
# Elevating Microinsurance

## Mastering Reinsurance Strategies for Small Portfolios

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# What we're covering today

Scope – why funeral microinsurance?

Why use reinsurance?

Reinsurance decisions given capital requirements

Types of claims risk

Fitting distributions to data

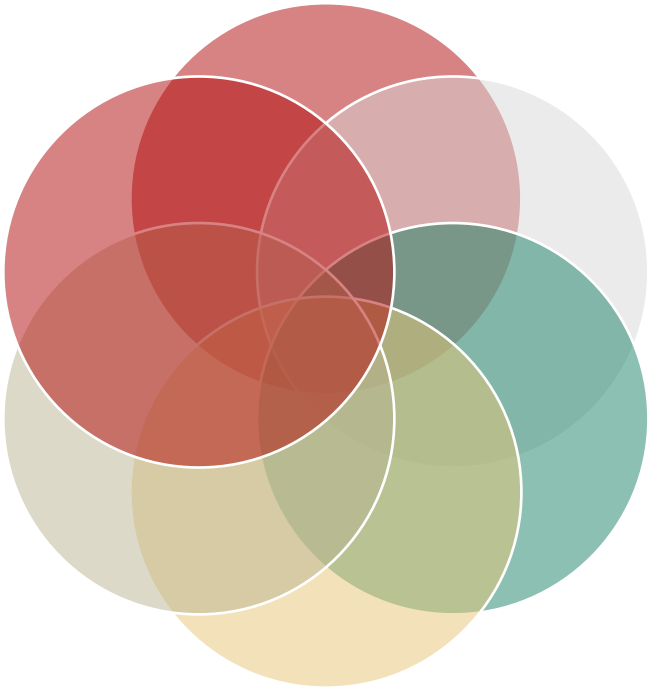
Simulating claims and assessing risk

# Scope – Why are we looking at funeral microinsurance?

**Regulatory definition of micro insurance**

**Lack of RBC**

**Life vs non-life?**



**Novel risks**

**Smaller portfolios?**

**Short term → more fluctuation risk than trends risk**

# Why use reinsurance?

## (and some myth busting)

# Why use reinsurance?

## Great Fellowship exam question

1. Access to underwriting, pricing and claims handling expertise
2. Access to valuation basis benchmarks
3. Skin-in-the-game independent confirmation of product and pricing
4. Provide liquidity / financing for upfront expenses
5. Decrease capital requirements / meet regulatory solvency
6. Decrease risk of failure / probability of ruin
7. Improve Return on Capital
8. Decrease volatility of earnings

Focus on use of reinsurance for optimisation for risk-adjusted performance within risk appetite.

Often 1 in 10 or 20 year measures

*Rather than 1 in 200 or beyond*

# Why use reinsurance?

## (and some myth busting)

# Why use reinsurance?

**MythBusters aside #1**

*I don't want to use reinsurance because I don't want to pay away my profits.*

Reinsurance or return commission can compensate for high expected profit margins in a product.

**MythBusters aside #2**

*Financial Reinsurance can dramatically improve solvency by increasing assets without increasing liabilities.*

A net increase or decrease in NAV from FinRe is a red flag for inappropriate accounting or regulatory treatment.

**Do not get accounting or regulatory advice from the person who is selling you a structure.**

**MythBusters aside #3**

*FinRe has no benefit under IFRS17 and SAM because you have to show a liability.*

FinRe can provide significant financing / liquidity as well as risk transfer (lapse and/or claim risk resulting in decrease in SCR) and can be an appropriate tool.

# Why use reinsurance?

**MythBusters aside #4**

*Reinsurance can "smooth" earnings between periods.*

Reinsurance can decrease the volatility of earnings but generally cannot smooth earnings between years by mis-allocating premiums/claims between periods.

**MythBusters aside #5**

*My mortality basis was set with input from reinsurers. It must be appropriate.*

Getting input on basis from a reinsurer is generally useful.

**I have seen mortality bases need to be changed by up to 50% within 5 years due to mis-estimation by reinsurers.**

**MythBusters aside #6**

*Profit share / profit commission / sliding-scale commission can get me significant capital benefits at low cost.*

Profit commission has a place when insurer and reinsurer cannot agree on expected experience.

**However, serious care is required to make sure the structure doesn't overstate the actual risk transfer and impact on decreasing volatility of earnings or regulatory / economic capital requirements.**

# Microinsurance capital vs Life insurance Return on Capital

# Model inputs and assumptions

| | Values | Notes |
|---|---|---|
| Policy term | 1 year | |
| Gross Premium | 100 | Annual premium value paid over the year |
| Gross Claims | (50) | Base scenario: qx = 1% and SA = 5,000<br>Reasonable if slightly high implied claim ratio compared to typical experience. |
| Expenses | (25) | Incurred over the 1 year term |
| Commission | (13) | Incurred over the 1 year term<br>(Can get different results if commission is upfront and not clawed back.) |
| Profit | 12 | Ignoring tax + reinsurance (for now)<br>Results in a negative BEL of 12 at inception or negative 6 on average over policy term |
| Other assumptions | | • No lapses (simplification, but mass lapse still considered. Mass lapse dynamically linked to BEL and profit and changes in qx)<br>• Assets = 50 invested in spread of bank deposits<br>• (Drives small amount of market risk)<br>• IFRS17 has no impact (this is true, not really an assumption)<br>• FSI & FSM SCR constant over the year (N=1 simplification) |

# FSM SCR vs FSI SCR initial results

| qx | FSM SCR [A] | FSI SCR [B] | FSM SCR / FSI SCR A / B |
|---|---|---|---|
| | | | |
| | | | |
| 1.00% | 15 | 27 | 56% |
| | | | |
| | | | |
| | | | |
| | | | |

# FSI SCR depends on qx – but what is the pattern?

| qx | FSM SCR [A] | FSI SCR [B] | FSM SCR / FSI SCR A / B |
|---|---|---|---|
| 0.50% | 15 | 27 | 56% |
| 0.75% | 15 | 26 | 57% |
| **1.00%** | **15** | **27** | **56%** |
| 1.25% | 15 | 28 | 54% |
| 1.50% | 15 | 29 | 52% |
| 1.75% | 15 | 30 | 50% |
| 2.00% | 15 | 32 | 48% |

# FSI SCR pattern is complex and requires unpacking

| qx | FSM SCR [A] | FSI SCR [B] | FSM SCR / FSI SCR A / B | FSI mortality risk | FSI Cat risk | FSI Mass Lapse Risk |
|---|---|---|---|---|---|---|
| 0.50% | 15 | 27 | 56% | 4 | 11 | 15 |
| 0.75% | 15 | 26 | 57% | 6 | 14 | 10 |
| **1.00%** | **15** | **27** | **56%** | **8** | **16** | **5** |
| 1.25% | 15 | 28 | 54% | 9 | 18 | - |
| 1.50% | 15 | 29 | 52% | 11 | 18 | - |
| 1.75% | 15 | 30 | 50% | 13 | 18 | - |
| 2.00% | 15 | 32 | 48% | 15 | 18 | - |

# How do TPs affect the overall capital required?

| qx | FSM SCR [A] | FSI SCR [B] | FSM SCR / FSI SCR A / B | FSI BEL at inception [C] | FSI capital required to cover SCR and average TPs B + C/2 = [D] | FSM SCR / FSI capital required A / D |
|---|---|---|---|---|---|---|
| 0.50% | 15 | 27 | 56% | (37) | 8 | 178% |
| 0.75% | 15 | 26 | 57% | (25) | 14 | 108% |
| **1.00%** | **15** | **27** | **56%** | **(12)** | **21** | **72%** |
| 1.25% | 15 | 28 | 54% | 1 | 28 | 53% |
| 1.50% | 15 | 29 | 52% | 13 | 36 | 42% |
| 1.75% | 15 | 30 | 50% | 26 | 43 | 35% |
| 2.00% | 15 | 32 | 48% | 38 | 51 | 30% |

# Introducing reinsurance to capital requirements

# Model inputs and assumptions

| | Description |
|---|---|
| Reinsurance type | Quota Share |
| Reinsurance commission | Priced to provide 10% margin for reinsurer for expenses and profit |
| Reinsurer credit rating | AAA<br>(to simplify CPD capital on FSI SCR – actually assumed to be risk-free) |
| Target SCR Cover | 1.5x |

# Profitability with reinsurance (e.g. 40% QS)

| | Values | Notes |
|---|---|---|
| Gross Premium | 100 | |
| Reinsurance Premium | (40) | 40% Quota Share Premium |
| Reinsurance Commission | 16 | Claims Ratio = 50%<br>10% Margin for profit and expenses<br>→ 40% reinsurance commission<br>40% * 40 premium = 16 reinsurance commission |
| Gross Claims | (50) | |
| Reinsurance Recoveries | 20 | 40% of 50 gross claims = 20 reinsurance recoveries |
| Expenses | (25) | unchanged |
| Commission | (13) | unchanged |
| Profit | 8 | Reduced from 12 by 4 = 10% margin for expenses and profit on 40 premium |
| | | |

# Implications for return on capital

| % ceded | Profit [A] | FSM SCR [B] | FSI SCR [C] | FSM SCR / FSI SCR B/C | FSM Profit / target SCR A / (1.5*B) | FSI Profit / target SCR and OF A / (1.5*C + TP/2) |
|---|---|---|---|---|---|---|
| 0% | 12.0 | 15.0 | 26.7 | 56% | 53% | 35% |
| 20% | 10.0 | 12.0 | 22.6 | 53% | 56% | 35% |
| 40% | 8.0 | 9.0 | 18.5 | 49% | 59% | 34% |
| 60% | 6.0 | 6.0 | 14.5 | 41% | 67% | 32% |
| 80% | 4.0 | 3.0 | 10.8 | 28% | 89% | 28% |
| 100% | 2.0 | - | 8.0 | 0% | ∞ | 18% |

**Increasing reinsurance:**  

# Conclusions on using capital and return on capital

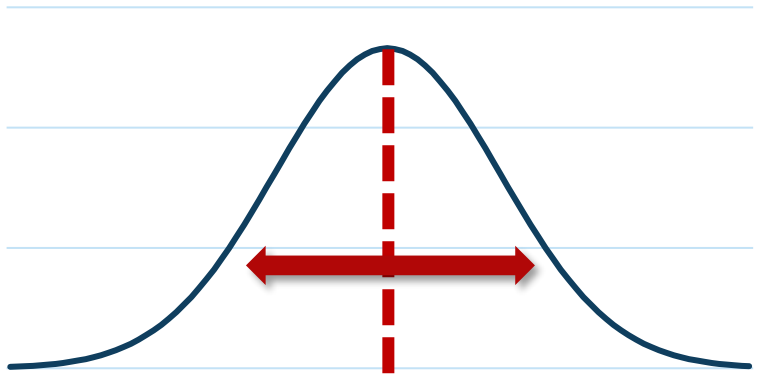
- Is 15% of NWP a reasonable measure of capital?
- What is the benchmark for an appropriate methodology?
- Is the reduction in FSM SCR from reinsurance appropriate?
- At what point must HAF say that the capital requirement isn't appropriate?
- Is the FSM SCR an appropriate measure to determine reinsurance needs?
- What counts as adequate reinsurance?

# Types of claims risk

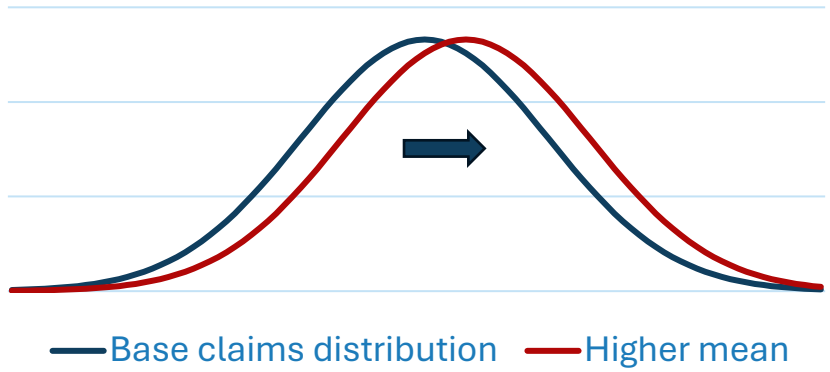
# Types of claims risk / causes of variability in claims

1. Incorrect best estimate assumption on the level of claims
2. Changes in the trend
3. Pandemics or other catastrophes
4. **Statistical fluctuation?**

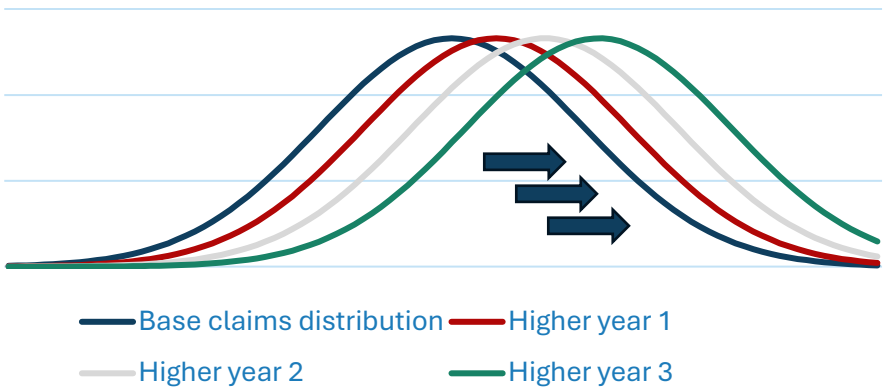
Claims distribution PDF



Claims PDF - Incorrect mean



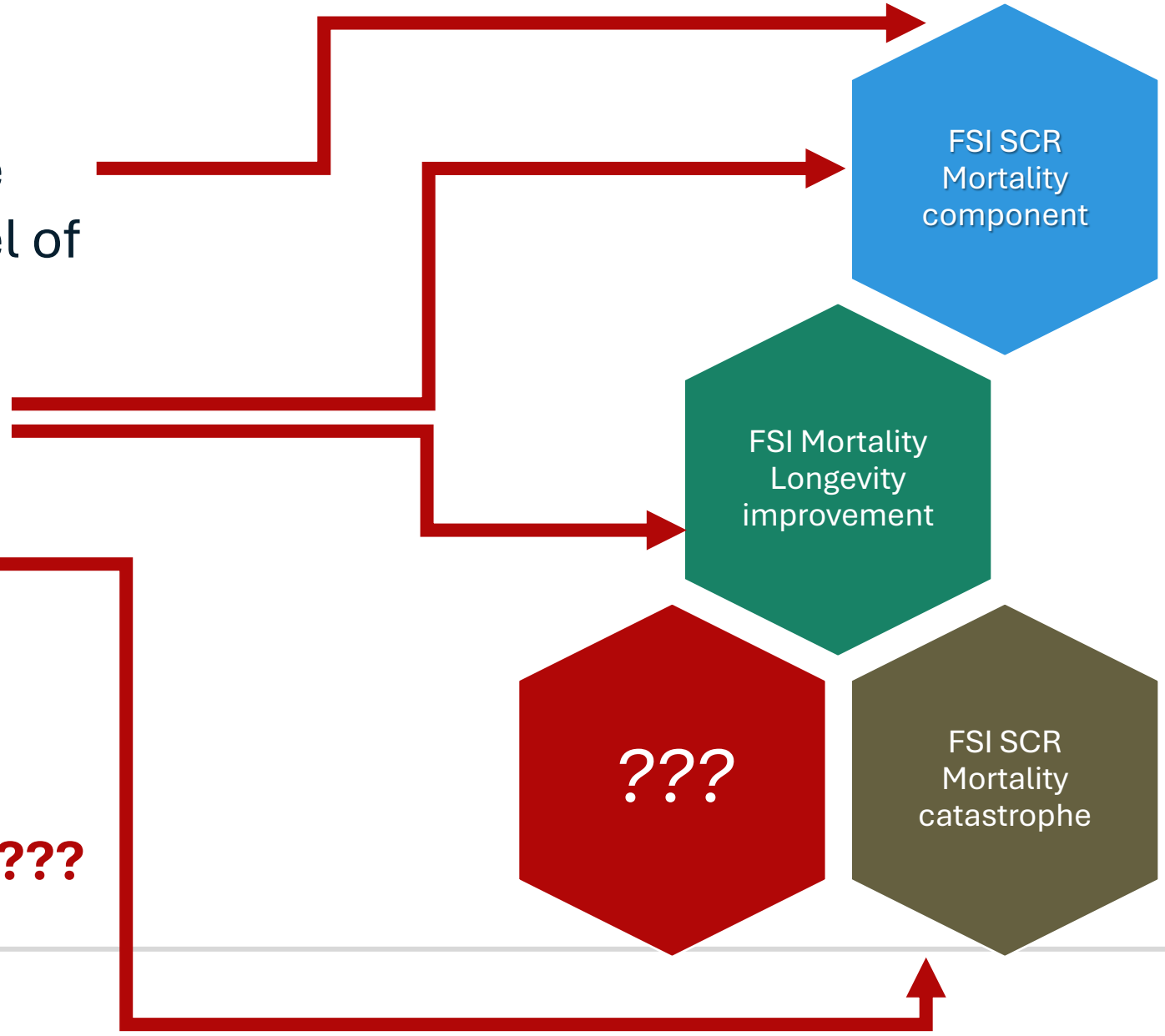

Claims PDF - trending




Claims PDF including catastrophe

# FSI Standard Formula doesn't cater for statistical fluctuation

1. Incorrect best estimate assumption on the level of claims
2. Changes in the trend
3. Pandemics or other catastrophes
4. **Statistical fluctuation???**

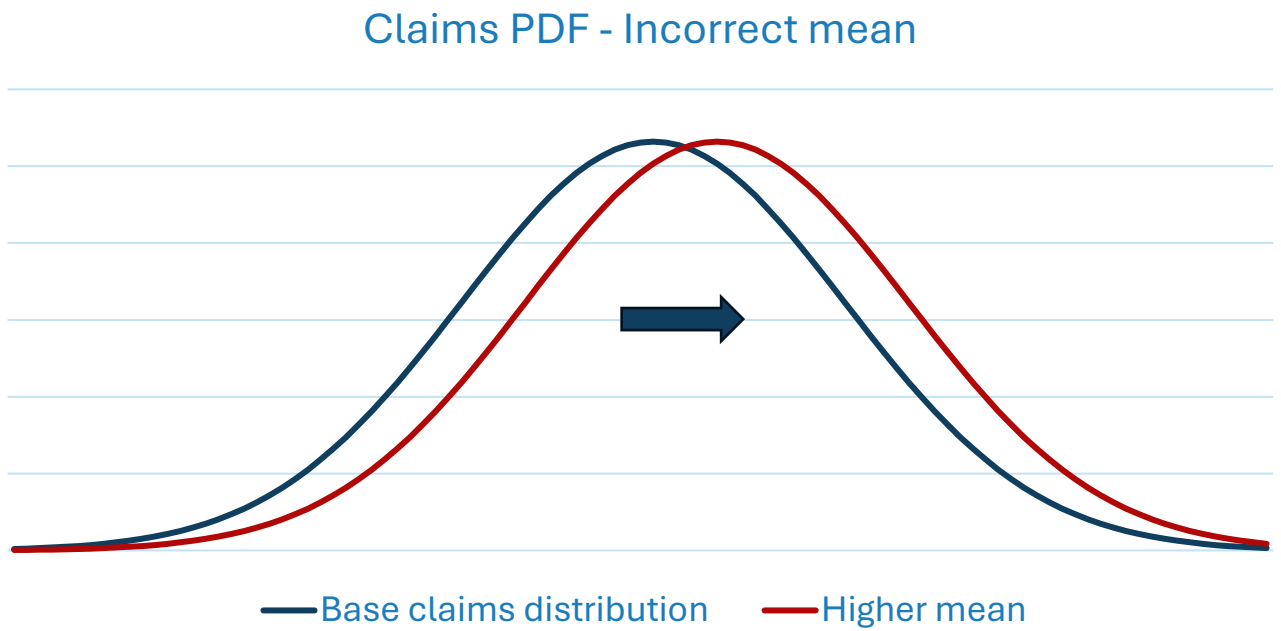


# 1. Incorrect best estimate mean

## Approximating 1 in 10 risk from standard formula

- Familiar process from determining IFRS17 Risk Adjustment
- Standard Formula specifies 1 in 200 stress of 15%
- Fit normal / lognormal model to this indicates 1 in 10 stress is around 7.5%

| Percentile | Approximate mortality stress implied from FSI Standard Formula |
|---|---|
| 75th | 4% |
| 85th | 6% |
| 90th | 7.5% |
| 95th | 10% |



# Dealing with each of the four components of mortality risk

1. Incorrect best estimate assumption on the level of claims
2. Changes in the trend
3. Pandemics or other catastrophes
4. Statistical fluctuation

Approximate with standard formula

Exclude based on short term view

Assume no catastrophe within return period (1 in 10)

Focus on this next

# 4. Statistical Fluctuation

## What distribution do claims follow?

- Perhaps a large population of lives
- Constant, uniform probability of death qx
- i.i.d.

- Implies a binomial distribution
  - Mean $Nq_x$
  - Variance $Nq_x(1-q_x)$
  - (Might be more used to Np and Npq but here we have q for mortality)
- Or Poisson (close approximation since $q_x$ is small)
  - mean $\lambda = Nq_x$
  - Variance $\lambda = Nq_x$
- Or Normal approximation to Binomial with same mean and variance

FAIL!

Go directly to jail.
Do not pass statistics.
Do not collect your degree.

# i.i.d.

Homogenous grouping

GLMs

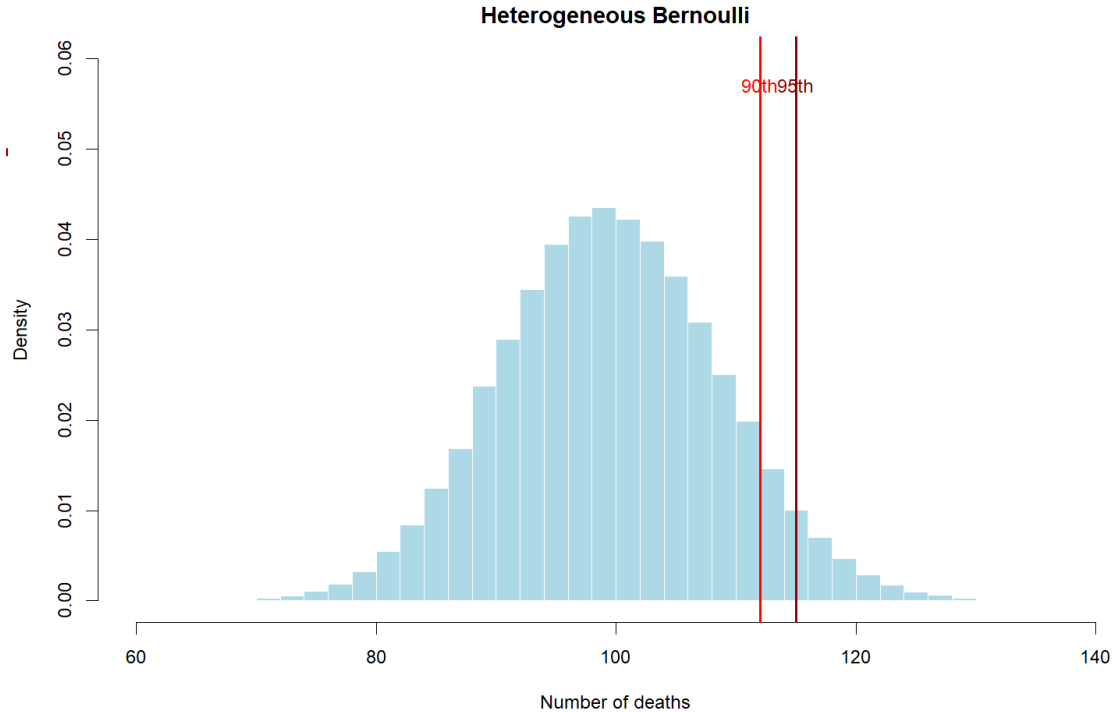
Quantile Regression

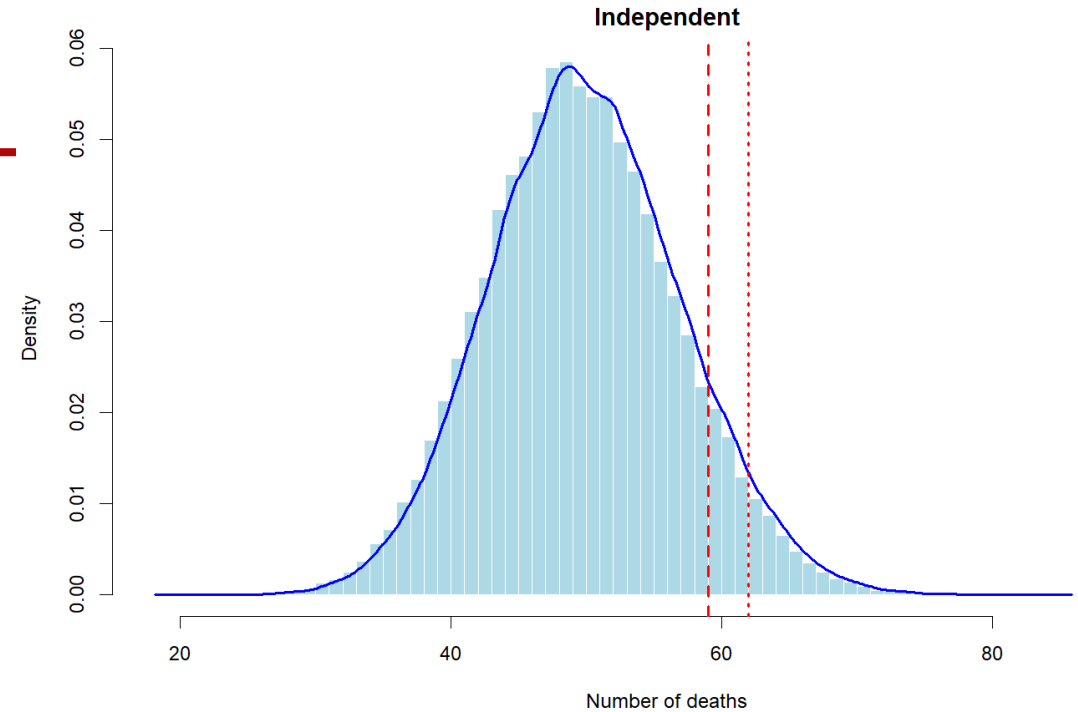
Mixed Effect Models

Fitting appropriate distribution

## Independent and identically distributed

- Lives with different age, gender, smoking status, SEC, duration in force, distribution channel, province, environmental exposures, genetic predisposition, family history, access to healthcare, employment status, industry, credit score, diet, exercise habits and alcohol consumption, marital status, education level, vaccination status, travel habits, length of commute,
- Sum Assured adds significant additional volatility and dependence (aside from potential skew to the mean)
- Geographic clustering (work or home), family structure, multiple policies, seasonal temperatures, seasonal flu, disruptions in healthcare, may create dependence between risks


Heterogeneous Bernoulli
90th
95th
Density
0.00
0.01
0.02
0.03
0.04
0.05
0.06
60
80
100
120
140
Number of deaths


Independent
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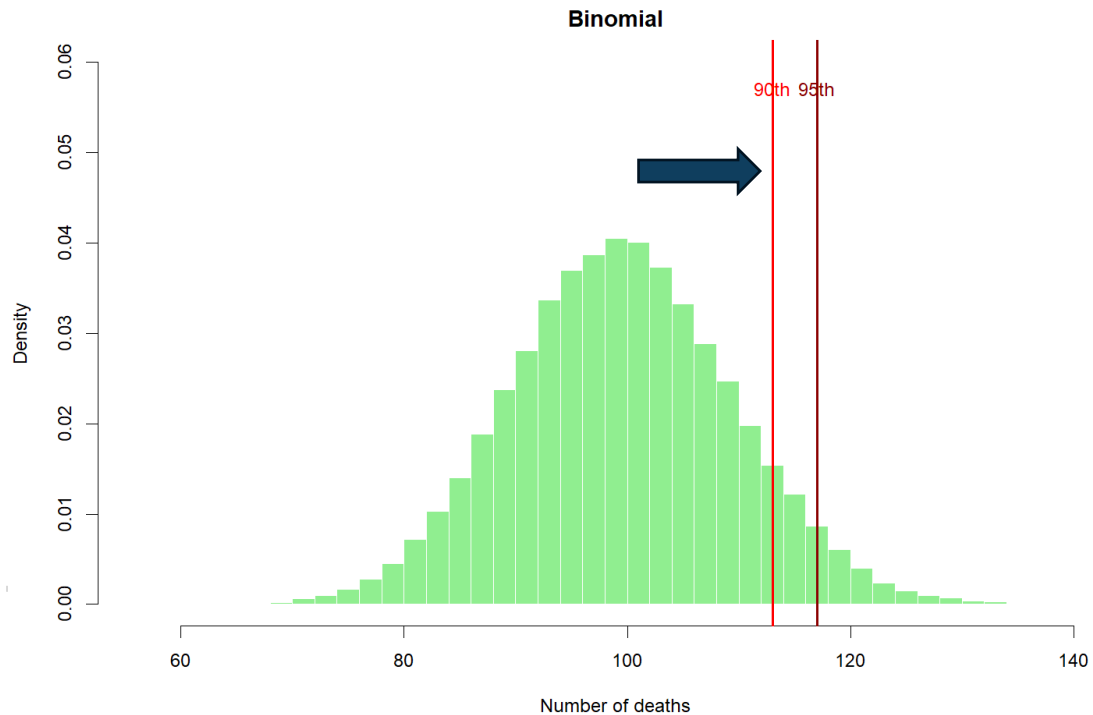
Number of deaths


Binomial
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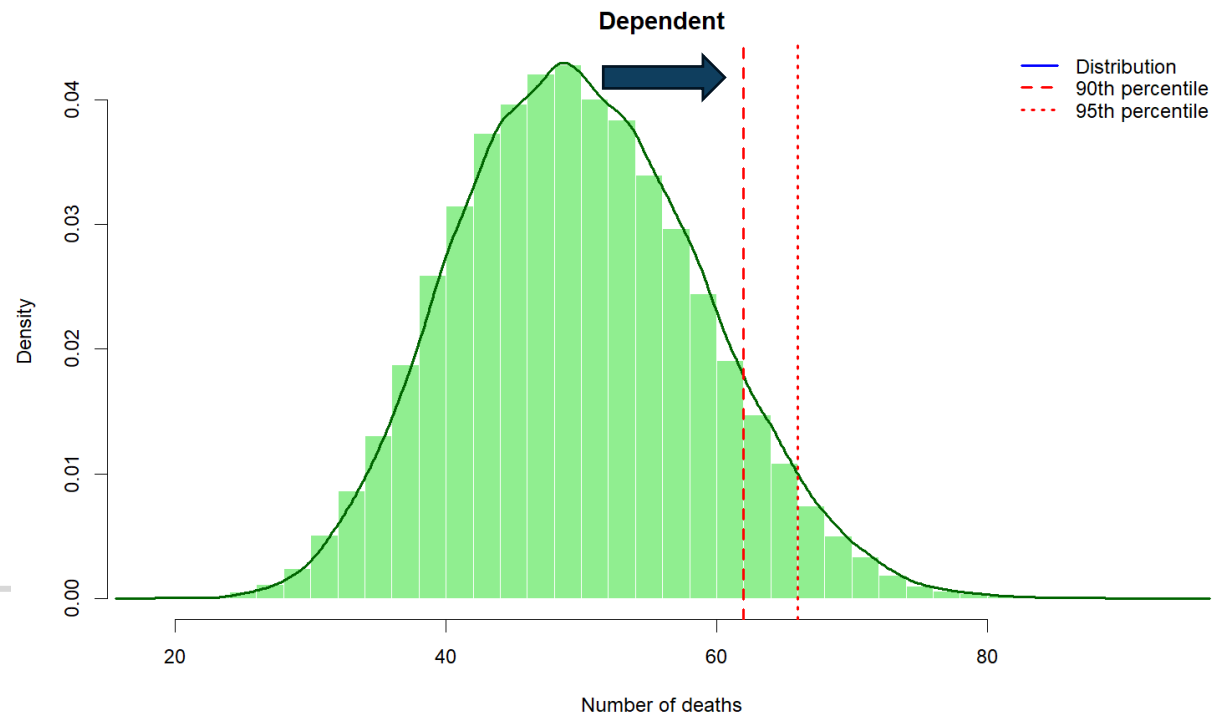

Dependent
Distribution
90th percentile
95th percentile
Density
0.00
0.01
0.02
0.03
0.04
20
40
60
80
Number of deaths

# Fitting distributions to claims experience

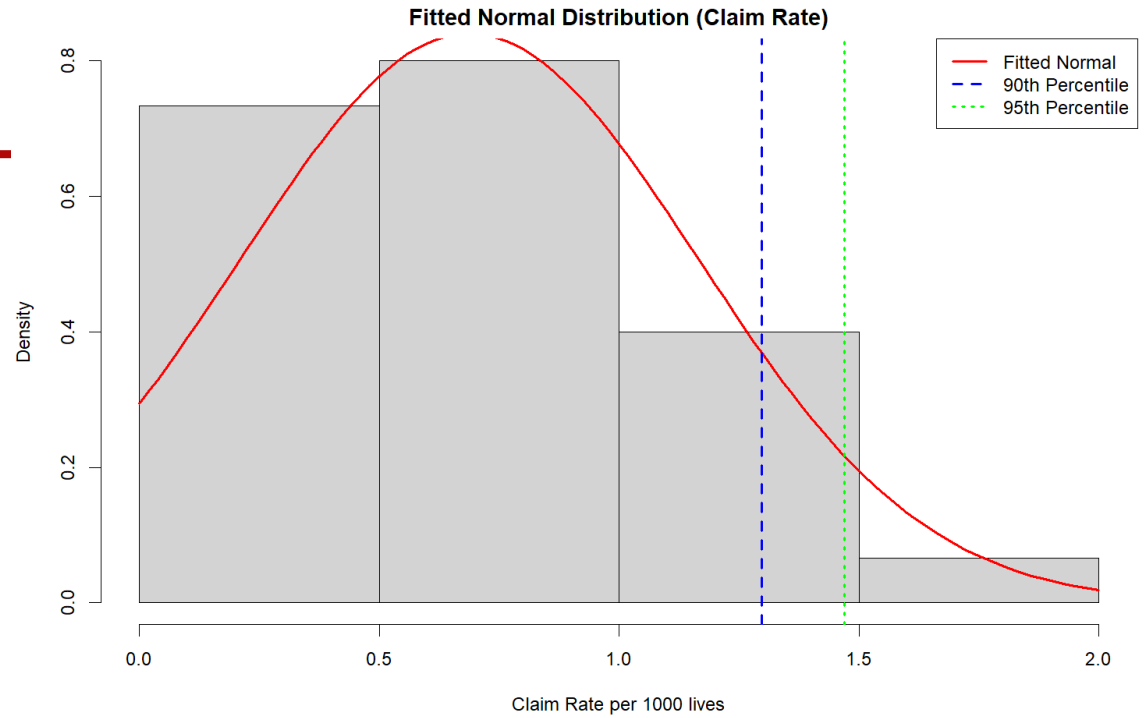
# Theoretical consideratons on modelling statistical fluctuation

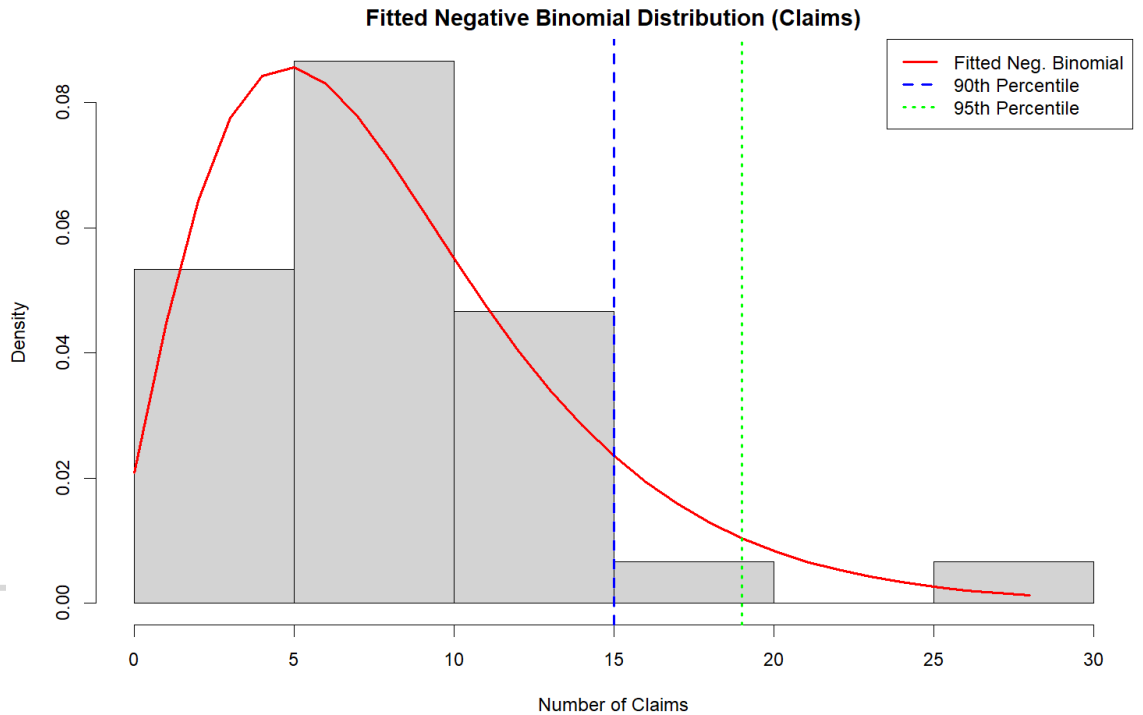
1. Recognise data likely not i.i.d.
2. Analyse data directly to evaluate heterogeneity and dependence
    - Summary statistics, histograms
3. Consider homogenous grouping and GLMs
    - especially if exposure is changing over time
4. Simpler approach is to fit distribution to the overall data
    - Monthly or quarterly depending on volume
    - More data points better
    - Consider Normal, Negative Binomial, Student's T et al
5. Can also consider Quantile Regression to directly estimate the ($90^{th}$) percentile

# Simple example using real data

- Around 10,000 average lives exposed per month
- Around 30 months of exposure and deaths
- Approximately 8 deaths on average per month
- Fit Normal (Shapiro-Wilk test p-value: 0.29)
- Fit Negative Binomial (Chi-square test p-value: 0.24)

| Monthly Measures | Normal | Negative Binomial |
|---|---|---|
| Mean | 0.7 | 8.1 |
| Standard Deviation | 0.5 | 5.5 |
| 90th Percentile Stress | 88% | 86% |
| 95th Percentile Stress | 114% | 136% |



# Annualise…

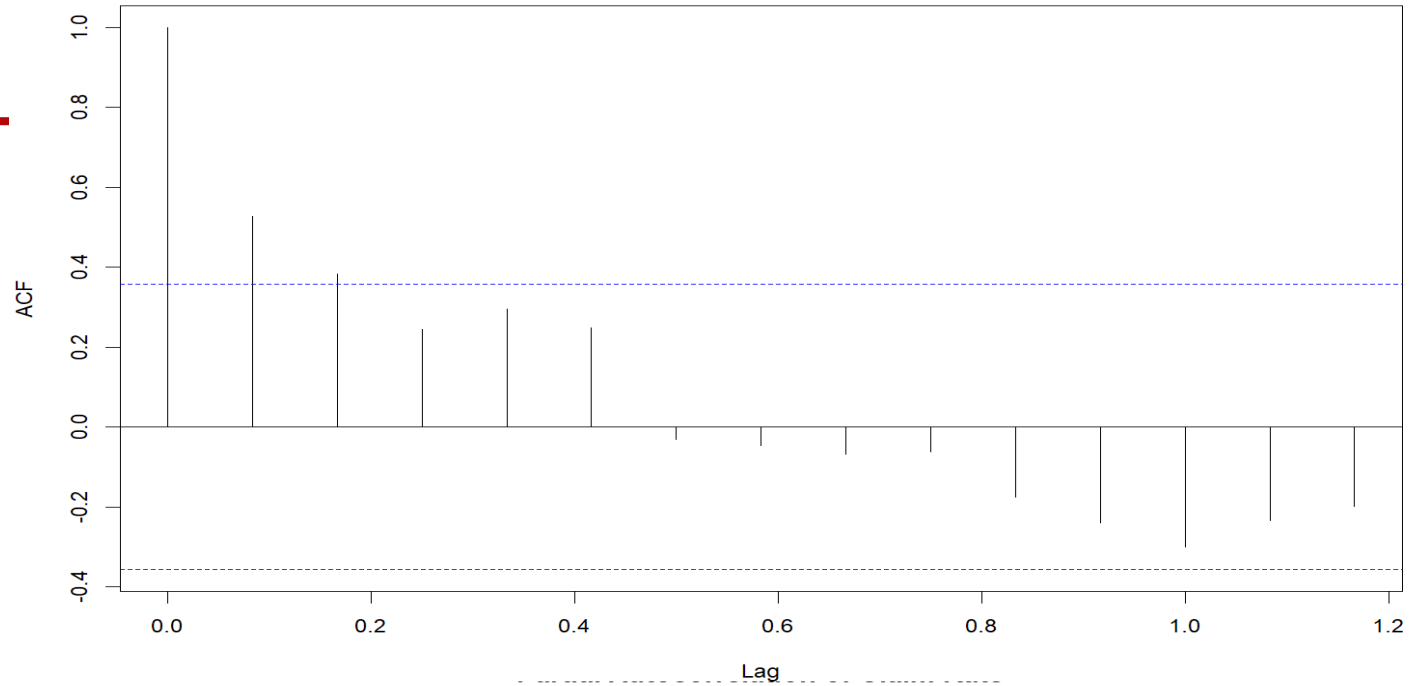
- Working with monthly data
- Require an annual stress?
- Need to assume something about dependence between months
- Should evaluate the extent of time independence
- Here independence is assumed to annualise monthly stresses

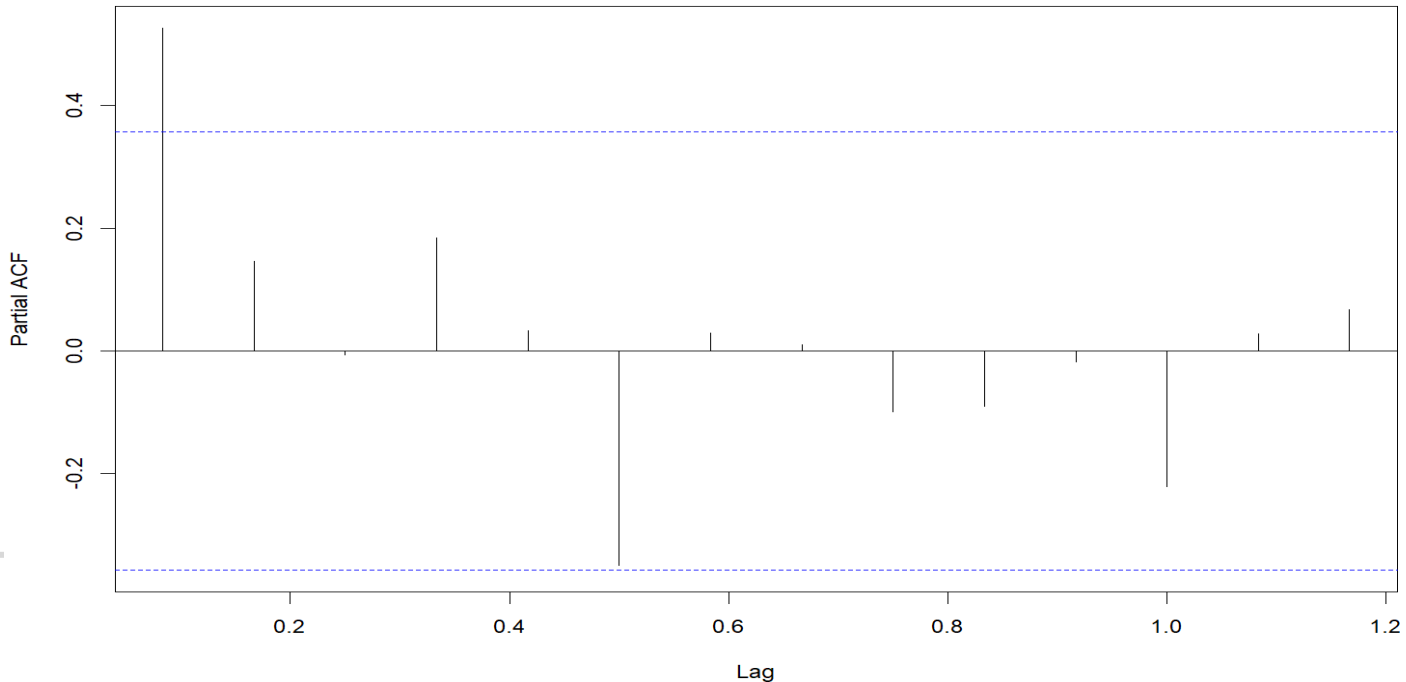
| Monthly Measures | Normal | Negative Binomial |
|---|---|---|
| Mean | 0.7 | 8.1 |
| Standard Deviation | 0.5 | 5.5 |
| 90$^{th}$ Percentile Stress | 88% | 86% |
| 95$^{th}$ Percentile Stress | 114% | 136% |

| Annual Measure | Normal | Negative Binomial |
|---|---|---|
| Mean | 8.3 | 96.8 |
| Standard Deviation | 10.4 | 122.0 |
| **90$^{th}$ Percentile Stress** | **26%** | **26%** |
| 95$^{th}$ Percentile Stress | 33% | 34% |

# Complication!

- ACF (top)
- PACF(bottom)
- Suggest AR(1) time series process
- Annual stresses derived assuming independence will **understate** the risk.



# Simulating claims and assessing risk

## Combining risks for 1 in 10 Earnings Stress

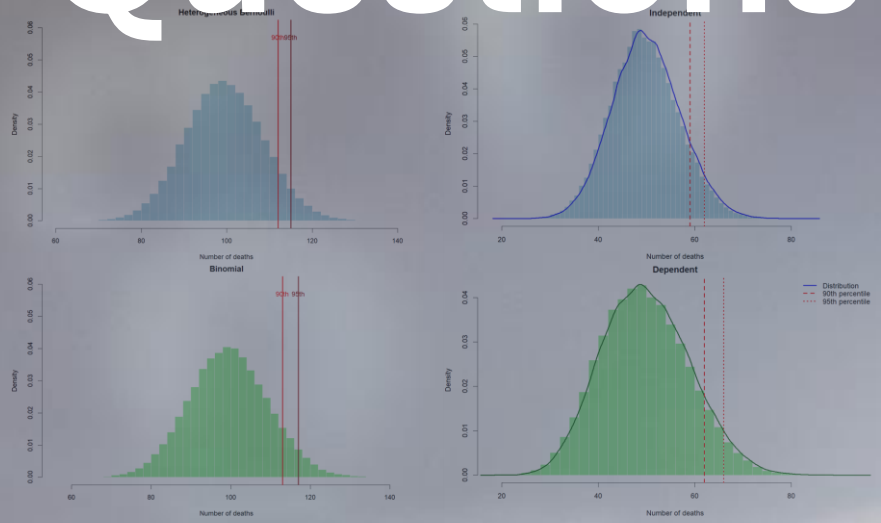
- Interpretation *[JUST AN EXAMPLE – YMMV]*
- Could expect claims for this portfolio to be 33% to 35% higher than expected once every ten years Excluding catastrophes
- Assuming composition of portfolio similar (no GLM applied here)

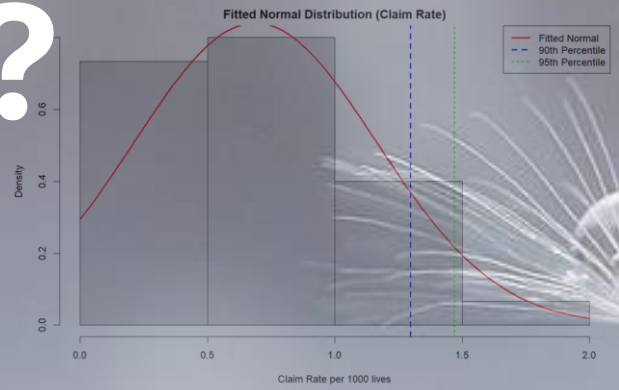
**R500k average SA & 10,000 lives covered ~ R15m 1 in 10 year hit to earnings. Compare to Risk Appetite to determine reinsurance needs.**

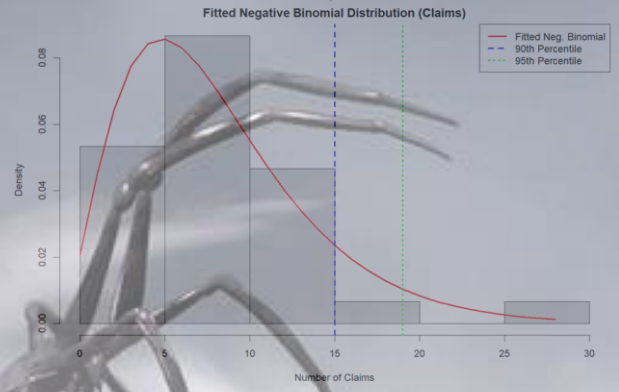
## Conclusions

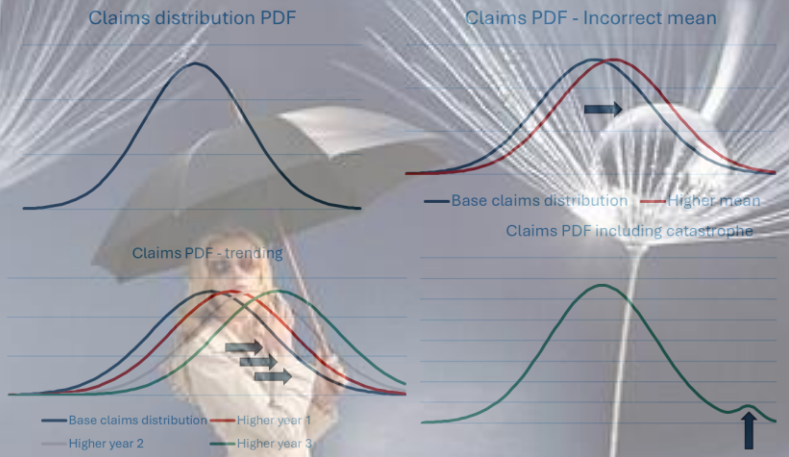
1. Careful relying on the FSM capital requirement to assess risk or risk-adjusted returns
2. Not only applicable to microinsurance
3. Sources of fluctuation in claims – and product term and portfolio size
4. Analyse your own data & watch implicit assumptions
5. Careful of assuming i.i.d. and independence over time
6. Think about changes in the composition of the portfolio over time
7. Are your ORSA scenarios too gentle?
8. Consider whether the standard formula is appropriate for short boundary business where fluctuation risk likely greater than best estimate uncertainty
9. Dust off your statistics textbooks and update your R packages

# Questions?




### Implications for return on capital

| % ceded | Profit [A] | FSM SCR [B] | FSI SCR [C] | FSM SCR / FSI SCR B/C | FSM Profit / target SCR A / (1.5*B) | FSI Profit / target SCR and OF A / (1.5*C + TP) |
|---|---|---|---|---|---|---|
| 0% | 12.0 | 15.0 | 26.7 | 56% | 53% | 35% |
| 20% | 10.0 | 12.0 | 22.6 | 53% | 56% | 35% |
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| 80% | 4.0 | 3.0 | 10.8 | 28% | 89% | 28% |
| 100% | 2.0 | - | 8.0 | 0% | ∞ | 18% |

Increasing reinsurance: ↗ ↘

| Annual Measure | Normal | Negative Binomial |
|---|---|---|
| Mean | 8.3 | 96.8 |
| Standard Deviation | 10.4 | 122.0 |
| **90th Percentile Stress** | **26%** | **26%** |
| 95th Percentile Stress | 33% | 34% |

7.5% stress to best estimate parameter for risk of mis-estimated mean

26% stress (for this portfolio) for statistical fluctuation risk

Combine assuming these risks are independent

33.5%

Compare with varying levels of reinsurance to your risk appetite