



QUANTIFYING RISK, ENABLING OPPORTUNITY

Agenda

Presented by Cliff Barnes (Price Forbes & Partners)

- 1. Principles of Insurance**
- 2. Typical Energy Risks**
- 3. Some Major Losses**
- 4. Quantification of Risks**



Presented by David Kirk (KPMG)

- 5. The Project**
- 6. Software and modelling constraints**
- 7. Model Validation**
- 8. Results**
- 9. What affects optimal strategy?**



Principles of Insurance

- Insurable Interest
 - Legal right. Insured must stand to lose from damage to property, life
- Utmost Good Faith (*uberrimae fidei*)
 - The positive duty to disclose accurately and fully all facts material to the assessment of the risk – exceeds duty owed in normal commercial contracts
- Proximate Cause
 - The risk that caused the loss must be covered by the Policy. There must be an unbroken causal link

Principles

- Indemnity
 - Places the Insured in the same financial position as if the loss had not occurred
- Fortuity
 - The loss must be sudden and unexpected
- Subrogation
 - The right of the Insurer, having indemnified the Insured, to stand in the place of the Insured to recover from third parties

Types of insurance normally provided in Energy

- Property Damage
- Construction All Risks
- Oil in Store
- Control of Well – Blowout
- Business Interruption, incl. CBI and ECW
- Third Party Liability















The Principal Insurable Risks

- Fire & Explosion
- Blowout & Cratering
- Storm Damage
- Vessel Impact
- Alterations & tie-ins
- Construction Defects
- Dropped Objects

Some Major Losses

- Piper Alpha – 1989
- KOC Rawdatain – 2002
- Bombay High
- “Deepwater Horizon” BP Macondo Gulf of Mexico

PIPER ALPHA, 06.06.1988





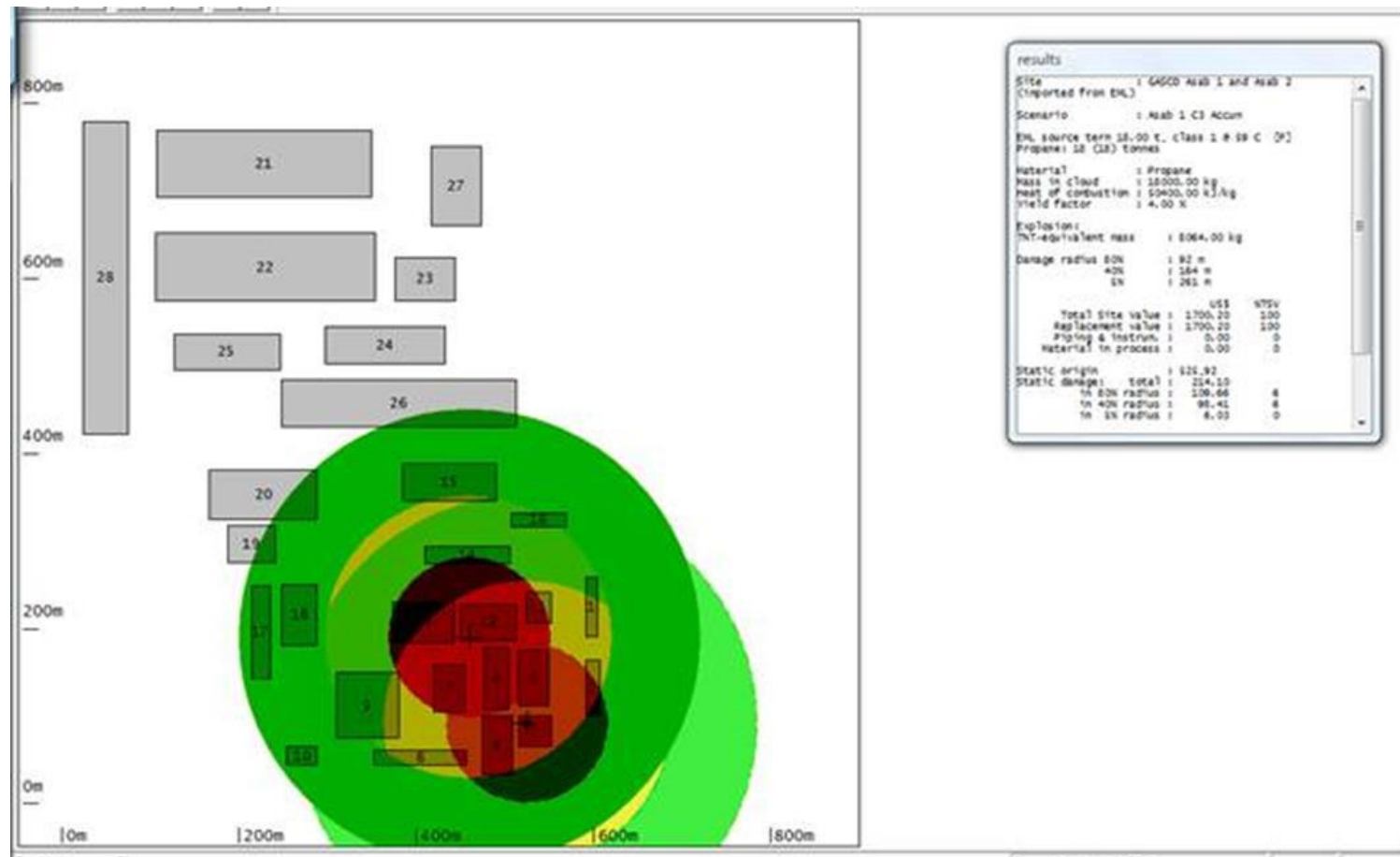




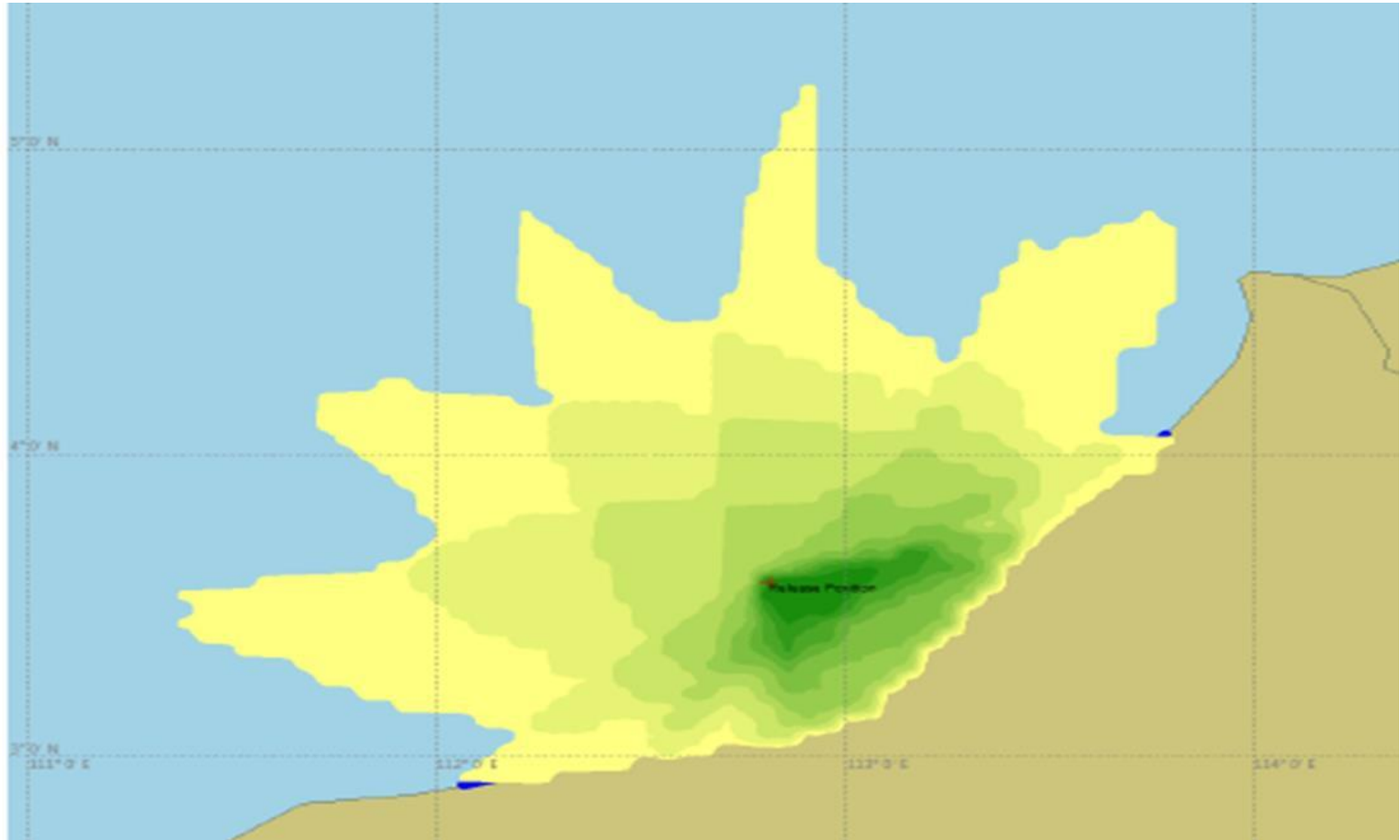
Quantification of Risks

- Estimated Maximum Loss (EML) analysis
 - Loss scenarios postulated. Vapour Cloud Explosion
- Third Party Liability
 - Adjacent exposures. Pollution
- Control of Well Limit
 - Scenario covers Making safe, Re-drill and S&P
- Business Interruption analyses
 - Loss scenarios. Revenue less Variable costs

Vapour Cloud Explosion Modelling



Oil Spill Analysis



Risk Surveys - Iraq

- Site location – roughly 150 km north of Basra
- Met at airport by Security detail and transferred to staging area outside airport
- Bullet proofed vehicles used for transfer to site. Weight of 4.5 tons, normal 2.3 tons
- Accompanied by Security to production facilities outside of base Camp
- Modern, new production facilities
- ISIL mainly in the north – no incidents





Bullet Proofing



Risk Surveys - South Sudan

- Great potential
- Most of Sudan's crude oil
- Gold deposits
- Bigger animal (antelope) migration than Serengeti
- Well watered arable land. Sugar estates
- More water per capita than London
- Civil war has spread to the streets of capital Juba











Risk Surveys - Nigeria

- Oil rich
- Huge inequality
- Corruption
- Security issues – MEND in oil states
- Accompanied by military and company security
- Risk surveys on power stations to date
- Oil & Gas facilities imminent



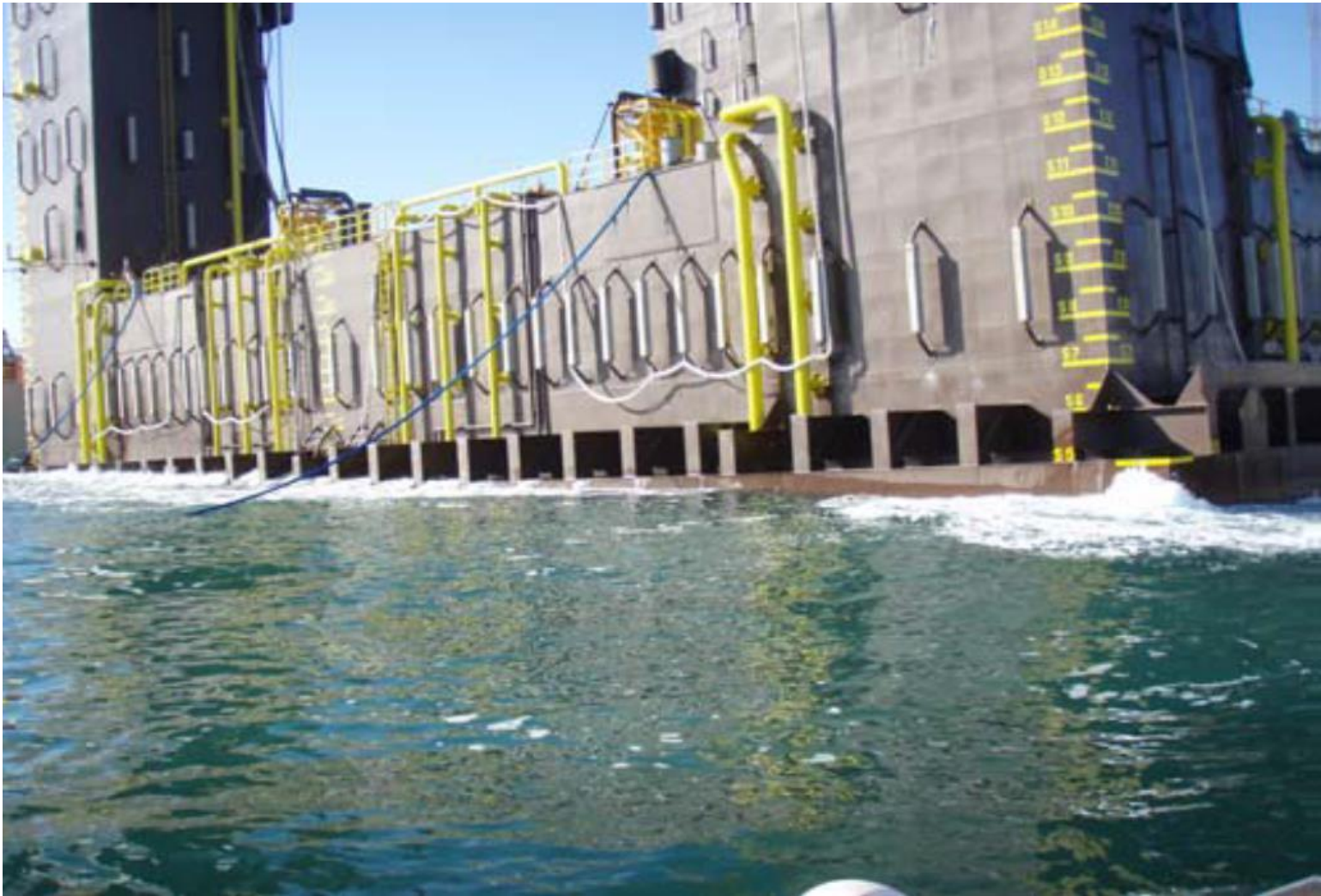


Risk Surveys - Turkmenistan

- Former USSR state
- Run by the Turkmenbashy
- A closed society. Gold plated statue of first president Niyazov in Ashgabat
- Newly built holiday hotels on the Caspian Sea
- Caspian Sea development
- Prototypical technology – gravity base structure for seismic risk







Risk Surveys - Myanmar (Burma)

- Beautiful country
- Gentle people
- Military government
- Opening up – release of Aung San Suu Kyi, attracting foreign investment
- Striking change over past 6 years



Figure 1.0(a): Yetagun Offshore Field



Figure 2.4(b): PTT Sales Point

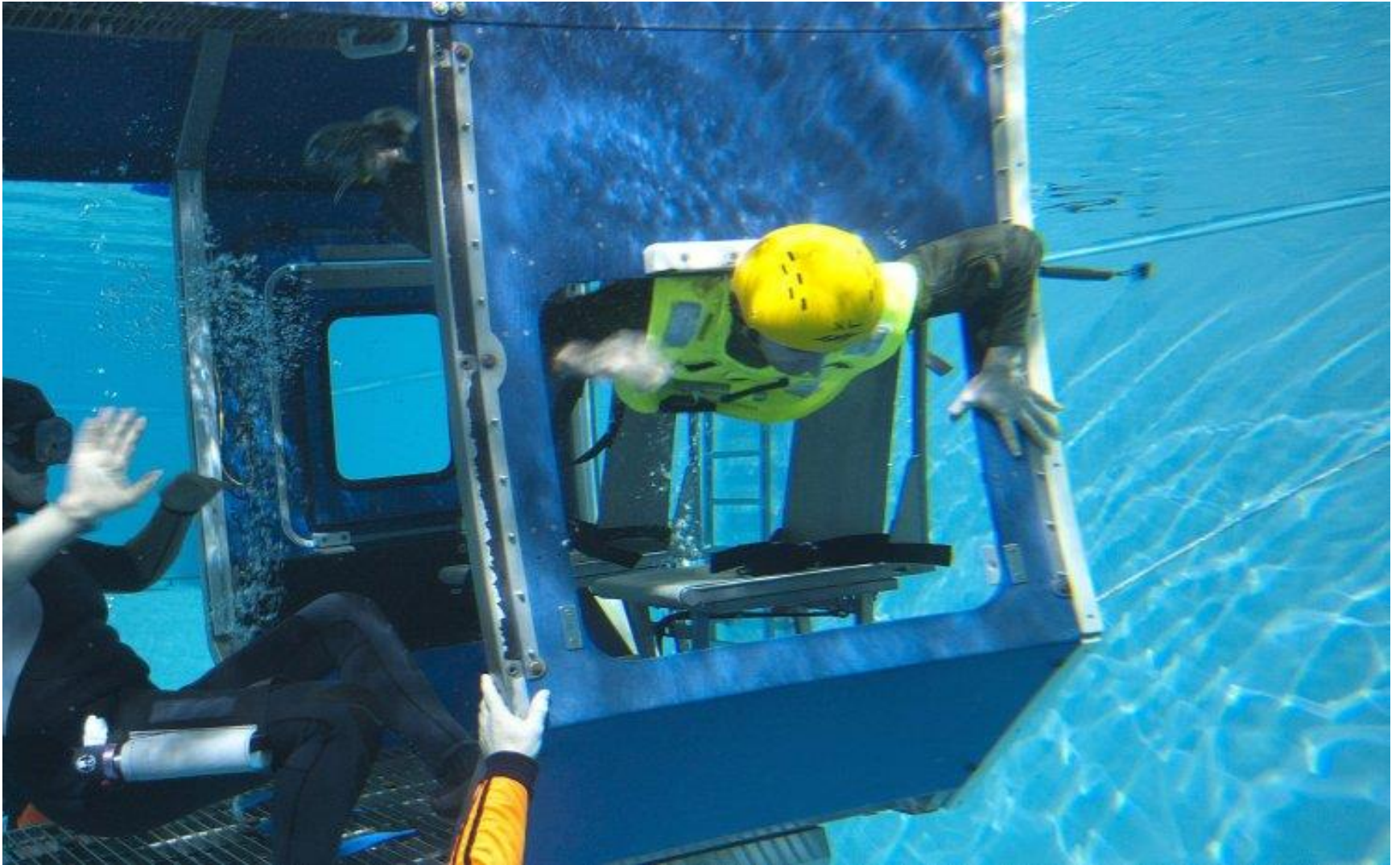


Figure 2.4(a): Metering Station

Offshore Surveys

- Offshore assets surveyed are mainly in SE Asia, but also Egypt and the North Sea
- Transfer from the company base to the offshore platforms is by helicopter
- All persons to offshore require Survival training, a component being HUET – helicopter underwater escape training









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The Project

- Parent company in the Energy sector with a very large risk portfolio containing several policies.
- The reinsurance structure currently in place is:
 - an excess of loss reinsurance on a per policy basis
 - an aggregate stop loss over the whole portfolio.
- Required to deliver claims and reinsurance model to our client
 - Understand risk return trade offs
 - Optimize their reinsurance strategy

Software and modelling constraints

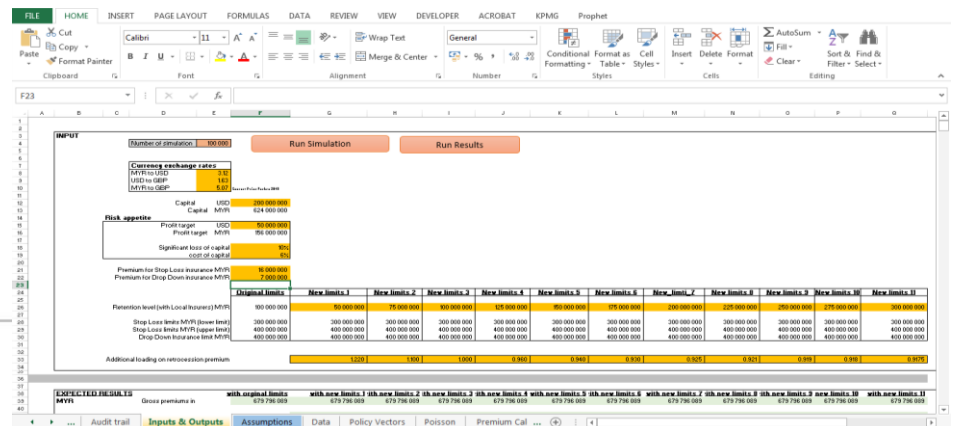
- Required software that the client would be able to use without additional licensing costs
- Excel (skills and software almost universally available)



- Traditional spreadsheet formulas
- Data Tables
- Macros
- User Defined Functions

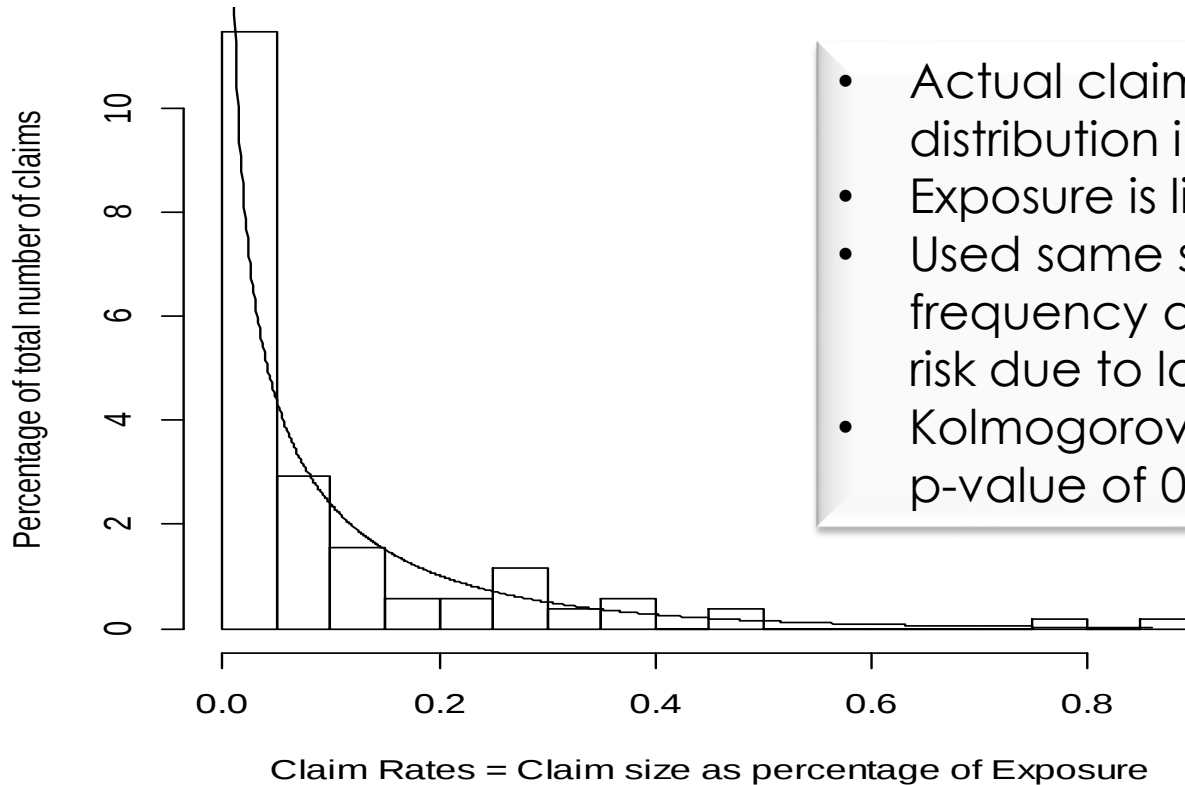
- R (open source, wide range of quality packages)

- Distribution Fitting
- Diagnostics



Model Validation

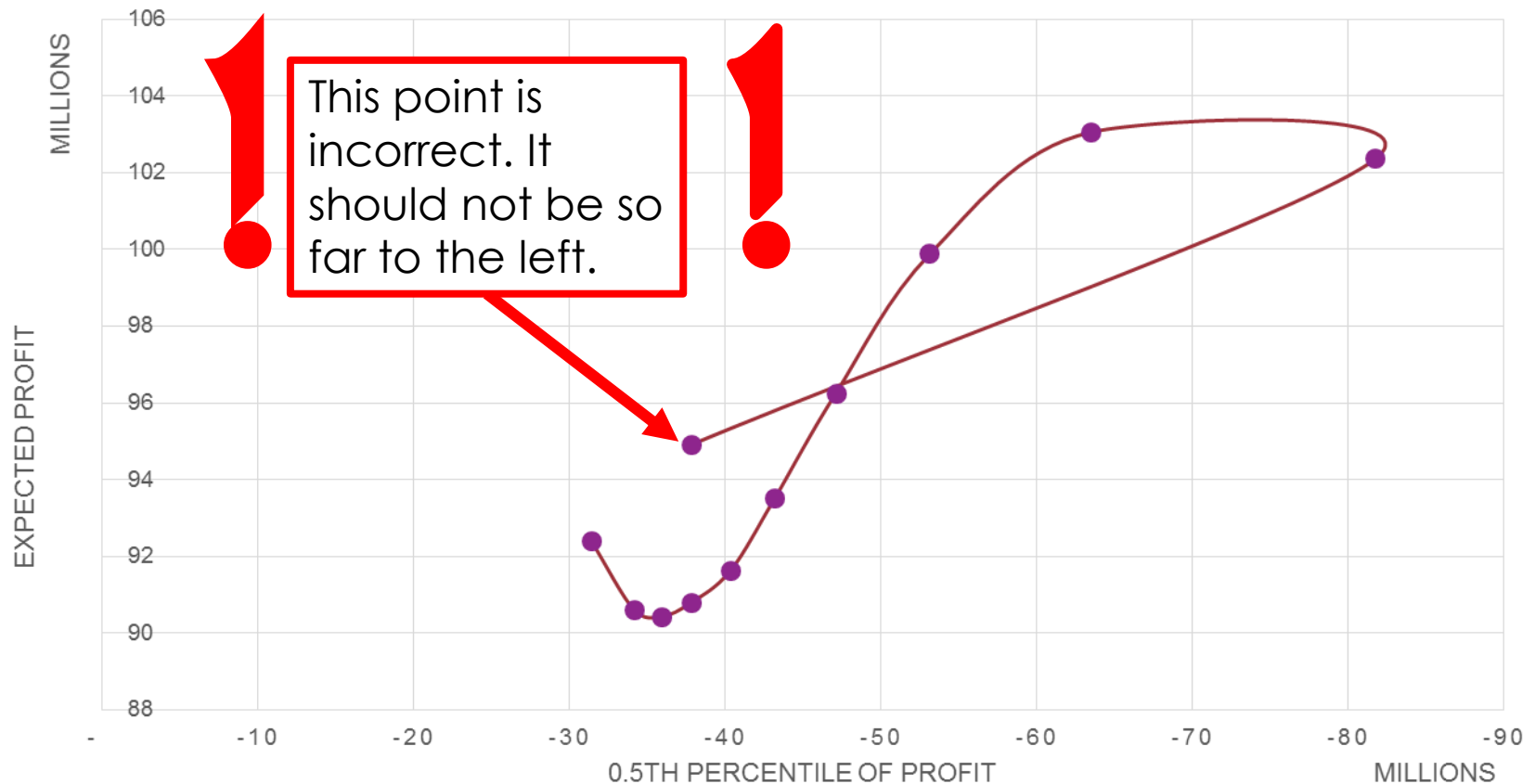
Gamma fitted to Claims Rates Data



- Actual claims fitted to Gamma distribution in R
- Exposure is limited to PML
- Used same severity and frequency assumptions for all risk due to low data available
- Kolmogorov-Smirnov GOF test p-value of 0.75

Model Validation

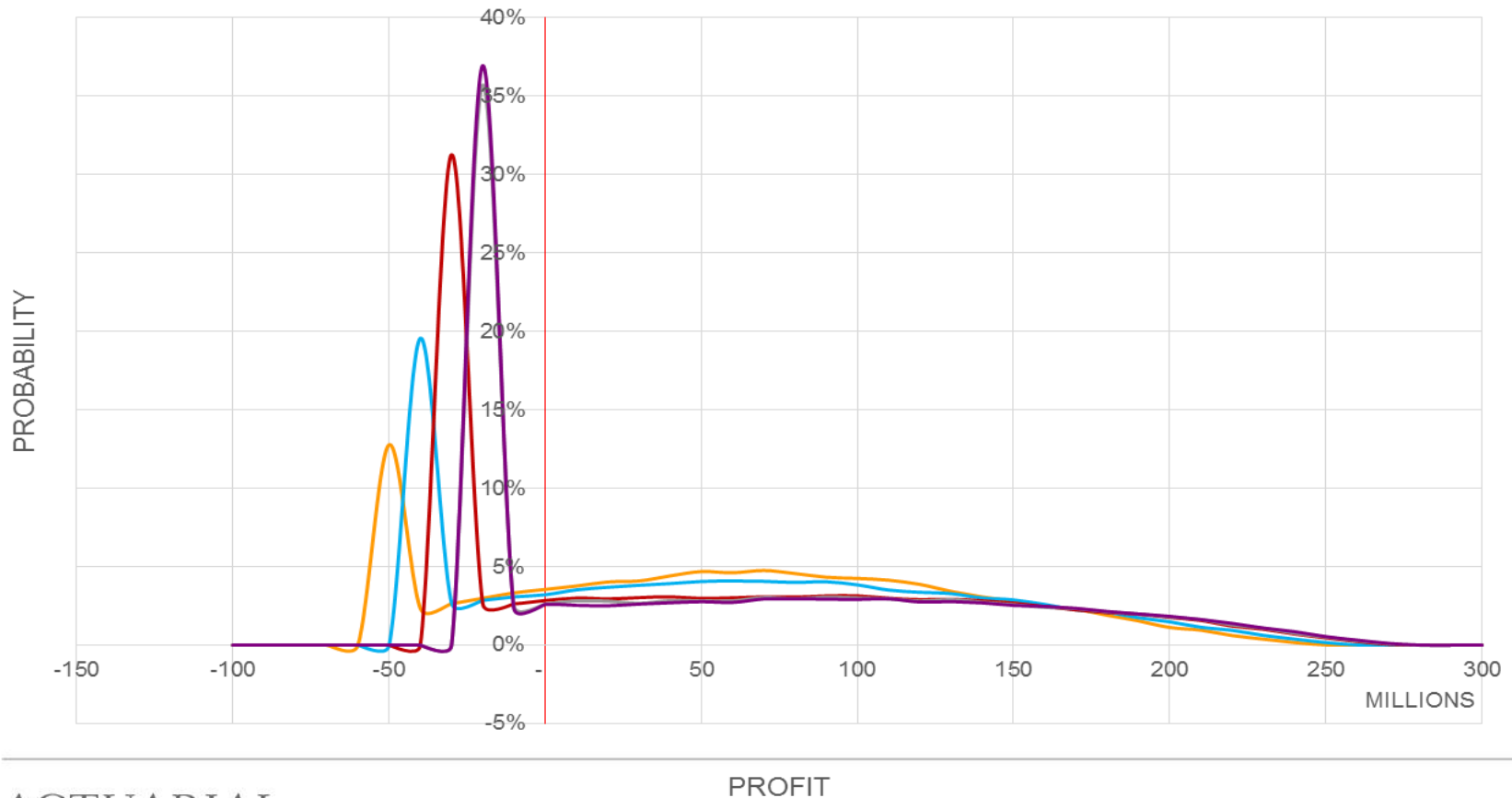
Analysis of graphs reveals problems



Model Validation

Odd at first glance, but clearly right

PROFIT DISTRIBUTION PER RETENTION LIMIT



Results: Value Metrics

Underwriting Profit

Claims ratio

Return on Capital

Economic Value Added

- Underwriting profit – cost of capital

Results: Risk Metrics

Standard deviation of claims

Loss of capital

Probability of negative variance
from annual profit targets

Probability of credit rating
downgrade

Results: Optimisation tools

Maximise Return on Capital

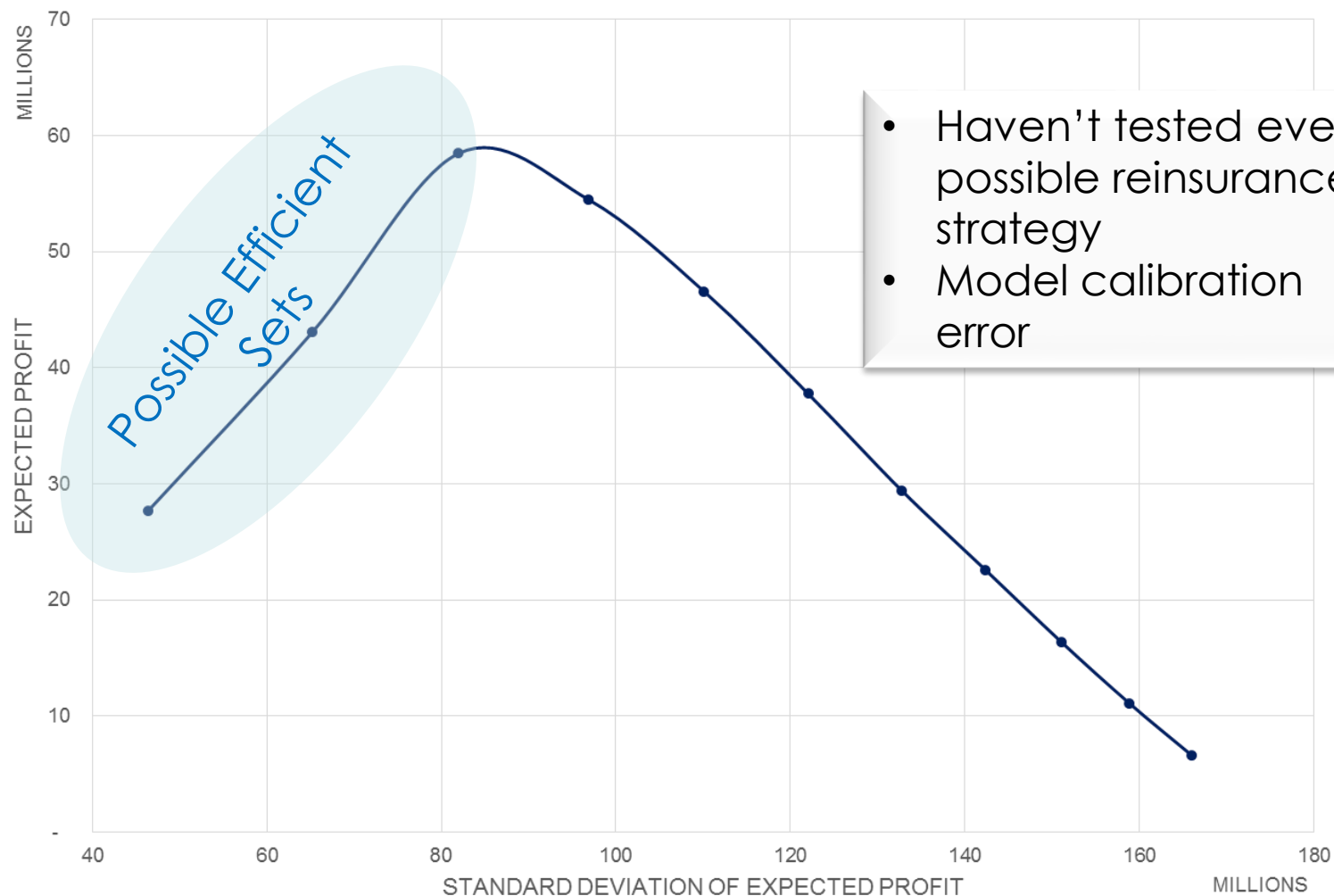
Maximise Economic Value Added™

Efficient Frontiers

- Optimal vs Efficient

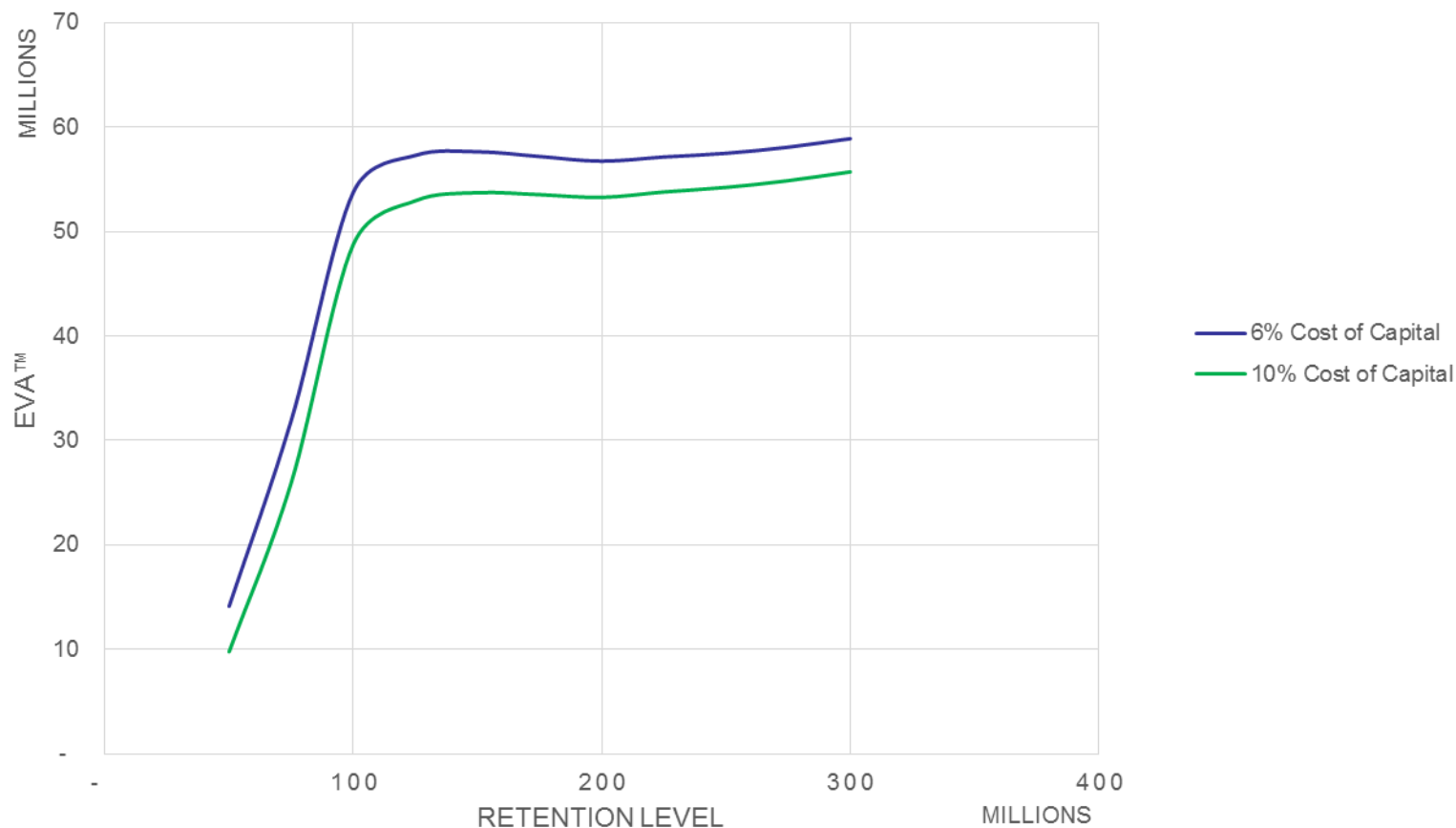
Mapping to vectors of Risk Appetite

Results: Efficient Frontier

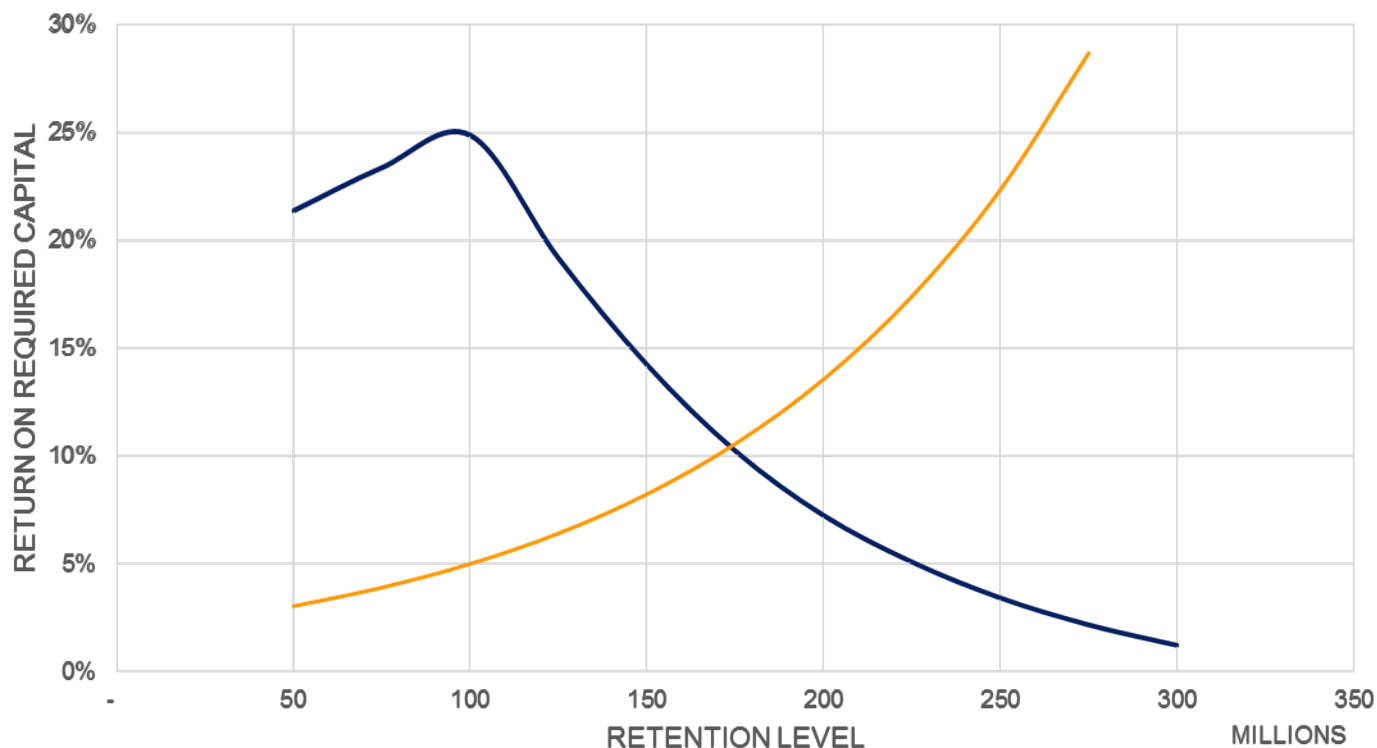


- Haven't tested every possible reinsurance strategy
- Model calibration error

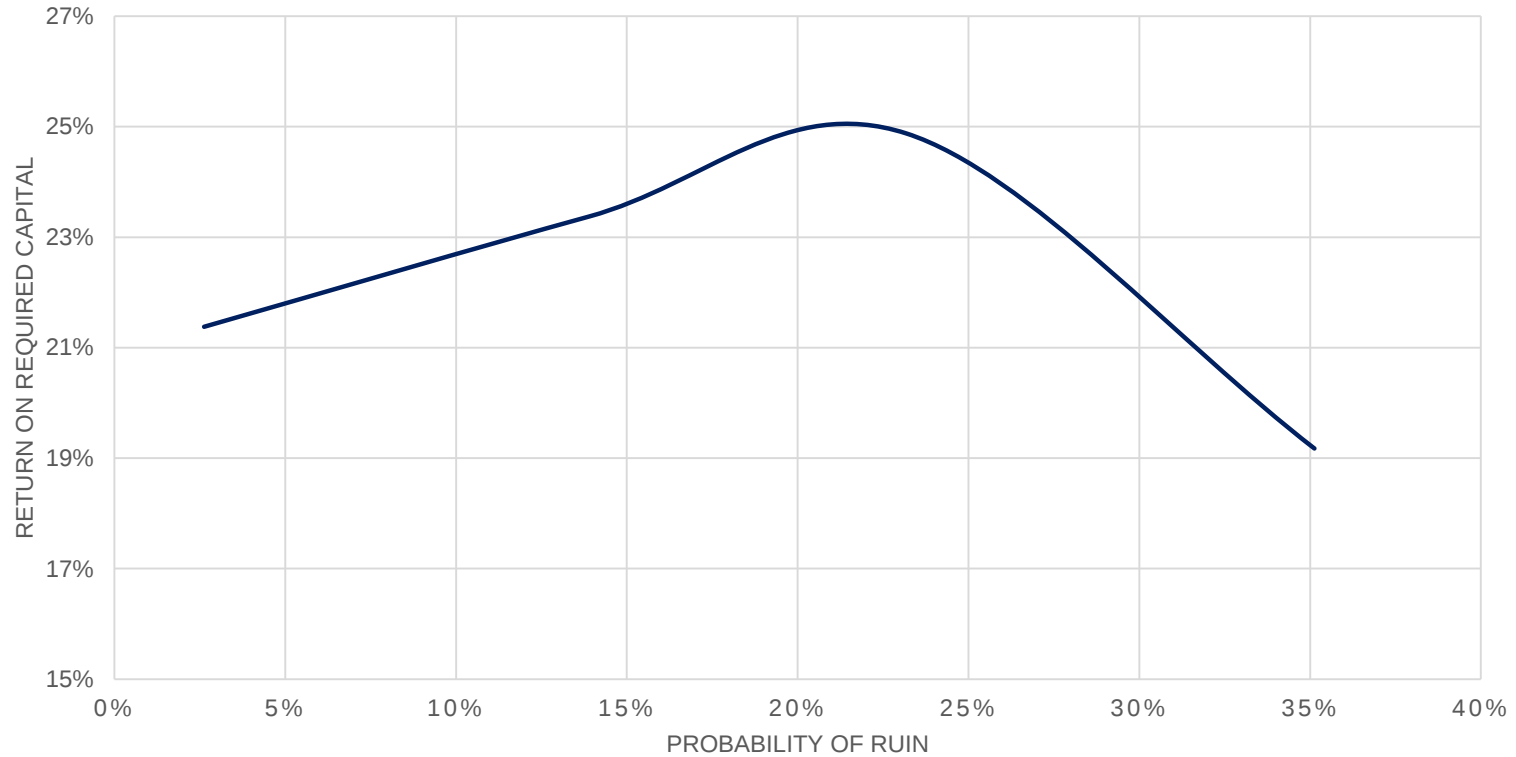
Results: Economic Value Added™



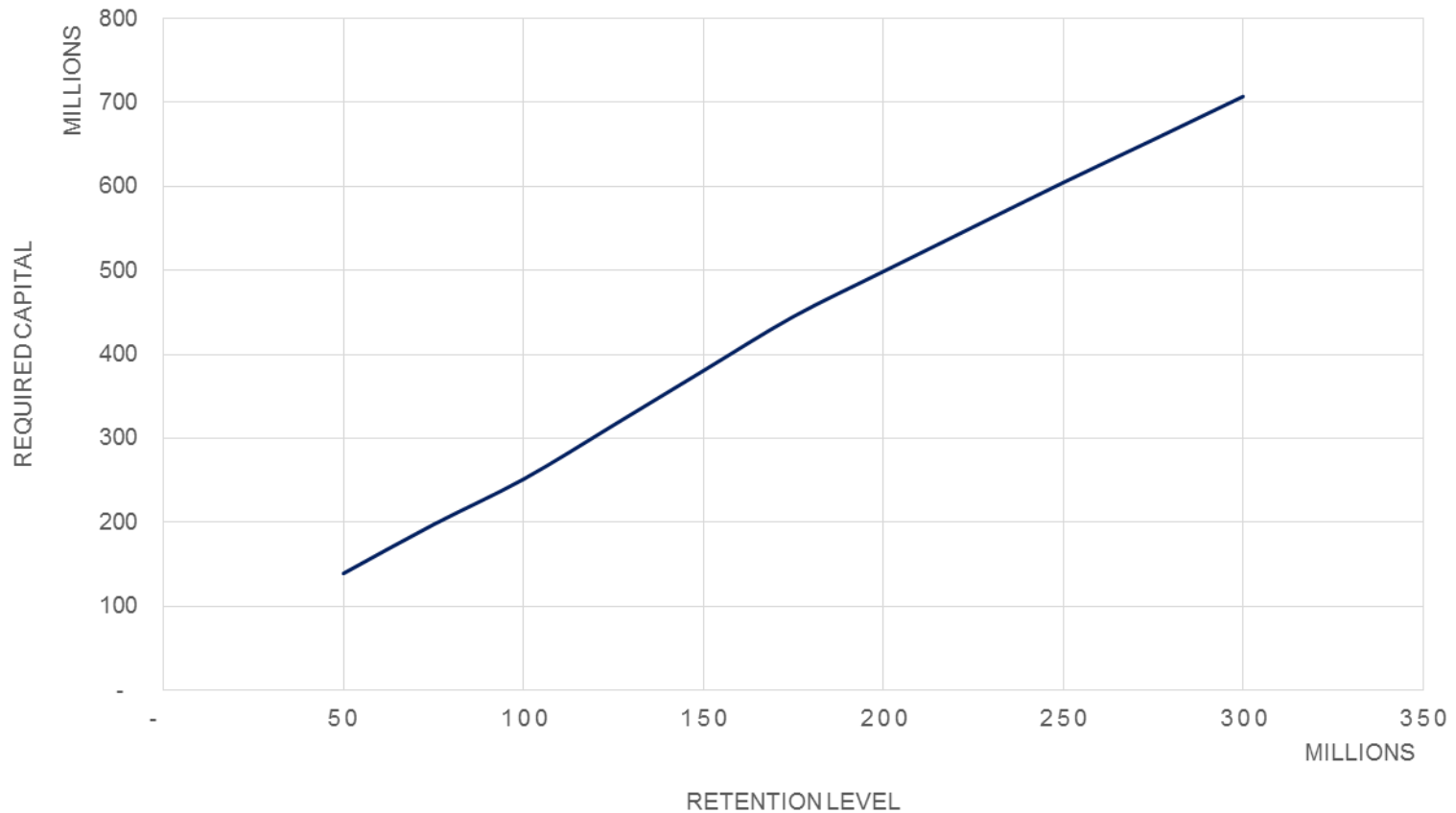
Results: Return on Capital vs Retention



Results: Return on Capital vs Probability of Ruin



Results: Capital and Retention



Results: What drives shape?

Optimising to
reality or
amplifying model
imperfections?

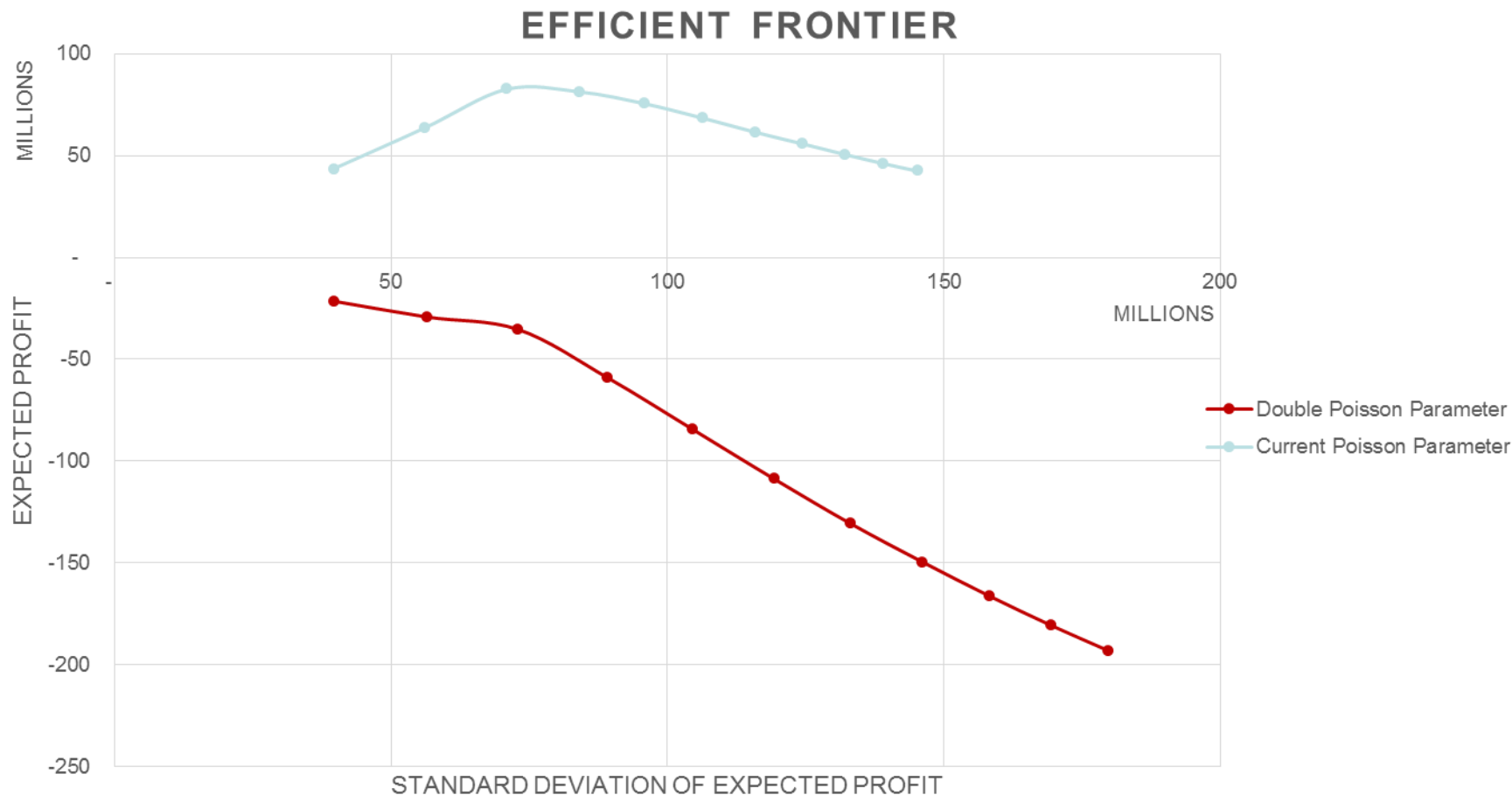
Parameters

Distributions

Reinsurance pricing

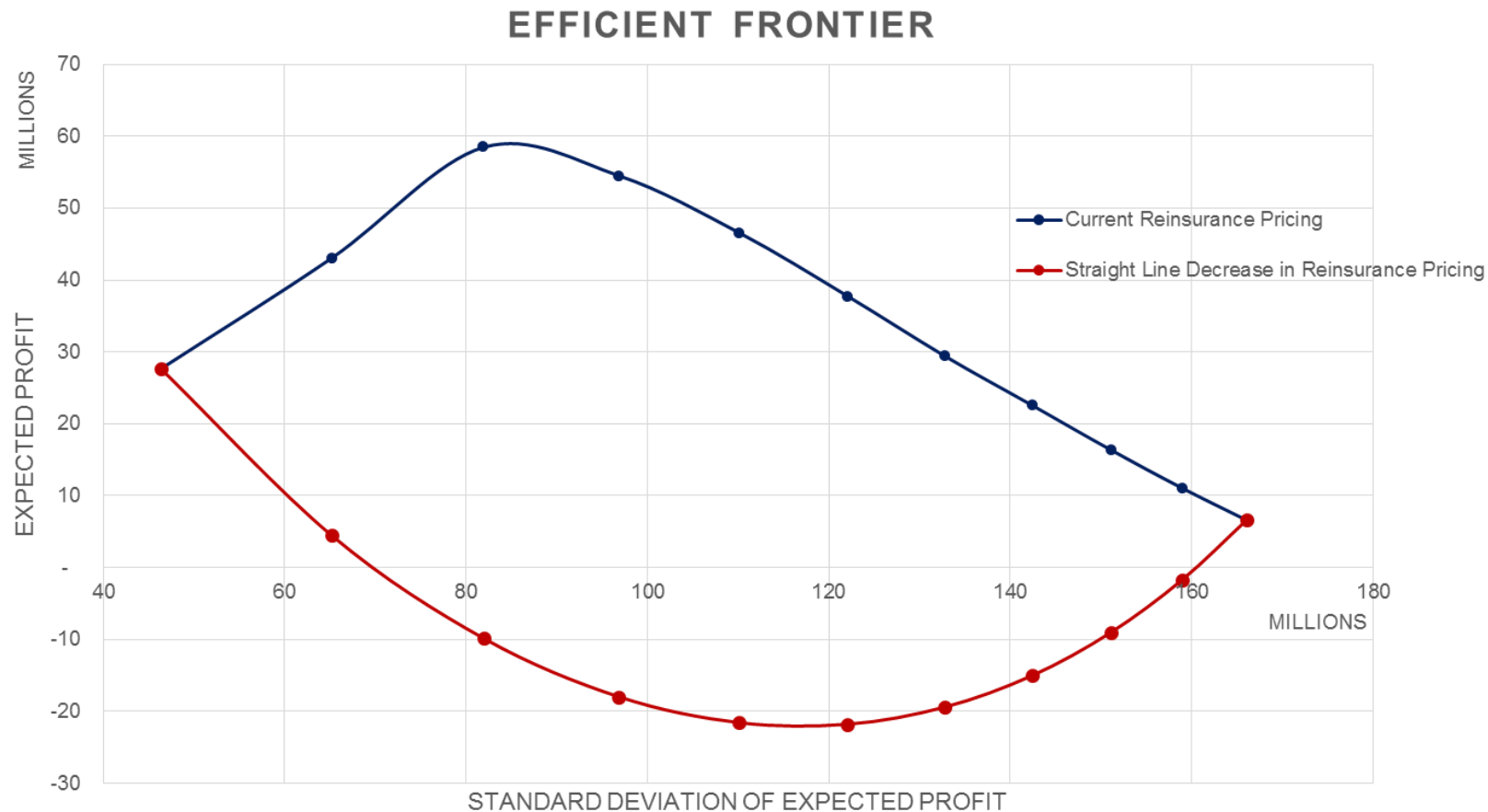
Correlation/Copula

What affects the optimal strategy: Parameters

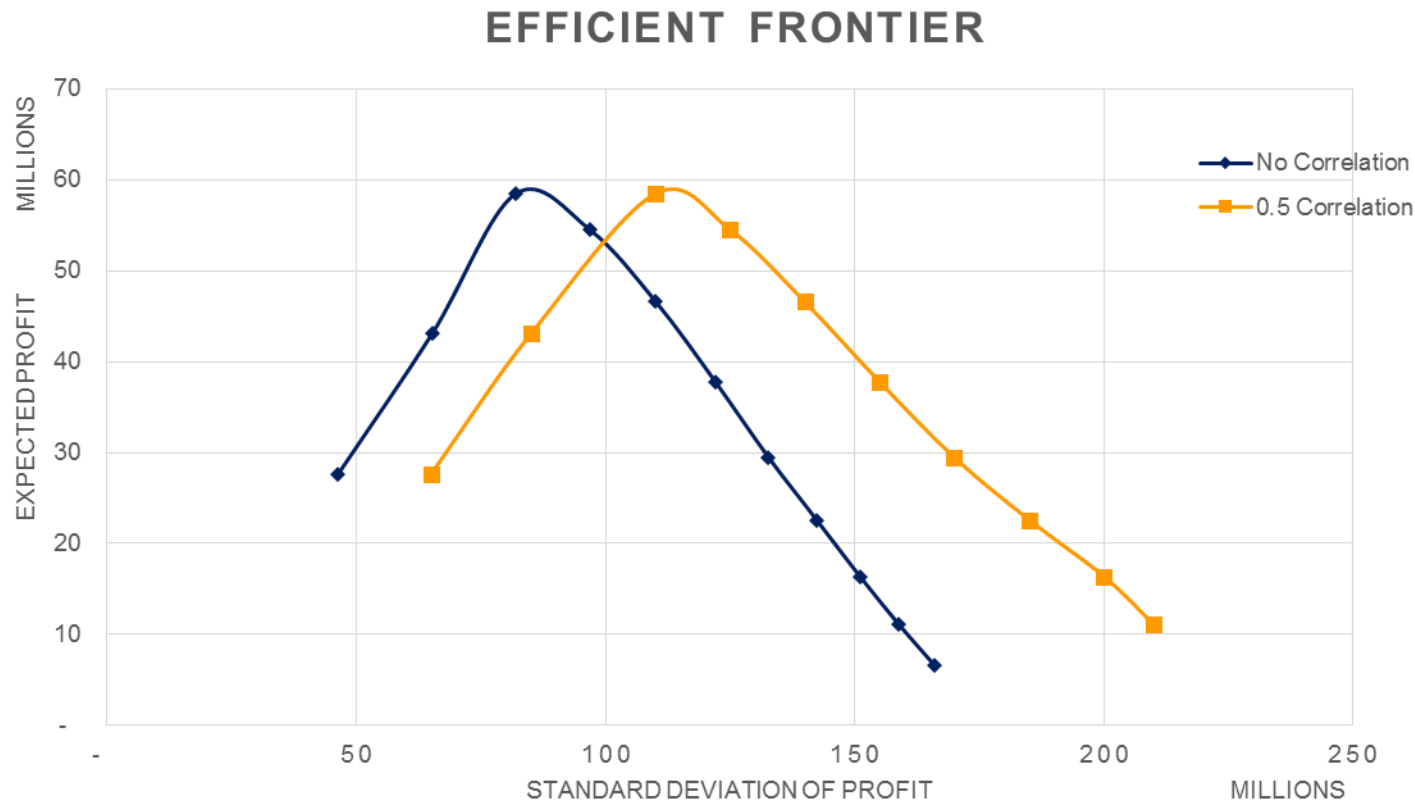


*No stop loss applied

What affects the optimal strategy: Reinsurance Pricing

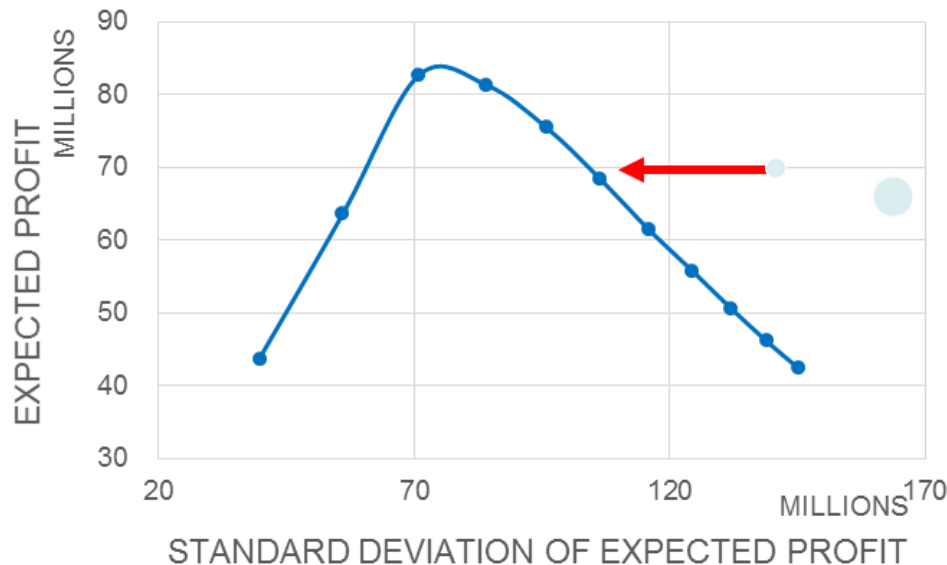


What affects the optimal strategy: Correlation- Gaussian Copula



Results: Anchoring and Adjustment

- Adjust slightly from current “anchor” rather than optimize directly
- Irrational?
 - Regret reduction?
 - Informal Bayesian updating?
 - Offsets model and calibration error?



“Anchor” here might result in “more efficient, non efficient” new structure



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