SOA Challenge

2024

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Report Contents

Growing SuperLife's Business

Executive Summary

Purpose

The purpose of this report is to provide the relevant analysis to support the Chief Marketing Officer and Appointed Actuary of SuperLife in providing retail and actuarial advice to the business in relation to the proposed health incentive programs that will act as an extension to the two main life products offered to clients. These products are:

- 20-year level term life insurance (T20)
- Single premium whole life (non-participating) life insurance (SPWL).

According to the Actuarial Advice Framework (CPS 320), the proposed structural changes will affect existing business and will require more than Č100m of capital. Therefore, SuperLife's Appointed Actuary is required to provide actuarial advice and advise on the implementation of such extensions to the board of directors.

Summary of Key Findings

Through the modelling approach, Luminous Lake Lifeguards found that SuperLife would have saved Č5.7B if the proposed incentive program was implemented 20 years ago. The T20 in-force portfolio in particular yielded an internal rate of return (IRR) of 29.8%, which was a 2.5% increase. Overall, the appraisal value of both product portfolios grew by Č4.2 billion, reinforcing the strong recommendation for implementing this proposed program.

Objectives of Proposed Incentive Program

The proposed health incentive programs have been designed to achieve key business objectives:

1. Enhance health outcomes by incentivizing healthy behaviours through participation in the program, thereby reducing expected mortalities.
2. Improve SuperLife's product marketability and competitiveness, elevating life product sales and increasing overall industry market share, measured by an increase in premiums in force (PIF) and policies in force.
3. Drive economic value for SuperLife by reducing claim payouts and increasing premiums collected, measured by uplifts to SuperLife's Internal Rate of Return (IRR), embedded value and appraisal value.

Key Metrics & Features of Program to Measure Success

The proposed health incentive programs have been tailored with key features aimed at reducing mortality amongst policyholders, whilst encouraging participation:

1. **Smoking cessation programs:** Recognizing the health risks associated with smoking, this initiative is proposed to reduce mortality by an average of 25%.
2. **Cancer prevention initiatives:** With an approximate 7.5% mortality reduction, this will involve widespread awareness and vaccination campaigns.

3. **Health check-ups:** By subsidising health check-ups for program participants, the program aims to facilitate early detection of potential health issues and thereby reduce mortality by on average 7.5%.

Program Design

2.1 Smoking Cessation Program

Research identifies smoking as a leading cause of preventable deaths contributing to cancer, heart, and respiratory diseases (Burns, 2013; Graham, 2013; Hersi et al., 2019). This is echoed by SuperLife's data, showing that whilst smokers only comprise 4.5% of the in-force policyholders, they have accounted for 35% of deaths in the last two decades. (See appendix 1.2 & 1.3 which highlight these figures). It is also important to consider what SuperLife's competitors are achieving worldwide. Examples of this include:

- **United healthcare America 'Quit for Life' program:** A program that has helped 5.9 million smokers quit successfully (United Healthcare, 2024), providing nicotine replacement options and constant support.
- **John Hancock 'Vitality Program' or 'Vitality PLUS Program' (Hancock, 2024):** A program that offers a 15% or 25% premium reduction for participation by enabling access to early cancer screening.

Incentives Contributing to a Decreased Mortality and Increased Participation

SuperLife can employ several areas for which policyholders will be able to choose how they want to quit smoking. Some that will be included in the smoking cessation program for SuperLife include:

- **Nicotine replacement therapy (NRT):** SuperLife can subsidize nicotine replacement therapies, including gums, patches, and medications to facilitate affordable access and support.
- **Mentorship/counselling/support groups:** Offering a support network to aid quitting by offering empathy, accountability, and encouragement throughout the cessation program.

Encouraging Participation

- **Cash rewards and bonuses for quantifiable health improvements for milestones being met:** Policyholders can earn cash from a tiered profit-sharing system; 12.5% reduction for one smoke-free year, 15% for 2-4 years and 22.5% for 5 years or more, which can also be used towards discounting premiums.

Pricing Evaluation & Timeframes

SuperLife will monitor short-term engagement and reward early progress in the first 1-3 years. In the long-term, as health benefits attributed to smoking cessation become more prevalent, SuperLife should evaluate the realised profits after 10 years and gauge program success.

2.2 Cancer Prevention Initiatives

The second tier in SuperLife's proposed health incentive program involves offering cancer prevention initiatives. The main aim of this is to reduce mortality associated neoplasms, the current leading killer

in SuperLife's dataset accounting for 32.8% of deaths (see appendix 1.3). Recent research suggests that detecting cancers early (a stage before metastasis) can substantially increase treatment success rates (Crosby et al., 2022, Schiffman et al., 2015), thus justifying the focus on the cancer prevention scheme. As with smoking cessation, there are initiatives already in place globally by SuperLife's competitors to improve mortality of policyholders with neoplasms. These include:

- **Colonial Life:** Offers a cancer insurance program designed to reduce costs associated with check-ups, screenings, and treatment (Colonial Life, 2024).

<u>Incentives Contributing to a Decreased Mortality and Increased Participation</u>
SuperLife's cancer initiatives aim to reduce mortality and to create economic value when coupled with the low implementation cost of Č20-Č85 per initiative. The program includes:
- **Regular screenings:** Subsidized screenings for early detection
- **Vaccination programs:** HPV vaccinations to prevent related cancers
- **Genetic counselling:** Specifically testing those with a familial risk

<u>Encouraging Participation</u>
- Fully **subsidizing costs** associated with cancer screenings for all types of cancers to ease out-of-pocket costs for policyholders.
- Offering **vaccination voucher**s for individuals who take part, which can result in discounts for various health-related products.
- Profit redistribution via **discounted premiums** or **cash bonuses**.

<u>Pricing Evaluation & Timeframes</u>
In the short-term, SuperLife can evaluate the participation of its policyholders on the program by comparing ratios of individuals who participated in screening and vaccination before the implementation of the program and after (within the first 5 years). In the long-term, SuperLife can reassess mortality after 10 years since the effectiveness of the program can only be determined with adequate time for it to take full effect and for mortality changes to be realised.

2.3 Health Check-Ups
SuperLife's third focus relates to general health check-ups, vital for early disease detection and mortality reduction. (Wu et al., 2015). Wu et al. (2015) identifies that the likely cause of mortality might be due to subsequent referrals after health check-ups. Within SuperLife, circulatory system, respiratory system and digestive system diseases make up a combined 40.5% of deaths and can be mitigated through regular health check-ups. The proposed health check-ups will occur once every four years to maximise the impact to policyholders, as the Č175-Č870 costs per check-up is relatively expensive. Currently, SuperLife's global competitors Medibank, Australian Unity and United Healthcare offer their policyholders with the following programs:
- **Doctor health checks:** Offer policyholders Č150 per person, per calendar year on recognized health checks performed by doctors in private practice, where Medicare doesn't cover (Australian Unity, 2024).

- **Claims for health screenings:** Offer policyholders the opportunity to claim any health screenings if their cover includes benefits for health screenings (Medibank, 2024).
- **Financial goals:** Policyholders can earn financial goals for achieving specific health goals and health-related activities, using wearable devices to sync results; FIT (Frequency, Intensity and Tenacity) (United Healthcare, 2024).

Incentives Contributing to a Decreased Mortality and Increased Participation

SuperLife's health check-ups aim to detect diseases early and reduce mortality, providing economic value by redistributing profits of the program back to policyholders. The following are program details within these health check-ups:

- Subsidise health check-ups:
  - **Health savings accounts** that can be used for each check-up attended and can be put towards future healthcare expenses.
  - Loyalty program, where individuals who regularly attend health check-ups can earn funds that can be used to reduce premiums or cashbacks.
  - Partnerships with healthcare providers, which can offer subsidised health screenings to policyholders. This can include incentives such as priority scheduling or additional services for those who participate in the health check-ups.

Encouraging Participation

- Cashback rewards and discounted premiums, **where individuals earn monetary benefits by making annual efforts to check health regularly.**
- Again, a percentage of additional profits as a result of this program will be redistributed back to policyholders in the form of cashbacks or discounted premiums. These will be equally distributed amongst participating customers.

Pricing Evaluation & Timeframes

In the short term, SuperLife can track policyholder compliance by assessing yearly participation rates in the first 5 years. In the long-term, SuperLife can examine realised mortality reductions and quantify benefits after 5 years and giving the program an opportunity to be implemented. Also, after this time, SuperLife can assess the number of diseases screened early, to ensure the program is achieving its desired goal.

Insurance Pricing and Program Costs

To effectively implement the three-tiered program, a pricing model needs to be devised to feed through provided client data to quantify the impacts of the program. This begins with first determining premiums at a customer level by leveraging a bottom-up pricing strategy to accurately calculate premiums while catering for all costs associated with providing life products.

Mortality Adjustment Factors

To accurately measure expected payouts, the Lumarian mortality rate table was used as a starting position. Investigations into different demographic groups, however, revealed disparities in mortalities between the genders as well as their smoking status. Contrary to the uniform mortality rate table provided at the population level, it was seen that smokers were experiencing higher mortality rates compared to non-smokers, and males were facing higher mortality rates relative to

females. To accurately reflect these variations and ensure fair and precise pricing, adjustment factors were determined by comparing the proportion of individuals alive to those deceased within each demographic subgroup and trued up mortality rates. Refer to appendix 2.2.1 for further details. Furthermore, a flat adjustment of 23% was applied to the expected claims for all customers flagged as moderate or high-risk during underwriting to reflect true mortalities (A 2.2.8).

Expense and Commission Structure
All policyholders incur two forms of expenses, an acquisition cost and a renewal cost. The acquisition cost covers expenditures pertaining to marketing, underwriting and any other miscellaneous charges incurred in acquiring customers. The total cost is amortized across the entire book at a product level, resulting in a constant factor for all customers. A renewal cost is also incurred at a customer and product level which covers ongoing costs to maintain customers (A 2.2.4). Given SuperLife operates in an advised market, a two-stage commission structure is implemented to incentivize advisors and telemarketers to maximize customer flow to SuperLife, where reasonable. Distribution channel owners are paid an initial commission, a large percentage of first year premium, and a renewal commission (A 2.2.6 – 2.2.7) a smaller percentage of premium thereafter. A commission claw back structure is also implemented, whereby 100% of commissions are refunded to SuperLife if the customer lapses within the first year, 50% refunded if the customer lapses in the second year and 0% thereafter. This is to incentivize advisors to not churn customer policies to receive regular large initial commissions, and to only sell policies to customers interested in retaining their policy over the longer run. Refer to appendix 2.2.5 for further details regarding the commission claw back structure.

Other Margins
Given the varying degrees of risk associated with providing life insurance products to individuals of differing degrees of risks, varied profit margins determined by the underwriting class are further added onto the premium. These are split by product type, with T20 policies carrying a greater profit margin relative to SPWL, as T20 policies carry greater innate risk and therefore must be expected to have a greater profit margin. These margins ensure SuperLife's two insurance products remain profitable during fluctuating market conditions.

Mortality Savings
Had the proposed program been implemented over the past 20 years, SuperLife could have expected to realize a total of Č5.7 billion in saved claim payouts, with the majority of savings coming from SPWL policies. The mortality savings are primarily driven by the increased survival probability due to the healthy behaviors promoted by the implemented program, showcasing how SuperLife is able to meet two key health objectives through the introduction of the program.

The implementation of the three targeted programs – smoking cessation, cancer prevention initiatives and annual health checkups – all work in union to promote healthy behaviors among participants. Smokers are able to leverage the smoking cessation program to support them in quitting smoking and moving to a healthier lifestyle, while cancer prevention initiatives promote healthy lifestyles and early detection. These improved mortality rates lower expected claim costs compared to figures without the proposed incentive program as seen in table 1 below.

Product	Expected Discounted Claims Before Program (Č Billion)	Expected Discounted Claims After Program (Č Billion)	Savings (Č Billion)
T20	20.3	18.0	2.3
SPWL	104.0	100.6	3.4
Total	124.3	118.6	5.7

1: Mortality savings experienced by the two policy types if program was implemented 20 years ago

Economic Value

The proposed program was able to add economic value to SuperLife through an increase in embedded value and appraisal value. Embedded value is defined as the value in-force (VIF) plus adjusted net worth. The appraisal value is defined as the embedded value plus value of new business (VNB) and can be used as a proxy for the holistic value of an insurance company. VIF and VNB are defined as the present value of profits generated by the firm from in-force and new business policies respectively. The T20 product saw an IRR increase of 2.5% and an overall appraisal value increase of Č600 million and although the IRR for SPWL was unable to be determined, the overall appraisal value increased by Č3.6 billion, showcasing a clear increase in SuperLife's economic value after the implementation of the program.

Economic Value Metrics		IRR (%)	Embedded Value (Č Billion)	Appraisal Value (Č Billion)
T20	Before Program	27.3%	6.2	6.3
	After Program	29.8%	6.8	6.9
SPWL	Before Program	-	68.0	73.2
	After Program	-	71.3	76.8

2: Increase in economic value through a higher IRR, EV, and AV after program

Given that competitiveness and profitability are conflicting business objectives, management needs to consider which objective to prioritize in the short term. Provided that the firm's real IRR has increased, the year-on-year return to shareholders has also been projected to increase. If SuperLife wishes to maintain this position, management will be unable to further increase competitiveness through pricing reductions as this will compromise the current after program IRR. However, in order to ensure commercial viability over the longer run, SuperLife would now have the ability to use pricing as a strategic lever to reduce customer premiums, increasing the marketability of their products and therefore boost sales over the longer term. Although reducing profitability in the shorter term, by increasing volume of policies, SuperLife would be able to reduce unit acquisition expense given a larger customer base to amortize expenses across, maximizing the appraisal value over the longer run, as seen in sensitivities 14 and 15, reductions in acquisition expenses by 25% and 50% increase firm appraisal value by a further Č1.4 and Č2.6 billion respectively.

Pricing Changes

Given the increased economic value metrics, SuperLife may be able to optimize sales by reducing premiums for both product types. SuperLife would be able to leverage the increased profit to offset any premium reductions to maintain the starting appraisal value of the firm, while targeting lower and therefore more competitive ranks relative to their key competitors. This would boost marketability since advisors would be more inclined to recommend SuperLife products as offerings would be better value for money for customers, and hence increase customer volume. This would reduce unit acquisition costs and thereby boost economic value of the firm over the longer run.

SuperLife can also implement a profit-sharing approach, whereby a quarter of the delta of profit can be given back to customers through the incentives mentioned in section 2 of the report for participating customers. This would further incentivize existing customers to join the program and thereby reduce their mortality rates as well as further increase the marketability of SuperLife's products to new customers, which in both cases would maximise economic value in the long term.

Assumptions

In constructing the actuarial models for SuperLife's incentive program rollout, crucial assumptions were made. These are vital to guide our decision making and simplifying calculations that would otherwise be unfeasible. The following assumptions are considered to be the most influential on the projections and strategic direction of the programs:

- Interest rates

A standardized interest rate of 4%, measured by averaging historical spot rates across Lumaria, is used to discount future cash flows, providing consistency in discounting where the yield curve can't be used. The rate of 6% is assumed as the asset earning rate, mirroring conservative long term investment strategies.

- Sales growth rate after program implementation

After the implementation of the program, it is assumed that sales will grow by an additional 5% for non-smokers and 8% for smokers in addition to the already growing year-on-year trends. This conservative value, reflecting program targets and incentives is pivotal in ensuring future forecasting of profits remains consistent.

- At baseline (without the incorporated effects of the incentives bringing on more policies), SuperLife's insurance portfolio assumed to grow annually at historical average rate.
- It is assumed that 65% of all people in the SuperLife Insured Population, as well as those to join the insurance pool, will participate in the three programs.
- After program implementation and take-up by customers, lapse rate will reduce by 5% for participating policyholders.
- When calculating overall mortality reduction from multiple program implementations, a multiplicative approach is assumed as appose to additive.
- Premium pricing will be based on the equivalence principle, following a bottom-up pricing approach.
- SuperLife's policyholder data is taken as a reliable representation of the population, ensuring observed health trends from in-force dataset are indicative of broader societal patterns.
- There is no indexation of T20 premiums to vary with inflation.
- Reserve rates for T20 and SPWL policies varied, with T20 rates decreasing over the term and SPWL rates varying by gender and smoker status.
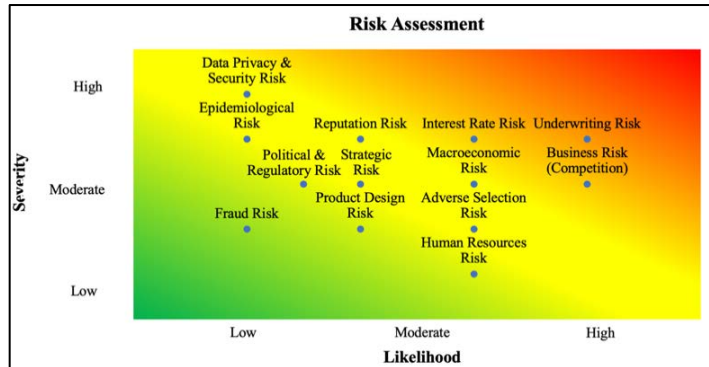
Refer to appendix 3.1 for a comprehensive breakdown of assumptions, justifications, and details.

When determining the factors impacting the costs of the proposed program, two key assumptions stand out: interest rates / asset earning rates and assumptions regarding the growth of new business

sales. Interest rates directly affect future cash flows' present value and sales growth assumptions impacting acquisition costs, thereby affecting program profitability and overall cost. Higher interest rates may strengthen program funding viability, while lower rates or conservative sales projections may constrain resources. Optimistic sales growth projections could reduce future acquisition costs while pessimistic sales assumptions could result in long run expense inefficiencies.

Risk and Risk Mitigation

Upon assessing several potential risks that may be faced during the implementation of the program, the four most likely and severe risks are detailed below, alongside possible risk mitigation techniques. The rest are detailed in Appendix 4.1.

Risk Assessment

Ranking Risks	Risk	Mitigation Strategies
1. Financial – Underwriting Risk	The risk that the actual mortality and lapse rate experience of future policyholders deviates from the rates used in the underwriting process. If program uptake rates fall short of expectations, this would further understate the mortality and lapse rates used in product pricing	Regularly reviewing and updating the projected mortality and lapse rates for policyholders who participate in the programs, as new data is collected. This will allow premiums and program incentives to be adjusted for potential future policyholders, if profit margins fall short of expectations.
2. Financial – Interest Rate Risk	If interest rates fluctuate from the expected 4% long-run historical average used as the basis for pricing future policies, the premiums being charged may no longer be appropriate. Premiums may be overly punitive if interest rates rise, in which case there's the risk of loss of business, or if interest rates fall, premiums may not be sufficient to cover future liabilities. Moreover, the rate of return on the company's investments will be affected, which will impact expected profitability and reserve levels.	Conducting regular stress tests or sensitivity analyses based on various interest rate scenarios at regular intervals and analysing whether premiums and reserves are sufficient to withstand plausible interest rate movements. This could inform potential repricing decisions or the decision to increase reserves. Matching the duration of assets to liabilities as a way of immunising the portfolio against interest rate movements.
3. Business – Competition Risk	If competitors decide to roll-out similar programs, perhaps with additional incentives over time, the company might lose market share and business growth won't be as high as expected following program implementation.	Constant monitoring of competitor activities and proactively adapting the program to stay ahead of its competitors. Prioritizing customer service, effective program implementation and minimizing the bureaucratic and administrative complexity of participating in the programs.

4. Financial – Macroeconomics Risk	A general downturn in the macroeconomic environment may affect the growth of new business and lead to increased lapse rates of existing policyholders, as individuals look to cut back on spending and are not as inclined to take out life insurance, despite the new program offerings.	Ensuring reserve levels remain appropriate to absorb any losses during periods of economic instability. Stress tests can be used to calibrate additional capital buffers to withstand such economic shocks.

Sensitivity Analysis

T20 Sensitivities	VIF ($billion)	VNB ($billion)	Embedded Value ($billion)	Appraisal Value ($billion)	Expected Claims ($billion)	Program Costs ($billion)	IRR (%)	Loss Ratio (%)	Expense Ratio (%)	Combined Ratio (%)	Profit Margin (%)
Base Case With Program	6.2	0.0	6.2	6.3	20.3	0.0	27.3%	57.5%	18.5%	88.9%	17.6%
Deltas											
Sens 1 (Worst case)	-0.2	0.0	-0.2	-0.2	1.6	-1.7	-1.0%	4.5%	-4.9%	-0.4%	-0.6%
Sens 2 (Best case)	0.1	0.0	0.1	0.1	-2.5	2.9	0.4%	-6.9%	8.2%	1.3%	0.3%
Sens 3 (Interest 6%)	0.2	0.0	0.2	0.2	-1.1	-0.1	0.8%	-3.1%	-0.4%	-3.5%	0.5%
Sens 4 (Interest 2%)	-0.3	0.0	-0.3	-0.3	1.4	0.1	-1.1%	3.8%	0.4%	4.3%	-0.7%
Sens 5 (Interest 9%)	0.4	0.0	0.4	0.3	-2.4	-0.2	1.5%	-6.7%	-0.8%	-7.5%	1.0%
Sens 6 (Interest 1%)	-0.4	0.0	-0.4	-0.4	2.2	0.1	-1.8%	6.1%	0.7%	6.8%	-1.2%
Sens 7 (Asset Earning Rate 8%)	0.7	0.0	0.7	0.7	0.0	0.0	2.9%	0.0%	0.0%	0.0%	1.8%
Sens 8 (Asset Earning Rate 4%)	-0.7	0.0	-0.7	-0.7	0.0	0.0	-2.9%	0.0%	0.0%	0.0%	-1.8%
Sens 9 (Asset Earning Rate 14%)	2.6	0.1	2.6	2.7	0.0	0.0	11.4%	0.0%	0.0%	0.0%	7.4%
Sens 10 (Asset Earning Rate 1%)	-1.6	-0.1	-1.6	-1.7	0.0	0.0	-7.1%	0.0%	0.0%	0.0%	-4.6%
Sens 11 (Acquisition Expense 300%)	-2.4	-0.1	-2.4	-2.5	0.0	0.0	-10.4%	0.0%	6.7%	6.7%	-6.7%
Sens 12 (Renewal Expense $250)	-0.7	0.0	-0.7	-0.7	0.0	0.0	-2.9%	0.0%	1.9%	1.9%	-1.9%
Sens 13 (Acquistion 300%, Renewal Expense $250)	-3.0	-0.1	-3.0	-3.2	0.0	0.0	-13.3%	0.0%	8.6%	8.6%	-8.6%
Sens 14 (Acquisition Expense 150%)	1.4	0.1	1.4	1.4	0.0	0.0	6.0%	0.0%	-3.9%	-3.9%	3.9%
Sens 15 (Acquisition Expense 100%)	2.6	0.1	2.6	2.7	0.0	0.0	11.5%	0.0%	-7.4%	-7.4%	7.4%

SPWL Sensitivities	VIF ($ billion)	VNB ($ billion)	PVExpectedClaims ($ billion)	PVProgramCosts ($ billion)	LossRatio (%)	ExpenseRatio (%)	CombinedRatio (%)	ProfitMargin (%)
Base Case With Program	68.0	5.3	104.0	0.0	54.2%	20.5%	91.4%	35.4%
Deltas								
Sens 1 (Worst case)	1.3	0.1	-1.2	0.3	-0.6%	0.2%	-0.4%	0.7%
Sens 2 (Best case)	6.4	0.5	-6.9	2.8	-3.6%	1.5%	-2.1%	3.4%
Sens 3 (Interest 6%)	-4.1	0.0	-31.3	1.1	-16.3%	0.5%	-18.5%	-2.1%
Sens 4 (Interest 2%)	19.4	1.7	46.6	1.4	24.3%	0.9%	30.4%	10.1%
Sens 5 (Interest 9%)	-8.0	-1.3	-53.7	1.0	-28.0%	0.4%	-32.4%	-4.2%
Sens 10 (Interest 1%)	33.6	-9.3	86.4	1.6	45.0%	1.0%	55.9%	17.5%
Sens 5 (Asset Earning Rate 8%)	47.9	0.3	-3.4	1.2	-1.8%	0.7%	-1.1%	25.0%
Sens 6 (Asset Earning Rate 4%)	-41.3	3.3	-3.4	1.2	-1.8%	0.7%	-1.1%	-21.5%
Sens 13 (Assest Earning 14%)	181.8	-1.3	-3.4	1.2	-1.8%	0.7%	-1.1%	94.7%
Sens 12 (Assest Earning 1%)	-108.3	0.2	-3.4	1.2	-1.8%	0.7%	-1.1%	-14.4%
Sens 7 (Acquisition Expense 30%)	-15.9	4.1	-3.4	1.2	-1.8%	10.7%	8.9%	-8.3%
Sens 8 (Renewal Expense $200)	2.9	-3.6	-3.4	1.2	-1.8%	0.9%	-0.9%	1.5%
Sens 9 (Acquistion 30%, Renewal Expense $200)	-16.3	15.7	-3.4	1.2	-1.8%	10.9%	9.1%	-8.5%
Sens 14 (Acq 15%)	12.9	1.1	-3.4	1.2	-1.8%	-4.3%	-1.1%	6.7%
Sens 15 (Acq 10%)	22.5	1.9	-3.4	1.2	-1.8%	-9.3%	-1.1%	11.7%

2: T20 and SPWL Sensitivity Analysis – Deltas of scenarios compared to base case with program

The variables which resulted in the largest fluctuations in key financial metrics were sensitivities on the interest rate, asset earning rate and acquisition expense ratio. Given acquisition expense ratio can be controlled by increasing sales volume, the variables which need to therefore be modelled more conservatively are the interest and asset earning rates.

Degree of Certainty

The extent to which the proposed programs will reduce mortality rates is contingent on the uptake rates of the programs amongst policyholders. It can be concluded with near certainty that the proposed suite of programs will in fact lower mortality rates and contribute to some level of mortality savings for SuperLife. Given that new business growth, portfolio lapse rates, and portfolio mortality rates are variables that SuperLife has in its power to influence (at least partially) through its future program offerings, business strategy, and underwriting decisions, the main drivers of uncertainty in the company's projection of future net benefits will be interest rates and asset earnings rates. These variables were assumed to be normally distributed, and 95% confidence intervals were constructed for the basis of the above sensitivity analyses. The new program offerings should lead to a net benefit for SuperLife, provided that interest rates and asset earning rate fluctuations do not lead the

company's post-program VIF to fall below the pre-program VIF of Č6.37b for T20 policies and Č67.99b for SPWL policies. For T20 policies, normal probability theory and linear extrapolation were used to demonstrate that a 0% interest rate leads to a post-program VIF of $6.27b. However, for SPWL policies, it was calculated that if interest rates exceed 7.5%, which has a 2% probability of occurrence, then the post program VIF will fall below the pre-program VIF. These results indicate that with perfect certainty, the program offerings will deliver a net benefit for SuperLife on the basis of its T20 policies, irrespective of interest rate movements, whilst there is a 98% probability that SuperLife's SPWL policies will deliver a net benefit given interest rate fluctuations. Moreover, when looking at asset earnings rates for T20 policies, it was calculated that an asset earnings rate of less than 4.3% would cause the VIF to fall below the pre-program VIF (with 22% probability of occurrence), and similarly for SPWL policies, an asset earnings rate of less than 5.9% would cause the VIF to fall below the pre-program VIF (with 41% probability of occurrence).

Data and Data Limitations

The in-force dataset does not provide the issue date of each policy, only the issue year. Similarly, only the year of death and year of lapse are provided. This made it impossible to determine the exact in-force duration of each policy, which for the purposes of calculating mortality savings, meant that it was assumed that both policy origination and claims settlement occur at the start of each calendar year. Additionally, mortality rates for the general population of Lumaria were only provided with respect to the base year 2010, and on a combined population basis. It would have been ideal having cohort mortality tables, rather than assuming mortality rates remain static over time. Moreover, given that sex and smoker status were found to be significant determinants of mortality, the expected profit modelling would have been made more accurate if separate mortality tables were provided for each combination of these two risk factors. Though a high-level adjustment factor approach was used to approximate these mortality tables based on the historically observed trends in the in-force dataset, this approach was limited by the lack of historical data available for these groups of policyholders, and by having to assume that SuperLife's historical life insurance portfolio is perfectly indicative of mortality rates in the general Lumarian population. No data was also provided on SuperLife's historical asset earning rate or investment mix. As a result, it was assumed that assets earn a fixed rate of return equivalent to the historical average 10-year spot rate, given that life insurers tend to hold most of their assets in long-term bonds (Koller 2011, p.19). Although the previously detailed sensitivity analysis demonstrated that varying this assumption could lead to a 10% swing in profitability, it provides assurance that the roll-out of the proposed programs will still deliver a net positive expected profit for SuperLife. However, this benefit could vary quite significantly in reality, due to incomplete information and such limitations with the provided data.

Final Summary & Key Takeaways

Luminous Lake Lifeguards' final recommendation to SuperLife's strategic implementation of health programs is to proceed with the three advised health initiatives. It is made clear through quantitative and qualitative analysis that the programs result in reduced mortality, increased marketability and competitiveness of SuperLife's offerings, and thereby boosting overall economic value.

References

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Appendix

1. Appendix for Program Design Section

1.1.   Further Incentives

- Age distribution: With 46% of population being between ages 25-54, workplace wellness initiatives e.g., additional paid time off/health savings account contribution.
- Wide range of earned income: could utilize a sliding scale depending on income class. E.g., lower income has cash bonus/premium reduction incentives, higher income earners have tax deductions or contributions to a retirement fund.
- With cancer prevention initiatives in the form of billboards, vaccinations, and advertisements, could utilize areas of high foot traffic e.g., areas surrounding Luminous Lake or even at major sporting events during halftime shows.
- [1]Table 1 – Proportion of Smokers & Non-Smokers in Policyholder Experience & Deaths Attributed to Smokers & Non-Smokers in Policyholder Experience

1.2.   Distribution of Smokers & Non-Smokers

[1]

	Proportion of Population	Proportion of Deaths
Smoker (S)	4.5%	35.4%
Non-Smoker (NS)	95.5%	64.6%

1: Smokers and Non-Smokers Distributions

1.3.   Distribution of Comorbidities

	Proportion of Top 4 Comorbidities			
Disease	Neoplasms	Circulatory System Diseases	Respiratory System Diseases	Digestive System Diseases
Proportion of Total Deaths	32.8%	29.4%	6.6%	4.5%
Smoker (S)	8%	90%	60%	1%
Non-Smoker (NS)	92%	10%	40%	99%

1: Proportion of Top 4 Comorbidities

2. Appendix for Pricing/Costs Section

2.1.   Premium Component

Premium Component	Description
Discounted Expected Claims	Expected Discounted claims are determined by first projecting expected payouts for the lifetime of the benefit and taking the discounted sum using the yield curve.
Risk Margin	All individuals classified as moderate or high-risk during underwriting have a 23% in their discounted expected claims, as determined by realized experiences over the past 20 years for both T20 and SPWL policies.
Acquisition Expense Factor	A percentage of first year premium set constant to 205% for T20 policies and 20% for SPWL policies, this covers costs entailing marketing, underwriting and any other miscellaneous charges in acquiring customers. The total cost is amortized across the entire book, resulting in a constant factor for all customers at a product level.
Discounted Renewal Expense	A fixed dollar amount set constant to Č170 for T20 policies and Č145 for SPWL policies, this covers ongoing costs to maintain customers, including admin charges, claim investigations, and any other recurring costs in maintaining customers. The renewal expense is also projected according to customer exposure and then discounted to determine the present value of the renewal expense at a customer level.
Initial Commission Factor	A percentage of first year premium is paid out to distribution channel owners as a fee for providing SuperLife business. A commission claw back structure is implemented at 100% of commissions if customer lapses in first year, 50% of commissions if customer lapses in the second year and 0% if the customer lapses thereafter. This is to incentivize the varying distribution channels to not churn policyholders to receive regular large initial commissions and only sell policies to customers who are interested in life insurance for the long run.
Renewal Commission Factor	A percentage of annual premium for T20 policies and first year premium for SPWL policies is paid out to distribution channel owners as an ongoing fee for providing SuperLife business, providing an incentive to advisors to ensure policyholders maximize the amount of time they stay on as a customer with their respective benefit. Renewal commissions are also bound by the commission claw back structure, whereby a 100% refund of all commissions paid by SuperLife are refunded if the customer lapses within the first year, 50% refunded if the customer lapses within the second year and 0% thereafter.

2.2.   Assumptions Setting

Mortality Rate Table Adjustments	Before Program	After Program (Worst Case)	After Program (Middle Case)	After Program (Best Case)
FNS	52.8%	51.0%	47.8%	43.3%
FS	498%	464%	363%	214%
MNS	87.5%	84.4%	79.1%	71.6%
MS	436%	406%	317%	187%

1: Lumaria Mortality Rate Table Adjustments for SuperLife Experience

		Lapse Rate Tables		
Year	Before Program	After Program (Worst Case)	After Program (Middle Case)	After Program (Best Case)
1	0.99%	0.98%	0.94%	0.89%
2	0.99%	0.98%	0.94%	0.89%
3	0.99%	0.98%	0.94%	0.90%
4	1.00%	0.99%	0.95%	0.90%
5	0.98%	0.97%	0.94%	0.89%
6	0.98%	0.97%	0.93%	0.88%
7	1.03%	1.02%	0.97%	0.92%
8	1.00%	0.99%	0.95%	0.90%
9	1.00%	0.99%	0.95%	0.90%
10	1.02%	1.01%	0.97%	0.92%
11	1.00%	0.99%	0.95%	0.90%
12	1.00%	0.99%	0.95%	0.90%
13	0.99%	0.98%	0.94%	0.89%
14	1.00%	0.99%	0.95%	0.90%
15	1.01%	1.00%	0.96%	0.91%
16	1.00%	0.99%	0.95%	0.90%
17	0.99%	0.98%	0.94%	0.89%
18	0.98%	0.97%	0.94%	0.89%
19	0.98%	0.97%	0.93%	0.89%
20	98.99%	99.00%	99.04%	99.09%

2: Lapse Tables as per SuperLife Experience

Program Costs	Before Program	After Program (Worst Case)	After Program (Middle Case)	After Program (Best Case)
NS	Č0	Č291.63	Č135.32	Č35.31
S	Č0	Č3,602.38	Č1,549.31	Č339.81

3: Program Costs

Expenses	T20	SPWL
Acquisition	205.0%	20.0%
Renewal	Č170	Č145

4: Pricing Expense Assumptions

Commission Clawback	Refund Amount	Probability (From Lapses)
1 yr	100.0%	0.99%
2 yrs	50.0%	0.98%
3+ yrs	0.0%	98.0%

5: Commission Claw back Structure

Initial Commissions	T20 % of premium	SPWL % of premium

Agent	80%	8%
Online	10%	3%
Telemarketer	75%	6%

6: Initial Commissions Structure

Renewal Commissions	T20 % of premium	SPWL % of premium
Agent	10%	0.5%
Online	0%	0%
Telemarketer	15%	0.2%

7: Renewal Commissions Structure

Risk Margin	% of Exp Claims
Very Low Risk	0%
Low Risk	0%
Moderate Risk	23%
High Risk	23%

8: Risk Margins

Profit Margin	T20	SPWL
Very Low Risk	3.5%	3%
Low Risk	4.5%	4%
Moderate Risk	5.5%	5%
High Risk	7.5%	7%

9: Profit Margins

2.3.   Methodology for Expected Claims

Methodology

The following describes the methodology for determining expected claims:

1. Exposure was projected for 20 years or till the year 120 for each policy in force, depending on the type of product they had. Exposure was calculated with the assumption that lapse and death occurred at the end of the period year. Note the lapse rate was only present for the T20 policy.
   a. $Exposure_x = Exposure_{x-1} \times (1 - Mortality\ Rate - Lapse\ Rate)$
2. Expected deaths were then calculated based on the exposure for that year. These expected deaths were calculated for each projected year on a policy level basis.
   a. $Expected\ Deaths_x = Exposure_{x-1} * Mortality\ Rate$
3. Expected claims were then projected by multiplying the Sum Insured amount by the expected number of deaths
4. A yield curve was then used to discount the expected claims figure from every projected year down to time 0.
5. This process was conducted for every policy in the in-force dataset.

Main Assumptions
- The 1-year spot rate was used as the yield curve when discounting cashflows over the past 20 years. This gave a conservative estimate as to the risk-free rate.
- For years where the risk-free rate was not present, a 4% rate assumption was implemented. This was determined by averaging the 1-year spot rate for Lumaria over a suitable time-horizon in the past

2.4.   Methodology for Reserves and Capital

Methodology

The following describes the methodology for determining reserves and capital:

1. Exposure was projected for 20 years or till the year 120 for each policy in force, depending on the type of product they had. Exposure was calculated with the assumption that lapse and death occurred at the end of the period year. Note the lapse rate was only present for the T20 policy.
   a. $Exposure_x = Exposure_{x-1} \times (1 - Mortality\ Rate - Lapse\ Rate)$
2. The reserve rate and capital rate is multiplied by the exposure to calculate the corresponding decremented value.
   a. $(Capital\ rate + Reserve\ rate) \times Exposure \times \frac{Sum\ Insured}{1000}$
   b. The capital rate and reserve are per 1000 sum insured
3. Reserve Increase is then determined by the difference in decremented reserve value of the previous two years.
4. A yield curve was then used to discount the decremented figures from every projected year down to time 0.
5. This process was conducted for every policy in the in-force dataset.

Main Assumptions
- The 1-year spot rate was used as the yield curve when discounting cashflows over the past 20 years. This gave a conservative estimate as to the risk-free rate.
- For years where the risk-free rate was not present, a 4% rate assumption was implemented. This was determined by averaging the 1-year spot rate for Lumaria over a suitable time-horizon in the past
- Reserve rate differed between T20 policies and SPWL policies
  - T20 rate started at 0.8 per 1000 sum insured and decreased as the term progressed. This rate was constant for all policyholders in the T20 in-force book
  - Policies in the SPWL in-force book have three different starting reserve rates depending on gender and smoker status. Smokers have a higher starting reserve rate per 1000 sum insured because of their increased probability of claiming.
  - For SPWL policies, the required reserve rate increases to 950 at higher ages, as individuals alive at this age have a much higher probability of claiming. Hence

appropriate reserves need to be held. The starting reserve rates are listed in the table below:

Starting Reserve Rate for SPWL			
FNS	FS	MNS	MS
20	200	30	300

3: Starting reserve rates per 1000 sum insured for SPWL policy holders

2.5. Methodology for Profit

Methodology
The following describes the methodology for determining profit:
1. The interest earned per year is first projected per policy holder.
    a. $Interest = Investment\ Rate \times (Decremented\ Reserve\ \&\ Capital + Decremented\ Premium - Decremented\ Commission)$
    b. 'Decremented' in the above equation refers to values that have been multiplied by the exposure value for that particular projection year
2. Profit for a particular projection year is calculated as:
    a. $Profit = Dec.Premium - Dec.Commission - Dec.Expenses - Dec.Expected\ Claims + Reserve\ Increase + Interest$
    b. "Dec." in the above equation represents decremented value
3. A yield curve was then used to discount the profit figure for every projected year down to time 0
4. This process was conducted for every policy in the in-force dataset.

Main Assumptions
- The 1-year spot rate was used as the yield curve when discounting cashflows over the past 20 years. This gave a conservative estimate as to the risk-free rate.
- For years where the risk-free rate was not present, a 4% rate assumption was implemented. This was determined by averaging the 1-year spot rate for Lumaria over a suitable time-horizon in the past.

3. Appendix for Assumption Section

3.1. Full Assumptions Table

Assumption	Detail	Justification
SuperLife's data is an accurate representative of Lumaria population.	SuperLife's life table is assumed to reflect mortality and health trends of the general Lumarian population.	Given SuperLife is a major Life insurance carrier in Lumaria, it is reasonable to infer that policyholder demographic is broad and

		diverse, reflecting a cross-section of the natural population.
Stability of smoking habits	Assumed that the trend of smoking habits in the population and their impact on mortality remain constant over time, allowing the use of a single smoker adjustment factor in the model.	Based on longitudinal studies that smoking-related mortality risks are relatively stable across different time periods. Simplifies the model and analysis of implementation of smoking cessation programs.
Assuming SuperLife will not be forced to repriced by regulator or trustee	With the decrease in mortality due to health interventions, SuperLife will experience favourable claims experience and lower loss ratios. It is assumed regulators or trustees will not compel SuperLife to lower premiums to reflect enhanced claims experience.	Allows for a simpler projection of profitability, where cost savings translate directly to bottom line. Rationale is that regulators/trustees may permit a period of improved profitability to bolster company reserves or provide a buffer against potential future losses.
Future interest rates taken to be average of historical interest rates	The long-term nature of the products makes it fair to assume that future interest rates, despite possible fluctuations throughout, will average to the historical average of interest rates. This assumed interest rate will be used to discount future cash flows and determine investment strategies.	This assumption is made to standardize discount rates across all calculations,, providing consistency in future cash flow valuations. The choice of 4% is in line with historical 1-year risk free and 10-year risk free averages.
Everyone's age rolls over at start of year	All Policyholders' ages are incremented by one year at the start of each year. This is done to simplify calculations in SuperLife's large dataset.	Given that distribution of birthdays is usually uniform throughout the year, this method allows for manageable calculations without significantly affecting accuracy of population-wide outcomes.
Interest rate**s** proxy	Interest rates are assumed to be proxied by the 1-year risk free annual spot rate	Interest rates are used for discounting, which is an annual short-term rate
Asset earning rate proxy	Asset earning rates are assumed to be proxied by the 10-year risk free annual spot rate	The nature of life insurance products are long term, so the corresponding assets which would be invested in would be long term assets
Non-Additive Compounding Benefits of programs	When calculating overall mortality reduction from multiple program implementations, a multiplicative approach is used as appose to additive.	This accounts for the interdependence of the programs, recognizing health improvements may not be independent between the three programs. For example, the effects of cancer prevention and annual health checkups are slightly diminished when combine, which is reflected in the multiplicative model.

Uptake of programs	It is assumed that 65% of all people in the SuperLife Insured Population, as well as those to join the insurance pool, will participate in the three programs.	Assumptions is made with design of program to have broad appeal and marketing efforts to encourage participation.
Premium Pricing Principle	Assumption that premium pricing will follow the equivalence principle.	Given lack of specific pricing methodology, this widely accepted actuarial principle is assumed to ensure fairness and solvency.
T20 policyholders are charged level premiums over the duration of their policy	Assumption that there is no indexation of T20 premiums to vary with inflation.	This is consistent with the company offering 6 discrete sum insured amounts (insurance benefits) which remain constant over the 23 years of historical data.
Profit Margin Consideration	Implicit profit margin assumed to ensure business sustainability.	Without explicit guidance by SuperLife, assumed includes margin to cover expenses and returns to shareholders, aligning with common industry practices.
Portfolio Growth rate at baseline	At baseline (without the incorporated effects of the incentives bringing on more policies), SuperLife's insurance portfolio assumed to grow annually at historical average rate.	Growth assumption used for future profitability projections. Historical growth rates provide reasonable basis for projection in absence of specific guidance.
1-year spot rate for discounting	The 1-year spot rate was utilized for discounting over the past 2 decades.	The use of the 1-year spot-rate ensured a conservative approach to discounting.

Differing reserve rates	Reserve rates for T20 and SPWL policies varied, with T20 rates decreasing over the term and SPWL rates varying by gender and smoker status.	Decreasing reserve rates for T20 reflect decreasing risk over the policy term.
Assuming Lapse rate changes after implementation of program	Assumption that after program implementation and take-up by participants, lapse rate will reduce by 5%	After the implementation of the programs with progressive monetary benefits, it would follow that program participants would be incentivised to stay on the program.

4. Appendix for Risk and Mitigation Considerations

4.1.   Additional Important Risk Considerations

Risk Category	Risk Subcategory	Risk
Operational	Disasters (Epidemiological Risk)	Risk that a pandemic or widespread infectious disease breaks out, resulting in higher-than-expected death claims, which would strain profitability and reserves. This could be especially troublesome if the programs lead to an elevated portfolio risk profile e.g. higher levels of smokers join on due to the smoking cessation program, who are more susceptible to mortality from infectious diseases.
Strategic	Implementation & Execution Risk	The risk of improper of ineffective implementation of the programs, leading to lower-than-expected mortality reductions, policyholder dissatisfaction, unwillingness to partake in the programs and increased policy lapses.
Operational	Reputation Risk	If the new programs are poorly implemented, attract complaints from policyholders, or don't deliver on what has been marketed, the company may receive negative publicity, which could lead to increased lapses and difficulty attracting new policyholders.
Regulatory	Political & Regulatory Risk	Changes in regulations or government policies such as tax laws could have

		pricing or reserving implications for SuperLife and affect the profitability of the company following the implementation of the programs.
Operational	Human Resources Risk	Poor customer service and poor effort by human resources in addressing policyholder needs, may lead to lower program uptake rates than anticipated.
Operational	Data Privacy & Security Risk	As new policyholders come onboard and the size of the company and its data grows because of the new programs, the risks of data branches or cyberattacks become more severe, which could lead to regulatory penalties, litigation costs and reputational damage.
Underwriting	Adverse Selection Risk	The new programs may inadvertently result in more individuals taking out policies at a higher risk of mortality based on known genetic predispositions to diseases. E.g. the cancer prevention initiatives program might entice an overly large proportion of individuals with a family history of cancer to take out policies.
Operational	Fraud Risk	Policyholders might provide false information about their participation in some of the programs, to receive the benefits offered, without taking part in them. This would lead to lower than anticipated mortality reductions.
Strategic	Product Design Risk	The risk that policyholders will not want to participate in the new programs, due to additional product complexity, or skepticism surrounding the terms and conditions of the programs' benefit offerings.

4.2 Overall Risk Grade for Important Risk Considerations

Risk	Likelihood (1-5)	Severity (1-5)	Score (Likelihood x Severity)	Overall Risk Grade
Underwriting Risk (Financial)	4	4	16	Moderate to High
Interest Rate Risk (Financial)	3	4	12	Moderate
Business Risk (Competition)	4	3	12	Moderate
Macroeconomic Risk (Financial)	3	3	9	Moderate
Reputation Risk (Operational)	2	4	8	Moderate

Implementation & Execution Risk (Strategic)	2	3	6	Low to Moderate
Adverse Selection Risk (Underwriting)	3	2	6	Low to Moderate
Data Privacy & Security Risk (Operational)	1	5	5	Low to Moderate
Political & Regulatory Risk (Regulatory)	1.5	3	4.5	Low to Moderate
Epidemiological Risk (Operational)	1	4	4	Low to Moderate
Product Design Risk (Strategic)	2	2	4	Low
Human Resources Risk (Operational)	3	1	3	Low
Fraud Risk (Operational)	1	2	2	Low