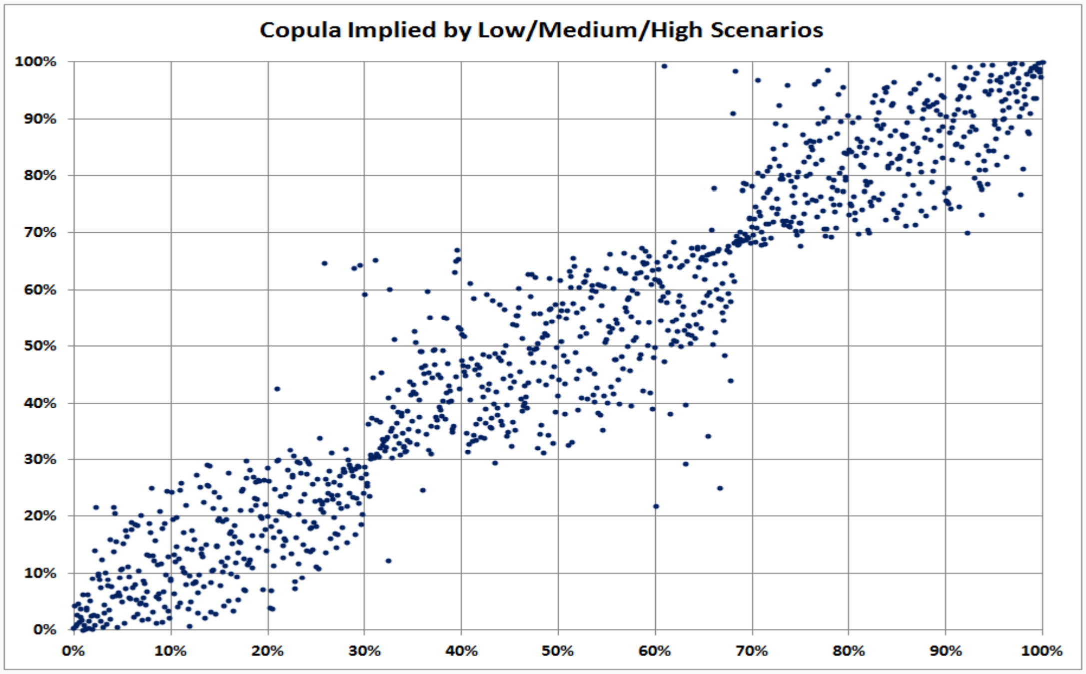
Scatter Plot from Copula: Gaussian



Scatter Plot from Copula: Heavy Right-Tail (HRT)



Scatter Plot from Copula: Scenario Testing



Separated at Birth - Mitigating Correlation Risk

Correlation due to market cycle is not a diversifiable risk.

However, the market cycle is largely an **epistemic** rather than an **aleatoric** (random) risk. That is, the risk is due to the fact that we do not really know what is being charged for the underlying risks.

While this risk cannot be diversified away, it can be mitigated. The mitigation of the risk is done by improving our knowledge of price adequacy via monitors, audits and controls.

THANK YOU VERY MUCH FOR YOUR ATTENTION.

Dave Clark