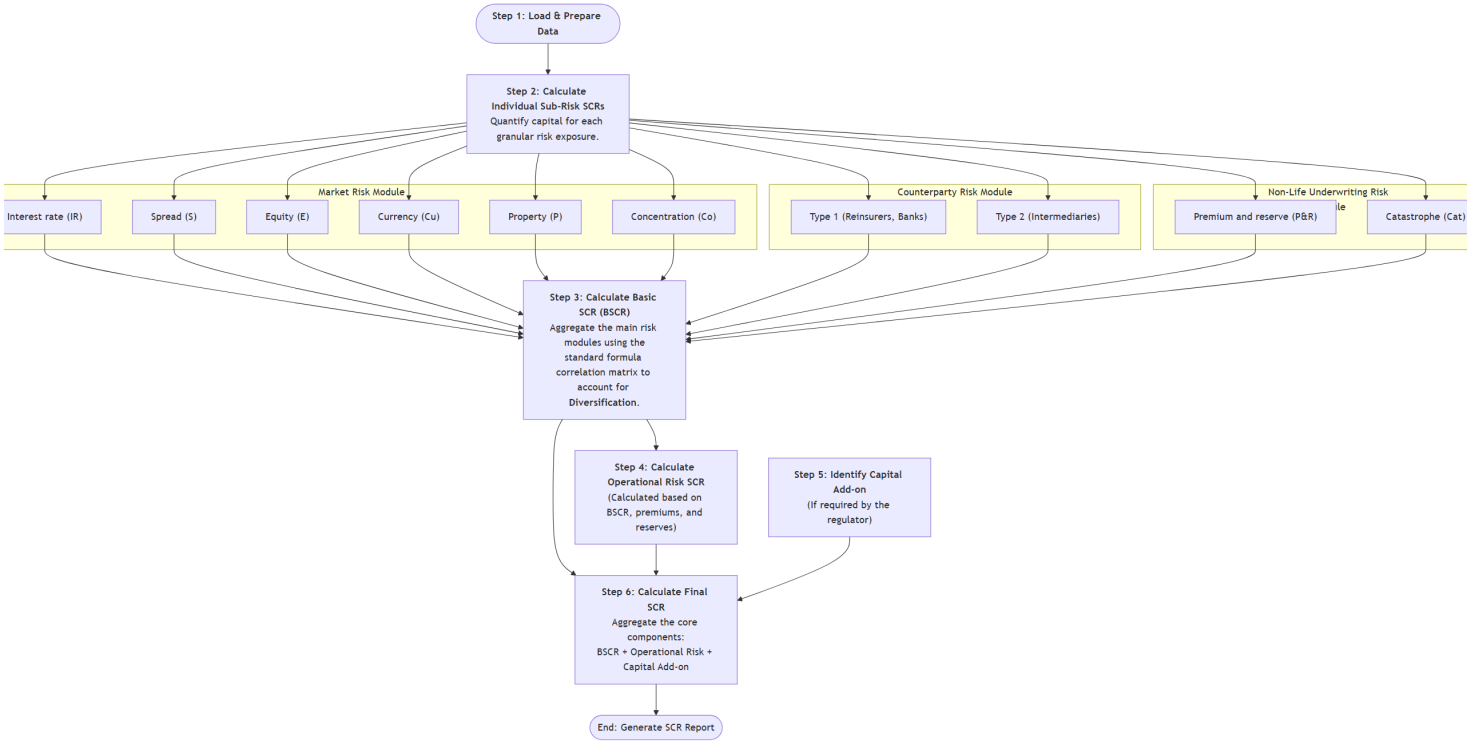
Methodology



1. Data Inputs from MI Pack

Extract the necessary starting figures from the MI pack's Balance Sheet and Profit & Loss files.

- **From the Balance Sheet:**
  - **Total Investments:** The starting value for all investment assets.
  - **Cash at Bank:** The total cash holdings.
  - **Reinsurance Recoverables:** The total expected recoveries from reinsurers, which is the best estimate of reinsurance technical provisions.
  - **Technical Provisions (Gross and Net):** The value of Mulsanne's liabilities to policyholders.
  - **Receivables from Intermediaries:** Needed for Type 2 counterparty risk.
- **From the Profit & Loss:**
  - **Gross Earned Premium (Current & Prior Year):** Needed to calculate operational risk and the premium volume measure for underwriting risk.
  - **Net Written Premium:** Used in the calculation of the Minimum Capital Requirement.

2. Modelling Process: Calculating the SCR Modules

The core of the model involves calculating a capital charge for each major risk category. The total of these, after allowing for diversification, forms the Basic Solvency Capital Requirement.

Market Risk Module

This module quantifies the risk of loss from movements in financial market variables. Will need detailed asset breakdown from the Mulsanne manual (the MI pack only has totals).

- **Interest Rate Risk:**
  - **What happens:** The model calculates the impact of a sudden change (up and down) in the term structure of interest rates on the company's net assets (Assets - Liabilities).
  - **Inputs:**
    - Asset cash flows from bonds and loans (from Mulsanne's asset list).
    - Net liability cash flows (derived from **Technical Provisions** in the MI pack, distributed over time using the payment patterns in the Mulsanne manual).
  - **Calculation:** The model re-values all interest-rate-sensitive assets and liabilities by applying prescribed stresses to the entire **risk-free yield curve**. These stresses are **maturity-dependent**, meaning the shock applied to the 1-year interest rate will be different from the shock applied to the 10-year rate, reflecting changes in the term structure of interest rates. The model calculates the change in net asset value under both a "shock up" and "shock down" scenario, and the SCR is the larger of the two resulting losses.
- **Spread Risk:**
  - **What happens:** Calculates the risk of loss from credit spreads widening on bonds and loans.
  - **Inputs:** The list of bonds, mortgages, and loans from Mulsanne's asset list, along with their duration and credit rating.
  - **Calculation:** For each asset, the SCR is `Market Value × Duration × Risk Factor (based on rating)`. Unrated assets with a duration under 5 years use a 3% risk factor.
- **Equity Risk:**
  - **What happens:** Calculates the risk of loss from a fall in equity prices.
  - **Inputs:** The list of equity holdings from the Mulsanne manual's asset list.
  - **Calculation:** The model applies a downward shock to the value of each equity holding. The base shock depends on the equity type:
    - **22%** for approved **strategic investments**.
    - **39%** for **Type 1** equities (defined as those listed in developed markets).
    - **49%** for **Type 2** equities(defined as equities in emerging markets and private equity).

    These base shocks are then modified by a **symmetric adjustment**. This is a regulatory mechanism that adjusts the shock up or down (typically within a +/- 10% range) based on recent market performance to reduce pro-cyclicality. For the December 2024 calculation, the symmetric adjustment was **+3.06%**, which increased the final shocks applied. The final capital charge for each equity is calculated using these adjusted shocks, and the results are then combined using a correlation formula to determine the overall equity risk SCR: `SCR_equity = SQRT( (SCR_type1)² + (SCR_type2)² + 2 * 0.75 * SCR_type1 * SCR_type2)`, where:

        - **SCR_type1**: The total capital charge for all **Type 1** equities.
        - **SCR_type2**: The total capital charge for all **Type 2** equities.
- **Currency Risk:**
    - **What happens:** Calculates the risk of loss from adverse foreign exchange rate movements.
    - **Inputs:** The value of assets and liabilities denominated in foreign currencies (USD assets from Mulsanne's list) and the value of any hedges like forward contracts.
    - **Calculation:** The SCR is **25%** of the net exposure (Assets - Liabilities - Hedges) in each currency.
- **Concentration Risk:**
    - **What happens:** Calculates the risk of being over-exposed to a single issuer of bonds or equity.
    - **Inputs:** The full list of investment assets.
    - **Calculation:** The model identifies all exposures to a single counterparty that exceed a prescribed threshold. The threshold depends on the type of exposure:
        - **3.0%** of in-scope assets for **rated** credit and loan exposures.
        - **1.5%** of in-scope assets for **unrated** credit and loan exposures.
          The Mulsanne manual focuses on the **1.5%** threshold as the "majority" of its relevant assets are unrated. For each exposure that exceeds its applicable threshold, a capital charge is calculated on the excess amount. These individual charges are then aggregated using a formula to arrive at the final concentration risk SCR2: $SCR_{conc} = \sqrt{\sum (Conc_i)^2}$, where:
        - $Conc_i$ is the capital requirement calculated for a single counterparty i (i.e., the charge on the excess exposure over the threshold).
        - **Σ** represents the sum across all counterparties that have a concentration charge. This formula assumes that the default of one over-exposed counterparty is uncorrelated with the default of another.

Counterparty Default Risk Module

This module quantifies the risk of loss if a third party defaults on its obligations.

- **Type 1 Risk (Reinsurers & Banks):**
    - **What happens:** This module calculates the risk of loss from the default of high-quality counterparties. This includes **reinsurers** failing to pay their share of claims and **banks** holding the company's cash failing.
    - **Inputs:**
        - **Reinsurance Recoverables:** The amount due from each reinsurer, as listed in the Mulsanne manual.
        - **Cash at Bank:** The amount of cash held at each banking institution.
        - **Risk Mitigation Effect:** The amount by which the reinsurance program reduces the company's underwriting SCR. This is calculated as the difference between the

gross and net underwriting SCR.

- **Calculation:**
  The model calculates a Loss-Given-Default (LGD) for each counterparty, which is then multiplied by a probability of default based on their credit rating. The LGD calculation differs for reinsurers and banks.
  - **For Reinsurers:** The LGD calculation accounts for both the money owed and the loss of risk protection.
    - **Formula:** `LGD = max[50% × (Recoverables + 50% × RM_re) - Collateral, 0]`.
    - `Recoverables` is the amount owed, and `RM_re` is that reinsurer's share of the risk mitigation effect.
  - **For Banks:** The calculation is more straightforward. The LGD is **100%** of the cash exposure to the bank.

- **Type 2 Risk (primarily Intermediaries):**

  - **What happens:** Calculates the loss if intermediaries (brokers) fail to pay the premiums they've collected.
  - **Inputs: Receivables from intermediaries** from the MI pack. As detailed below, an aging analysis is also required.
  - **Calculation:** The SCR is `90%` of receivables overdue by more than 3 months plus `15%` of other receivables.

  Note: **Type 2 Counterparty Risk** requires receivables to be split into two groups:

  - Receivables from intermediaries that are **overdue by more than 3 months**.
  - All other Type 2 exposures (including receivables due within three months).

  The MI pack's BS provides a single, total figure for "Amounts due from Intermediaries". It does not contain the aging breakdown necessary to apply the different risk weightings (90% for overdue, 15% for others). The manual confirms that this data is sourced separately, stating, "A periodical aging debtors study is received to calibrate which debtors are or not on credit terms".

Non-Life Underwriting Risk Module

This module quantifies the risk that premiums and reserves are not sufficient to cover future claims.

- **Premium & Reserve Risk:**
  - **What happens:** This is the core underwriting risk, covering volatility in claims.
  - **Inputs:**
    - **Net Technical Provisions** from `BS`.
    - **Gross Earned Premium** (from `PL`) from the last 12 months.
    - **Forecasted Earned Premium** for the next 12 months.

- Calculation:
  The SCR is calculated as `3 × σ × V`. The two key components, the volume measure (**V**) and the standard deviation (**σ**), are determined as follows:
  - **Volume Measure (V):** This measure is calculated **net of reinsurance** and is the sum of a premium component and a reserve component.
    - The **premium component** is the **larger of** the **forecasted earned premiums** for the next 12 months or the **actual earned premiums** from the last 12 months.
    - The **reserve component** is the value of the **net discounted claims provisions**.
  - **Standard Deviation (σ):** This factor is **prescribed by the Solvency II regulations** for each line of business; it is not a discretionary choice. The Mulsanne manual shows that the standard `σ` for Motor Vehicle Liability of 10% is adjusted down to **8%** because the company has a non-proportional reinsurance program in place, as the rules permit.

- **Catastrophe Risk:**
  - **What happens:** Calculates the risk of a single, large-scale event (natural or man-made) causing significant losses.
  - **Inputs:** This data is **not available in the MI Pack**. It requires specific exposure data, such as the largest sum insured by postal code for motor catastrophe risk.
  - **Calculation:** The model calculates the capital for various perils and aggregates them in three stages. Each stage uses a **square root of the sum of the squares** formula, which assumes the risks being combined are uncorrelated.
    1. **Aggregate Natural Catastrophe Perils:** The individual capital charges for natural catastrophes (e.g., windstorm, flood, earthquake) are combined.
       - **Formula:** `SCR_natCAT = SQRT( Σ (SCR_peril)² )`
    2. **Aggregate Man-Made Catastrophe Perils:** The individual capital charges for man-made catastrophes (e.g., motor, fire, liability) are combined.
       - **Formula:** `SCR_mmCAT = SQRT( Σ (SCR_peril)² )`
    3. **Calculate the Final Catastrophe SCR:** The results from the natural and man-made sub-modules are combined to get the total Catastrophe Risk SCR.
       - **Formula:** `SCR_Cat = SQRT( (SCR_natCAT)² + (SCR_mmCAT)² )`

3. Calculate Basic Solvency Capital Requirement

The BSCR Formula

The standard formula for aggregating these three modules is:

```
BSCR = SQRT(Σi,j Corr(i,j) * SCRi * SCRj)
```

Where:

- **SCRi** and **SCRj** are the capital requirements for the individual risk modules.
- **Corr(i,j)** is the correlation factor between module `i` and module `j`.

The Correlation Matrix

The primary correlation matrix for the Solvency II standard formula is found in **Annex IV of the Solvency II Directive (2009/138/EC)**. This matrix is used to aggregate the capital requirements for the different high-level risk modules when calculating the Basic Solvency Capital Requirement (BSCR).

The standard formula correlation matrix for the main risk modules:

	Market Risk	Default Risk	Life Underwriting Risk	Health Underwriting Risk	Non-life Underwriting Risk
Market Risk	1	0.25	0.25	0.25	0.25
Default Risk	0.25	1	0.25	0.25	0.5
Life Underwriting Risk	0.25	0.25	1	0.25	0
Health Underwriting Risk	0.25	0.25	0.25	1	0
Non-life Underwriting Risk	0.25	0.5	0	0	1

An automotive insurer is a non-life insurer. Its primary risks come from the policies it writes (Non-Life Underwriting Risk), the investments it holds with the premiums it collects (Market Risk), and the potential for its reinsurers or other financial partners to fail (Counterparty Default Risk).

The standard formula also includes **Life Underwriting Risk** and **Health Underwriting Risk**. For a pure automotive insurer, the capital required for these modules would be zero.

	Market Risk	Counterparty Risk	Non-Life UW Risk
Market Risk	1	0.25	0.25
Counterparty Risk	0.25	1	0.50
Non-Life UW Risk	0.25	0.50	1

How to Calculate

1. **Obtain the final capital requirement for each of the three main risk modules**:

- `SCR_Market`
- `SCR_Counterparty`
- `SCR_NL_UW` (Non-Life Underwriting)

2. **Apply the full BSCR formula**:
`BSCR = SQRT( (SCR_Market)² + (SCR_Counterparty)² + (SCR_NL_UW)² + 2*(0.25)*(SCR_Market)*(SCR_Counterparty) + 2*(0.25)*(SCR_Market)*(SCR_NL_UW) + 2*(0.50)*(SCR_Counterparty)*(SCR_NL_UW) )`

The result of this calculation is the **BSCR**, which is then used as an input for calculating the Operational Risk SCR and, ultimately, the Final SCR.

4. Operational Risk Module

This module quantifies the risk of loss resulting from inadequate or failed internal processes, personnel, or systems, or from external events. The calculation is capped relative to the company's overall risk profile (the BSCR).

- **Inputs:**
  - **Gross Earned Premium (current year & prior year):** Sourced from `PL`.
  - **Gross Technical Provisions (non-life):** Sourced from `BS`.
  - **The BSCR:** The diversified sum of the Market, Counterparty, and Underwriting risk modules, calculated in the preceding step of the model.
- Calculation:
  1. **Calculate the Premium-Based Component (`Op_Prem`):** This step calculates a value based on the insurer's earned premiums and its recent growth.
     - **Formula:** `Op_Prem = 3% × GEP_CY + Max[0, 0.3% × (GEP_CY - 1.2 × GEP_PY)]`.
     - This means the model takes **3% of the gross earned premium from the last 12 months** and adds a small additional amount if premium volume has grown by more than 20% compared to the prior year, capturing the operational risk associated with rapid growth.
  2. **Calculate the Provisions-Based Component (`Op_Prov`):** This step calculates a value based on the size of the insurer's technical provisions.
     - **Formula:** `Op_Prov = 3% × Max(0, TP_Non-Life)`.
     - For a non-life insurer, this is **3% of the gross non-life technical provisions**.
  3. **Determine the Final SCR:** The model then combines these values with the BSCR.
     - **Formula:** `SCR_Operational = Min(0.3 × BSCR, Max(Op_Prem, Op_Prov))`.
     - The logic is to first take the **larger** of the premium-based and provisions-based components. This result is then compared to **30% of the BSCR**. The final Operational Risk SCR is the **smaller** of these two figures.

5. Capital Add-on

A capital add-on is an extra amount of capital a regulator can require a firm to hold on top of SCR, done if the regulator believes the standard formula doesn't adequately capture the specific risk profile.

Inappropriateness of the Standard Formula

The regulator determined that the standard formula didn't fully represent the risk of some of Mulsanne's investment assets.

- **Requirement:** A **5% floor** is applied to the capital charge for any asset where the calculated market SCR is less than 5%. This ensures a minimum level of capital is held against these assets.
- **Capital Charge: £1.09m**.

Illiquid Asset Profile

This add-on addresses the risk associated with holding a significant amount of illiquid assets.

- **Requirement:** The regulator has established a charge for holding illiquid assets. The tolerance for these assets decreases over time to encourage the company to move towards more liquid investments.
- **Capital Charge: £0.125m**.

The manual also notes a future add-on is planned to address the risk around quota-share profit and sliding scale commissions, which is set to be introduced in the third quarter of 2025.

6. Model Output

After running all the calculations above, the model will produce:

1. **The Basic Solvency Capital Requirement (BSCR):** This is the aggregated capital requirement for Market, Counterparty, and Underwriting risk, after accounting for diversification benefits between them using a standard correlation matrix.
2. The Final Solvency Capital Requirement (SCR): This is the final output. It's calculated as: **SCR = BSCR + Operational Risk SCR + Any Capital Add-ons**

The final SCR figure is the model's primary output. It represents the total amount of capital the insurer needs to hold to ensure there is a 99.5% probability that it can meet all its obligations to policyholders over the next 12 months.