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SuperLife Saving Lives

SOA Research Institute – Case Study Challenge

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1. Executive Summary

SuperLife Saving Lives' product development team engaged YES SIR Consulting to propose a program that incentivises healthier behaviours and provides value to the customers and firm. The program is an application which promotes wellbeing and sun safety awareness with opportunities for hiking and outdoor activity groups. Initial best estimates of the proposed program price it Č243.937/year more competitively than current life products offered. However, risks and limitations are acknowledged and mitigation strategies have been recommended.

2. Introduction

SuperLife Saving Lives' (SuperLife) product development team investigated pairing health incentives and life insurance to achieve the goals of healthy behaviours, decrease mortality, increase sales and overall value to the firm. YES SIR Consulting has been engaged by Superlife's Jes B. Zane and Pat Moneywize's team propose a program that will help achieve the goals.

YES SIR Consulting will provide recommendations and supporting analysis for a proposed product on the following points:

- The proposed program consists of a wellbeing application which promotes outdoor activity groups and sun safety awareness programs.
- The projected financial outcomes with various sensitivity and stress testing on different variables if this program were to be adopted by Superlife. Also a historical financial view, if the program was adopted previously.
- All assumptions utilised in the various models which contributed to the development and financial analysis of this product.
- The foreseen risks such as pricing, regulatory, reputational, strategy, cyber , underwriting, liquidity and operational risk and methods to mitigate such risks.
- The data that was used such that the projections could be replicated and any limitations on the modelling.

As per engagement agreements, YES SIR Consulting will not provide any other recommendation outside of the agreed scope.

3. Program Objective and Design

YES SIR's proposed program is dedicated to promoting outdoor activities to enhance the well-being of SuperLife's policyholders, whilst ensuring the sustained growth for the firm. The program addresses objectives in detail below thus creating a comprehensive framework to ensure the program's success.

1. **Incentivise Healthy Behaviours:**

This program promotes active lifestyles by incentivising participation in various outdoor activities such as mountain hikes, swimming, and more. By monitoring yearly participation rates and setting achievable targets tailored to different age

segments of the population thus aiming to cultivate a culture of wellness and physical activity amongst policyholders.

2. **Decrease Expected Mortality Rates:**

   One of the primary goals is to reduce mortality rates over time. Mortality rates should be monitored on a 5-year basis to assess effectiveness of recommended interventions. Setting targets for a percentage reduction in mortality rates for each period tracks progression and any improvement in life expectancy and wellbeing.

3. **Improve Life Insurance sales:**

   Enhancing life insurance sales is essential for the sustainability of the proposed program. Sales targets should be set on a quarterly and annual basis, to monitor the success in increasing life insurance sales

4. **Improve Product Marketability and Competitiveness:**

   It is important to stay relevant and competitive in the insurance market. Thus, implementing built-in surveys and feedback mechanisms, will monitor customer satisfaction and gather insights to further the proposed program.

5. **Add Economic Value to Superlife:**

   A key aspect of the proposed program is to contribute economic value to SuperLife. By maintaining a sustainable profit margin, monitored on a frequent basis, ensures the financial health and viability of SuperLife. This economic stability enables continual investing into innovative solutions and delivering value to our stakeholders, whilst fulfilling the commitment of promoting healthy lifestyles for policyholders.

Proposed Program

In designing the proposed program, three interventions were selected to foster a culture of wellness and promote healthier lifestyles.. These interventions are selected to address specific aspects of out-door activities, including the creation of fitness communities, sun safety awareness, and technological integration to maximise efficiency, engagement and effectiveness.

We chose to centre our health program on outdoor activities due to the vast landscape in Lumaria, and the myriad of benefits physical activities offer for overall well-being. Engaging in outdoor activities is beneficial for cardiovascular health, stress reduction and significantly lowers mortality risk (Kokkinos, 2012). Through these activities, our program will promote a healthier lifestyle and reduce the risk of chronic diseases for individuals, while enjoying the benefits that nature has to offer.

Other potential interventions were also explored, such as the smoking cessation program. We recognised smoking as a significant contributor to mortality rates, and deliberated on its inclusion in our proposed initiatives. However, upon analysis, we realised that the extreme costs associated would outweigh its benefits. The metric for efficiency (**Appendix A**) revealed that the smoking cessation program would cost approximately $87.1 per individual for a 1% decrease in mortality, making it

financially inefficient. We ultimately decided against pursuing this intervention due to financial considerations.

Hiking and Outdoor Activity Groups:

Leveraging the abundant natural landscape of Lumaria, including the Lumarian Luminous Lake, Skyreach and Whispering Woods, the program proposes hiking and outdoor activity groups. These groups provide a platform for policyholders to immerse in nature and engage in physical activities that promote fitness and well-being.

Sun Safety Awareness:

Complementing outdoor activity groups, the proposed program includes a comprehensive sun safety awareness campaign. Recognising the importance of mitigating sun-related risks, this initiative aims to educate and equip policyholders with the knowledge and tools to protect themselves whilst enjoying the outdoors.

Well-being Application:

As part of technological innovation, the proposed program includes a centralised well-being application (app). It will feature in-built awareness programs on sun safety, general well-being, and hiking and outdoor activities opportunities. This app will be integrated into potential existing brands like CommBank Yello, which has proven to increase customer engagement and participation (Wang, 2020). Moreover, through synchronisation with fitness watches, the app can track an individual's activity levels and overall health, allowing users to monitor their health proactively.

Program Evaluation

Monitoring the effectiveness and impact of the proposed program interventions is vital. Below is a comprehensive program evaluation and monitoring framework:

Short Term: Conduct annual reviews to track the number of participants engaging in hiking and outdoor activities. These reviews provide valuable insights into program uptake and participation rates, allowing refinement in strategies and initiatives.

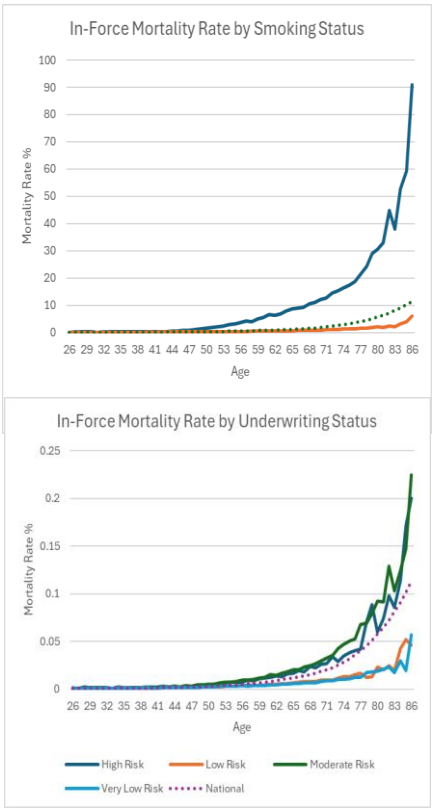
Long Term: On a 5-yearly basis, undertake thorough review to analyse the correlation between the reduction in mortality and the number of participants in outdoor activities groups. This long-term evaluation enables assessment of the program’s impact on overall health outcomes and mortality reduction, guiding future program enhancements and strategic decisions.

4. Pricing Impacts

To further support the chosen interventions, a quantitative approach to examine efficiency of each intervention - mortality reduction per cost. This was calculated by dividing the expected cost by the expected reduction in mortality. The lowest cost per reduction in mortality was heavily considered. Additionally, considering program goals in leveraging the vast outdoor landscape of Lemuria resulting in ‘Hiking and

Outdoor Activity Groups', 'Sun Safety Awareness', and the 'Well-being App'. (**Appendix A**)

5. Pricing Methodology



Through exploratory analysis, significant disparities in mortality rates between smoking status and underwriting class were found (See above images and **Appendix B**). To account for differences in mortality rates, a cox proportional hazard model was used to estimate relativities (see figure below). In forecasting future macroeconomic rates, ARIMA models were fitted for inflation (3,1,5) and the 1 year (4,1,9) and 10 year (4,1,3) spot rates (**Appendices C & D**).

The values under exp(coef) are interpreted as the hazard ratio increases applied to mortality rates. For example, smokers are 5.7 times more likely to die at a given age, according to the model. The products were priced according to the zero net present value (NPV) principle.

	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
as.factor(Sex)M	0.26105	1.29829	0.01113	23.461	< 2e-16	***
as.factor(Smoker.Status)S	1.73950	5.69448	0.01358	128.118	< 2e-16	***
as.factor(Underwriting.Class)low risk	-0.09510	0.90929	0.01811	-5.251	1.52e-07	***
as.factor(Underwriting.Class)moderate risk	0.04196	1.04285	0.01428	2.938	0.0033	**
as.factor(Underwriting.Class)very low risk	-0.23881	0.78756	0.01772	-13.474	< 2e-16	***

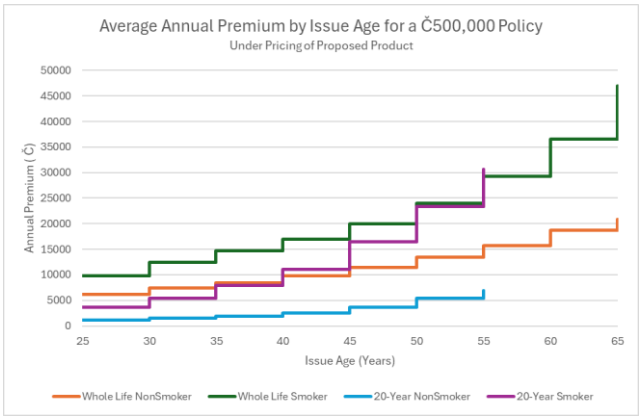
$$\text{Upfront cost} + \sum_{t=1}^{n} \frac{D_t}{(1+r)^t} + \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{P_t}{(1+r)^t} + \text{Interest earned}$$

The discounted value of expected inflows from premium (P) and interest are equated to the discounted expected value of outflows arising from claims (D) and expenses (C). Premiums were priced according to age group, policy type, underwriting and smoking status.

6. Pricing Results

The proposed product will be a 20-year or whole life product, priced according to policy type, age group, smoking status and underwriting class. The product is restricted by age likewise current products. When offered at the same price, SuperLife would expect to earn on average Č243.937 more from the proposed product than current offerings **(Appendix E)**. Through utilisation of the product's incentives, an individual aged 30 may also see an increase in life expectancy of up to 1.5 years (**Appendix F)**. Average annual premium for SuperLife's most popular insured amount is seen below.

In undergoing profit tests on the current inforce policyholders, our proposed prices under our central estimate assumptions incur an average loss of Č3.65, however, it must be noted that no profit margins were added with the intent that Superlife optimise profit margins according to their own sales targets and marketability.



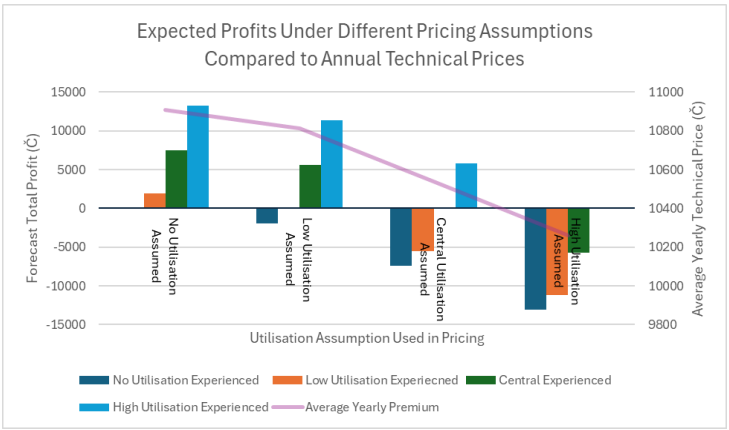
7. Sensitivity Testing

Sensitivity tests were conducted for 4 different incentive utilisation assumptions, and hence reductions in mortality (**Appendix I**). Performance was also tested under different combinations of the upper and lower 95% confidence intervals of both inflation and investment return. To ensure these values were feasible, they were also limited to their respective historical highs and lows. The current set of in-force active policyholders was used to model profitability and total values of profit and loss were averaged over the set of simulated policyholders. Profits and losses per policy in all sensitivity testing scenarios are presented in **Appendix G**.

The lowest average price, and hence most competitive, is attained when priced assuming all policyholders utilise initiatives to the highest extent. However, the greatest losses are incurred from poor utilisation of the initiatives under this assumption.

If priced assuming no or low utilisation, then the expected profit will be greater in cases where policyholders utilise more than what was priced for. Losses are also better contained. The greatest downside is that the product is no longer priced competitively, being Č29 per year more expensive than current life products offered by SuperLife **(Appendix E**).

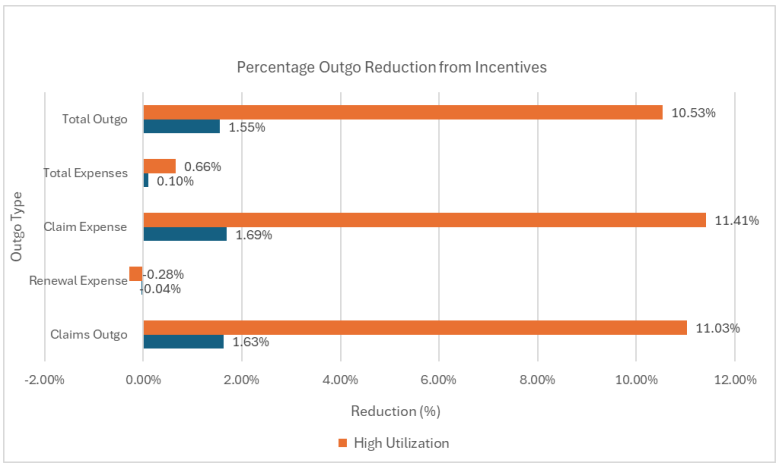
In pricing assuming the central estimate of utilisation, the average losses that would be incurred per policy are still relatively large, however, the pricing is now done assuming the average, and therefore, outlook is more reliable than that of the extreme cases. While an average total loss per policy of Č3.6 is estimated, in the context of being technically priced Č243.94 per year less than current products, added profit margin will provide profitability while maintaining competitiveness. In keeping prices competitive, the proposed product will add more value than SuperLife's current products on offer under these assumptions. All tested prices failed under extreme



scenarios of low investment returns. The product may still perform well under high inflation if investment returns are healthy, due to the assumption that indexation is limited to 5%p.a. However, high inflation coupled with low returns sees the product incur the greatest total losses. Risk management of inflation and investment returns is discussed in the Risk Mitigation section of the report.

Historical Implementation Savings

Projections were conducted on in-force policies over the past 20 years to evaluate the effect of different levels of intervention utilisation on expected deaths, claims outgo, and expense outgo. Hazard rate reductions from interventions reduced expected outgoings in claims and claims expense, simultaneously increasing the expected renewal expenses as customers are more likely to survive, hence are covered for longer. Initial expenses were unaffected by changes in mortality as they incur once at the start of policy.



Under the low utilisation assumption, total expected deaths were reduced by 1.69%, claims outgo decreased by 1.63%, and total expenses reduced by 0.10%, resulting in a 1.55% reduction in total outgo. Under the high utilisation assumption, total expected deaths were reduced by 11.42%, claims outgo decreased by 11.03%, and total expenses decreased by 0.66% leading to a 10.53% reduction in total outgo.

The results were then analysed splitting by age group and outgo type (**Appendix H**). Both assumptions exhibited the same trends in deaths and outgo reduction across age groups. Younger age ranges enjoy the highest percentage reductions in deaths and claims outgo and these reductions monotonically decrease with age. Meanwhile, expenses follow an opposite trajectory, with the older the age group the higher the percentage reduction in total expenses. Overall, this leads to the financial benefits of the program to be highest for middle aged policyholders between 45 - 49, tapering off at the younger and older extremes.

8. Assumptions

Rates of investment return and inflation - Modelled from historical one and ten-year spot rates and historical inflation rates using ARIMA modelling, with 95% CI intervals capped at the min and max historical values to model high and low-rate scenarios

Payment Patterns and Indexation - Claims and claim expenses are paid once at the end of the year of death, renewal expense is incurred at the beginning of the year, and initial expense is incurred once at the beginning of the first policy year. The face value lump sum of the amount insured is indexed to inflation at a maximum of

5% per year. There are no refunds upon lapse. Level premiums are paid at the start of each year, ceasing upon death and lapse.

Expenses - Claims expense of Č5000 is assumed per policyholder. Intervention costs of Č155, derived from the upper-bound total costs for all incentives implemented. Initial expenses are Č500 upon policy start and yearly renewal expenses are assumed to be Č200 at the start of each subsequent year of survival.

Death and mortality rates - The mortality rates are modelled according to discrete ages, assumed to be constant between ages.

Lapse Rate - Policyholders lapse on term completion and do not extend. Historical Lapse rates by age group, policy type and gender were used.

Interventions on mortality - Interventions are assumed to have an additive reduction in mortality rates, with levels of utilisation corresponding to different reductions in mortality. No utilisation leads to no reduction in mortality. A low level of utilisation corresponds to a 2.0 % reduction in mortality, While a high level of utilisation corresponds to a 13.4% reduction in the mortality rate. The central estimate is the average of the two limits, at a 7.7% reduction (**Appendix I**).

Key Assumptions to Costs - While costs of interventions may vary, the assumption is to take the upper limit of combined costs as a conservative measure. Unforeseen increases in recurring costs, translate to lower profit margins and even possible incurred losses. As demonstrated in sensitivity testing (**Appendix G**), scenarios in which rates of return differ to those expected will cause profitability to vary greatly.

Utilisation - It is conservative to price assuming a central estimate of utilisation according to the mortality changes given in the research provided by SuperLife.

9. Risk and Mitigations

There are risks related to the proposed program, however with careful attention, the risks can be mitigated. The risks and mitigation strategies are outlined in the following table. The likelihood and severity of risks have also been classified, with likelihood classes being (Infrequent, Occasional, Frequent) in increasing order of probability and severity classes (Negligible, Minor, Major) in increasing order of severity:

Risk (Likelihood /Severity)*	***Description of Risk***	***Mitigation Strategy***
Pricing Risk (Occasional / Major)	Risk of mispricing as data used could be skewed from the in force data set. This adverse selection could mean that high risk clients with higher premiums move to other insurers which don't use risk-based pricing [ANZIFF, 2020].	This has been mitigated by dividing the population of Lumania into age categories where similar/equal samples of each age group can be bootstrapped from the data, thus lessening the impact of incorrectly priced premiums.

Regulatory & Compliance Risk (Infrequent / Major)	Non-compliance of regulations with the possibility of SuperLife being exposed to legal penalties and financial forfeiture. Also, non-compliance with any anti-discrimination laws.	Conducting audits of SuperLife's financial position and statements. Periodic risk assessments should be carried out by in-house or external risk specialists and lawyers.
Reputational Risk (Infrequent / Major)	The risk of reputational damage to SuperLife. This can lead to reduction to SuperLife's future growth and earnings potential through damaged trust and impaired confidence with stakeholders and shareholders [Claringbold, 2023].	Sound risk assessment framework and PR team is required. Also mitigated by purchasing reputation insurance, which is a form of professional indemnity insurance and business interruption insurance [Claringbold, 2023].
Strategy Risk (Frequent / Major)	The health campaign may be received not as intended by the market. An example is Apple's health campaign "Close the Rings", author A. Furrows suggested over-reliance on technology has potential adverse psychological effects on users.	Through an integrated app with outdoor opportunities and catering to the younger demographics of Lumaria, should achieve the desired outcomes. The program also does not require smartwatches for it to work, unlike Apple.
Longevity Risk (Occasional / Major)	Assumptions around life expectancies and mortality rates are incorrect. There may be the risk of unprecedented events happening in the world which may affect the assumptions made in this report.	*The Financial Stability Review* [2006] suggests using updated mortality tables, mortality-linked securities, longevity bonds and mortality swaps to manage adverse mortality risk can hedge insurers against longevity risk.
Inflation Risk (Frequent / Minor)	Expected increase in the cost of doing business over time. Insurers also need to pricing their premiums at a competitive price such that their client's don't switch to their competitors.	Incorporating an indexation feature in policies to keep up with inflation. Also educating customers on potential impact of inflation on their coverage and risks. [Allianz 2023].
Operational Risk (Occasional / Minor)	Risk of integrating an app to existing platforms and ensuring appropriate maintenance is applied. Also failure of appropriately providing outdoor opportunities through our brand.	Establish protocols for continuous monitoring of app performance and user feedback. Automating processes and streamline operations to minimise risk.
Underwriting Risk (Frequent / Minor)	SuperLife underwriters incorrectly assess the overall risk on individuals taking out the policy, either via incurring unforeseen	Holding larger reserves to protect against potential higher claims outgo. Clarify to customers about

	circumstances, or underestimating liabilities.	misrepresentation and train underwriters to be risk alert.
Cyber Risk (Occasional / Major)	The wellbeing app and associated infrastructure (e.g. datacenters) being subject to cyber attacks resulting in leakage of customer and company data.	Partnering with an established software development company for app design, or leveraging existing, proven system architecture with robust security.
Market and Liquidity Risk (Infrequent / Major)	The risk of rate changes affecting assets held in reserves and overall return on capital funds. Also unable to liquidate assets in a timely manner to meet obligations hence becoming insolvency.	Preventative asset allocation that invests in a range of different asset classes to help insurers to spread their risk. [Allianz 2023]. Ensure correct asset - liability management strategies are applied and constantly reviewed.

For all degrees of utilisation modelled, historical life expectancy is increased for all ages (**Appendix F**). Considering the increase in profitability value to SuperLife, combined with the added value in benefits to policyholders, YES SIR is certain that the total value of the proposed product exceeds that of current life products.

10. Ethical Considerations

SuperLife's policies and product development will follow the Life Insurance Code of Practice in Lemuria (the Code). Similar to the Australian Code, it requires life insurers to offer products and services to an accurate, transparent and high standards [Life Insurance Code of Practice, 2023]. To adhere to this, the proposed program is a simple but effective solution. As the program only introduces a new feature, the fundamental policy wordings and claims processes remain the same. As such SuperLife, should be aware that its current processes are transparent and using appropriate sales techniques. Therefore, this program helps promote SuperLife's corporate social responsibilities by promoting well-being but also following the code by providing customers a high quality service.

Furthermore, the program involves a technological solution, hence there are ethical considerations on data and information privacy. The program will align to SuperLife's data and risk framework to support the ethical use of data and prevent any leaks of customer information. Furthermore, as a life insurer, it is important during the underwriting process to consider protected groups such as location and gender, YES SIR consulting has proposed pricing under different features, however SuperLife should consider Lumaria's anti-discrimination laws and adjust pricing appropriately.

11. Data Sources and Limitations

The data sources that supported the analysis of the program included SuperLife's inforce policies, Lumaria wikipedia page, and Lumarian economic and mortality data. External industry related research was also used to formulate the proposed program.

External data limitations

- No data on in market wellness programs and their results, for example reduction in mortality, increase in competitiveness and changes in revenue.
- Multinational corporations who did have such program (e.g. AIA) did not report financial end reports by region.
- Hard to find data on the effects of incentives on different health conditions, such as smoking, cancer and other health conditions.

Existing data Limitations

- Lumaria's macroeconomic variables were on an annual basis, which caused the rate forecasting to have a lack of granularity.
- Lumaria's mortality table was a combined version for both genders which is unrealistic as females generally have a longer life expectancy than males.
- In-force data set provided by Superlife had limited information on the health status of the insured and this limited the analysis on how chosen interventions would affect the mortality of each policyholder.

Therefore, the above limitations suggest uptake and utilisation of the program may be inaccurate, thus further surveys or focus groups need to be conducted within SuperLife's policyholders to obtain an improved view. Furthermore, the data limitations may cause deviations between forecasted and real returns. Hence, an expected versus actual analysis needs to be performed periodically to adjust pricing. With these ongoing measures, the proposed program can be refined to a greater extent.

12. Conclusion

The proposed program combines incentivising healthier behaviours and providing value to the customers and firm. The program introduces an application which promotes wellbeing and sun safety awareness with opportunities for hiking and outdoor activity groups. The financial analysis indicates that under normal circumstances, the proposed program will fare better than traditional products. However, there are risks and limitations which have been acknowledged and mitigation strategies were recommended.

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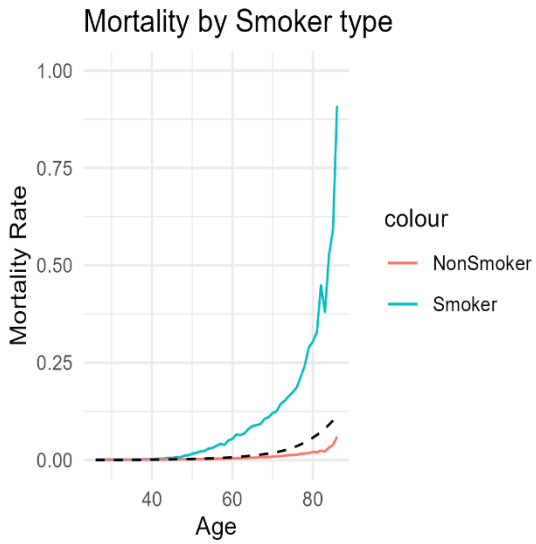
14. Appendix:

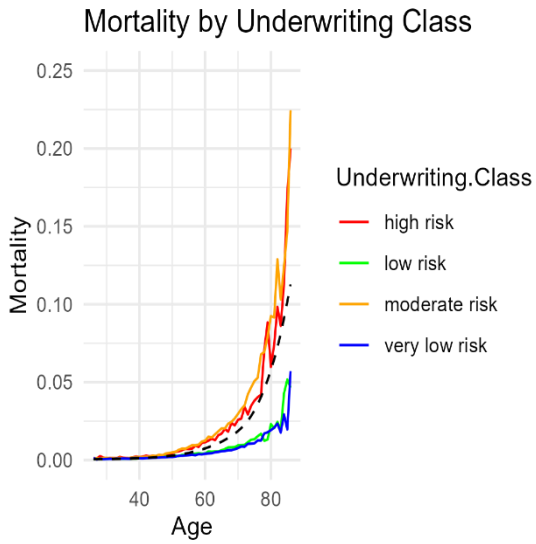
Appendix A - Intervention Efficiency Test

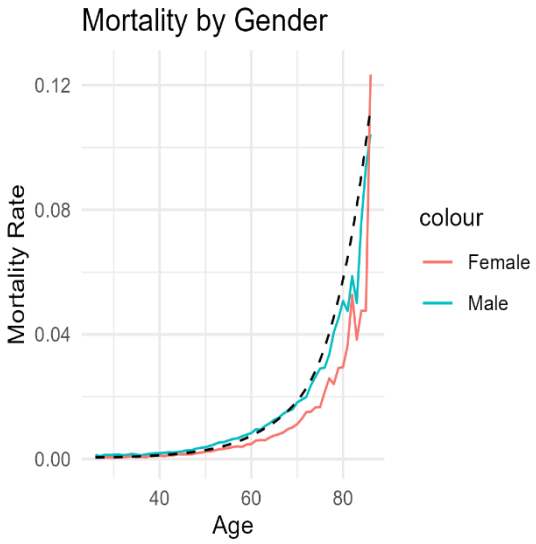
Intervention Name	Description	Approximate Impact on Mortality Rates	Lower	Upper	Average Impact	Approximate Per Capita Cost	Lower	Upper	Average Cost	Cost per Impact
Social Connection Initiatives	Encourage social activities to foster a sense of community and reduce isolation.	3-5% reduction in mortality	3	5	4	Ć10-Ć35 per social event	10	35	22.5	5.63
Safety Campaigns	Educate policyholders on safety measures at home and in daily activities.	3-5% reduction in mortality	3	5	4	Ć10-Ć35 per participant	10	35	22.5	5.63
Community Fitness Challenges	Organize community-based fitness challenges with rewards for participation.	2-5% reduction in mortality	2	5	3.5	Ć10-Ć35 per participant	10	35	22.5	6.43
Incentives for Preventive Screenings	Offer rewards for policyholders who undergo preventive health screenings.	5-10% reduction in mortality	5	10	7.5	Ć20-Ć85 per incentive	20	85	52.5	7.00
Cancer Prevention Initiatives	Provide resources and information on cancer prevention strategies.	5-10% reduction through early detection	5	10	7.5	Ć20-Ć85 per initiative	20	85	52.5	7.00
Healthy Eating Campaigns	Promote healthy eating habits through educational campaigns and incentives.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per participant	10	35	22.5	7.50
Online Health Resources	Provide access to online health resources for information and support.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per participant	10	35	22.5	7.50
Well-being Apps	Recommend and support the use of apps focused on mental and physical well-being.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per app	10	35	22.5	7.50
Sun Safety Awareness	Educate on sun safety to prevent skin cancer and other related conditions.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per campaign	10	35	22.5	7.50
Environmental Wellness	Promote awareness of environmental factors affecting health and well-being.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per campaign	10	35	22.5	7.50
Community Gardens	Support community gardens to promote access to fresh and healthy foods.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per garden plot	10	35	22.5	7.50
Parenting Support Services	Provide resources and support for parents to promote family well-being.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per session	10	35	22.5	7.50
Travel Safety Tips	Educate policyholders on travel safety to reduce risks during trips.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per campaign	10	35	22.5	7.50
Art and Creativity Classes	Promote engagement in artistic and creative pursuits for mental well-being.	2-4% reduction in mortality	2	4	3	Ć10-Ć35 per class	10	35	22.5	7.50
Hydration Campaigns	Promote the importance of staying hydrated for overall health.	2-3% reduction in mortality	2	3	2.5	Ć10-Ć35 per campaign	10	35	22.5	9.00
Holistic Stress Reduction	Promote holistic approaches to stress reduction, such as yoga and meditation.	3-8% reduction in mortality	3	8	5.5	Ć20-Ć85 per session	20	85	52.5	9.55
Mindfulness Programs	Introduce mindfulness and stress reduction programs.	3-8% reduction in mortality	3	8	5.5	Ć20-Ć85 per session	20	85	52.5	9.55
Incentives for Vaccinations	Encourage policyholders to stay up-to-date with vaccinations by offering incentives.	2-8% reduction in mortality	2	8	5	Ć20-Ć85 per incentive	20	85	52.5	10.50
Active Aging Programs	Encourage activities that promote active aging for elderly policyholders.	3-6% reduction in mortality	3	6	4.5	Ć20-Ć85 per program	20	85	52.5	11.67
Sleep Hygiene Programs	Educate on the importance of good sleep hygiene for overall health.	3-5% reduction in mortality	3	5	4	Ć20-Ć85 per program	20	85	52.5	13.13
Home Safety Inspections	Offer resources for home safety inspections to prevent accidents.	3-5% reduction in mortality	3	5	4	Ć20-Ć85 per inspection	20	85	52.5	13.13
Hiking and Outdoor Activities Groups	Facilitate outdoor activities groups to promote physical activity.	3-6% reduction in mortality	3	5	4	Ć20-Ć85 per group	20	85	52.5	13.13
Cognitive Health Programs	Offer resources and activities to support cognitive health.	3-6% reduction in mortality	3	5	4	Ć20-Ć85 per program	20	85	52.5	13.13
Financial Incentives for Healthy Behavior	Offer premium discounts or cash rewards for maintaining healthy behaviors.	2-5% reduction in mortality	2	5	3.5	Ć20-Ć85 per incentive	20	85	52.5	15.00
Incentives for Regular Medication Adherence	Offer rewards for policyholders who consistently adhere to prescribed medications.	2-5% reduction in mortality	2	5	3.5	Ć20-Ć85 per incentive	20	85	52.5	15.00
Educational Workshops	Conduct workshops on healthy living, disease prevention, and general well-being.	2-4% reduction in overall mortality	2	4	3	Ć20-Ć85 per workshop	20	85	52.5	17.50
Emergency Preparedness Training	Provide resources and training for emergency preparedness.	2-4% reduction in mortality	2	4	3	Ć20-Ć85 per trainining session	20	85	52.5	17.50
Holistic Nutrition Education	Provide education on the benefits of a balanced and holistic approach to nutrition.	2-4% reduction in mortality	2	4	3	Ć20-Ć85 per session	20	85	52.5	17.50
Financial Literacy Workshops	Conduct workshops on financial literacy to reduce stress related to money management.	2-4% reduction in mortality	2	4	3	Ć20-Ć85 per workshop	20	85	52.5	17.50
Ergonomic Workstation Assessments	Conduct ergonomic workstation assessments to address workplace ergonomics.	2-4% reduction in mortality	2	4	3	Ć20-Ć85 per assessment	20	85	52.5	17.50
Fitness Tracking Incentives	Provide rewards for policyholders using fitness trackers to monitor and improve physical acti	3-6% reduction in mortality	3	6	4.5	Ć35-Ć175 per tracker	35	175	105	23.33
Telemedicine Services	Provide access to virtual healthcare services for convenience and timely medical advice.	3-5% reduction in mortality	3	5	4	Ć50-Ć175 per consultation	50	175	112.5	28.13
Heart Health Screenings	Encourage regular screenings for cholesterol levels and blood pressure.	5-10% reduction in mortality	5	10	7.5	Ć90-Ć345 per screening	90	345	217.5	29.00
Mental Health Support	Provide access to mental health resources and counseling services.	3-8% reduction in mortality	3	8	5.5	Ć90-Ć345 per counseling session	90	345	217.5	39.55
Driving Safety Courses	Offer discounts for policyholders who complete defensive driving courses.	2-4% reduction in mortality	2	4	3	Ć85-Ć175 per course	85	175	130	43.33
Personalized Health Plans	Offer personalized health plans based on individual risk factors and goals.	3-6% reduction in mortality	3	6	4.5	Ć90-Ć345 per plan	90	345	217.5	48.33
Alcohol Moderation Programs	Offer resources and support for policyholders looking to moderate alcohol consumption.	3-6% reduction in mortality	3	6	4.5	Ć90-Ć345 per program	90	345	217.5	48.33
Holistic Health Assessments	Conduct holistic health assessments to address physical, mental, and emotional well-being.	3-6% reduction in mortality	3	6	4.5	Ć90-Ć345 per assessment	90	345	217.5	48.33
Employee Assistance Programs	Extend support services to family members of policyholders through workplace programs.	3-5% reduction in mortality	3	5	4	Ć90-Ć345 per counseling session	90	345	217.5	54.38
Mind-Body Wellness Retreats	Organize wellness retreats focusing on mind-body balance.	3-6% reduction in mortality	3	5	4	Ć90-Ć345 per retreat	90	345	217.5	54.38
Wellness Programs	Programs focusing on physical fitness, nutrition, and stress management.	2-5% reduction in overall mortality	2	5	3.5	Ć90-Ć345 per year	90	345	217.5	62.14
Annual Health Check-ups	Encourage regular health check-ups with discounts for compliance.	5-10% reduction in mortality	5	10	7.5	Ć175-Ć870 per check-up	175	870	522.5	69.67
Weight Management Programs	Support weight loss and maintenance through diet and exercise programs.	5-10% reduction in mortality	5	10	7.5	Ć175-Ć870 per program	175	870	522.5	69.67
Chronic Disease Management	Provide support and resources for policyholders managing chronic conditions.	5-10% reduction in mortality	5	10	7.5	Ć175-Ć870 per program	175	870	522.5	69.67
Financial Planning Assistance	Help policyholders with financial planning to reduce stress related to economic concerns.	2-4% reduction in mortality	2	4	3	Ć90-Ć345 per session	90	345	217.5	72.50
Regular Dental Check-ups	Stress the importance of oral health and offer discounts for regular dental check-ups.	2-4% reduction in mortality	2	4	3	Ć90-Ć345 per check-up	90	345	217.5	72.50

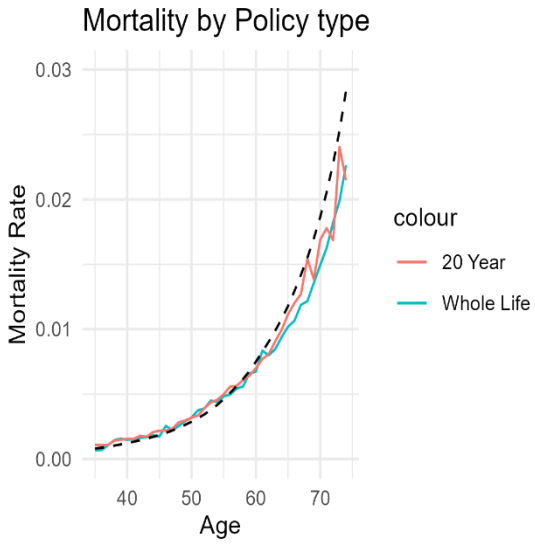
Appendix B- Exploratory Data Analysis of Mortality Rates

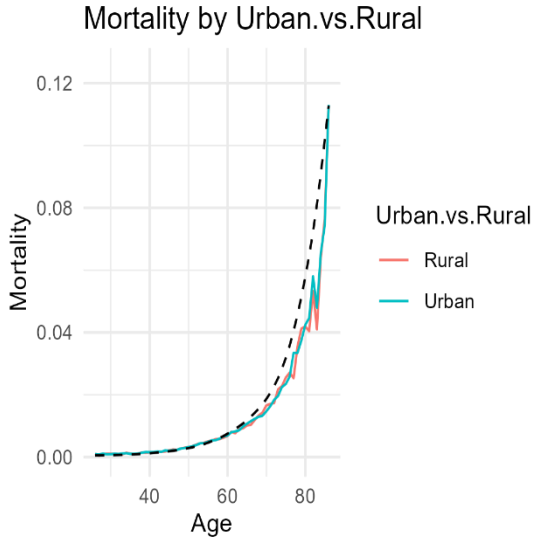
The greatest differences between classes occur in smoking type, followed by underwriting class and then gender. Policy type, and urban-rural classification saw minimal difference between rates, with mortality rates breaking down in older years due to less exposure. This effect was particularly present in plots of region and face amount, where insufficient exposure causes unreliable mortality rates between groups.

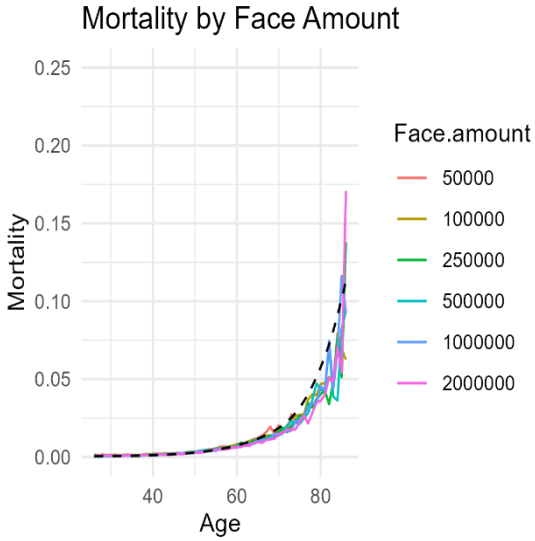


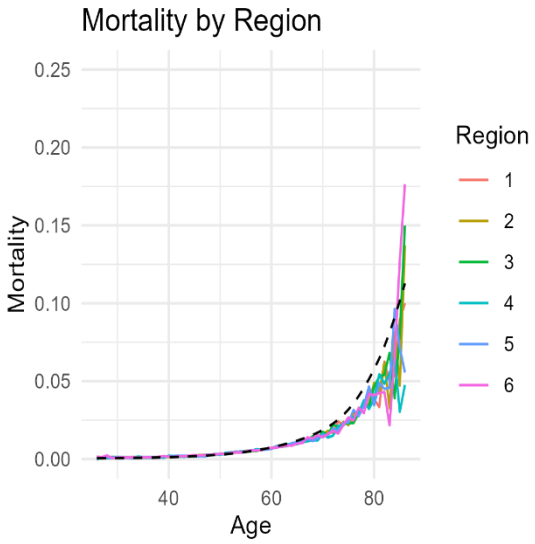



Mortality by Gender
Mortality Rate
0.12
0.08
0.04
0.00
40
60
80
Age
colour
Female
Male

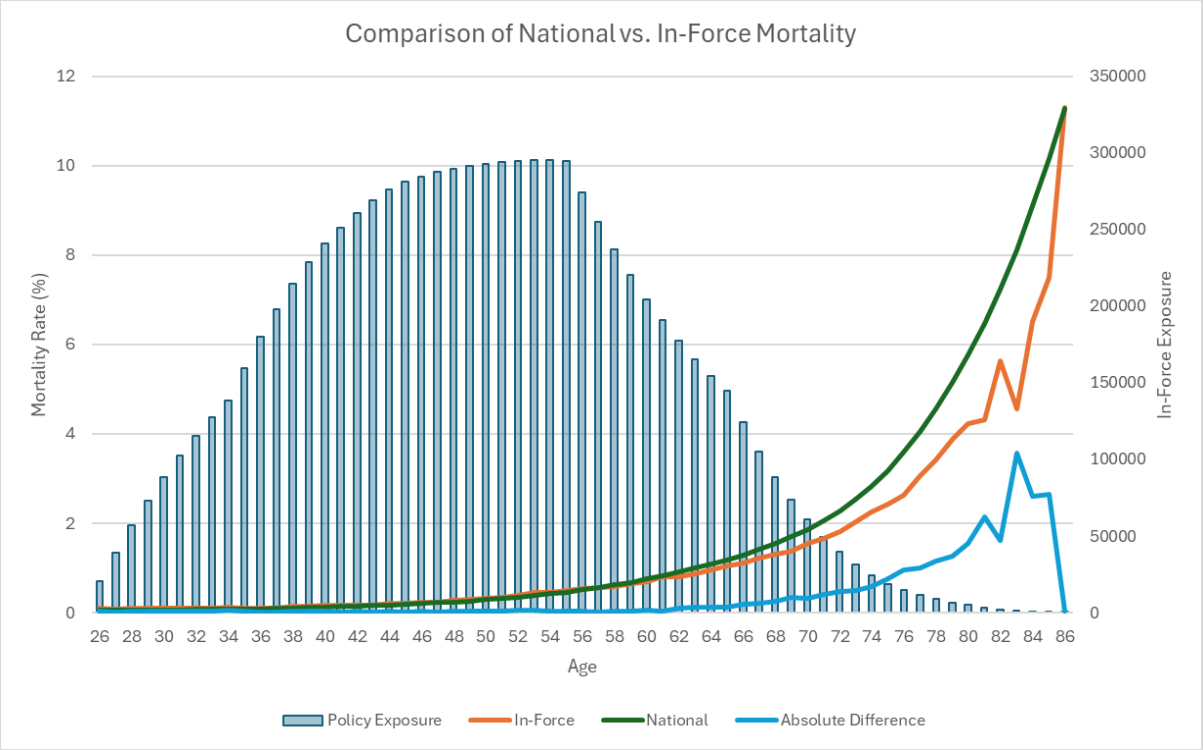

Mortality by Policy type
Mortality Rate
0.03
0.02
0.01
0.00
40
50
60
70
Age
colour
20 Year
Whole Life


Mortality by Urban.vs.Rural
Mortality
0.12
0.08
0.04
0.00
40
60
80
Age
Urban.vs.Rural
Rural
Urban


Mortality by Face Amount
Mortality
0.25
0.20
0.15
0.10
0.05
0.00
40
60
80
Age
Face.amount
50000
100000
250000
500000
1000000
2000000


Mortality by Region
Mortality
0.25
0.20
0.15
0.10
0.05
0.00
40
60
80
Age
Region
1
2
3
4
5
6

Below is a plot comparing the total in-force mortality to Lumaria's mortality from 2024 general population mortality table. Included in the plot is a line denoting the absolute difference between the two rates. In-force mortality follows the national mortality very accurately for ages where there is sufficient exposure. This difference increases as policyholders age and exposure decreases.
This analysis gave grounds to assume that SuperLife's past and current book of policyholders have a death distribution that follows the national distribution of deaths.



Appendix C - ADF Test

Macroeconomic Rates were forecasted as part of the pricing, namely, inflation, one-year and ten-year spot rates. The rates were forecasted using an ARIMA model, due to its simplicity and interpretability. To ensure an ARIMA model worked, the Dickey Fuller test was utilised on all three rates resulting in a p-value outside of the 0.05 (**see below**) which meant with zero differencing. The data was not stationary hence not suitable for ARIMA modelling. Therefore for all three rates, the data was differenced once to ensure it was stationary.

Inflation

```
        Augmented Dickey-Fuller Test

data:  ts_data
Dickey-Fuller = -2.4651, Lag order = 3, p-value = 0.3867
alternative hypothesis: stationary

> adf.test(diff_ts_data)

        Augmented Dickey-Fuller Test

data:  diff_ts_data
Dickey-Fuller = -4.1286, Lag order = 3, p-value = 0.01
alternative hypothesis: stationary
```

One Year Spot Rate

```
        Augmented Dickey-Fuller Test

data:  ts_data
Dickey-Fuller = -2.5029, Lag order = 3, p-value = 0.3713
alternative hypothesis: stationary

> adf.test(diff_ts_data)

        Augmented Dickey-Fuller Test

data:  diff_ts_data
Dickey-Fuller = -4.9656, Lag order = 3, p-value = 0.01
alternative hypothesis: stationary
```

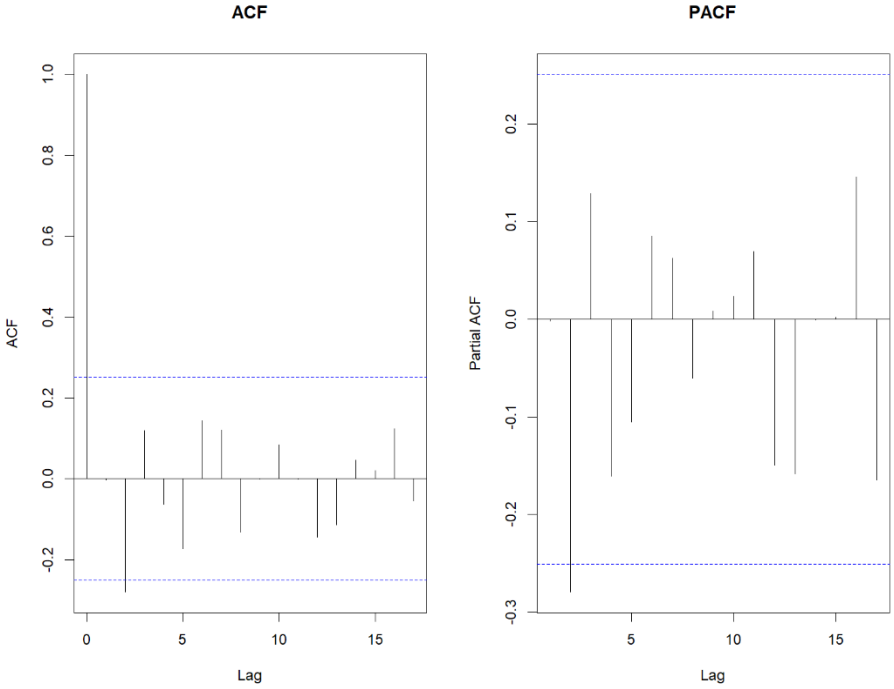
Ten Year Spot Rate

```
        Augmented Dickey-Fuller Test

data:  ts_data
Dickey-Fuller = -2.327, Lag order = 3, p-value = 0.4425
alternative hypothesis: stationary

> adf.test(diff_ts_data)

        Augmented Dickey-Fuller Test

data:  diff_ts_data
Dickey-Fuller = -3.8039, Lag order = 3, p-value = 0.02422
alternative hypothesis: stationary
```

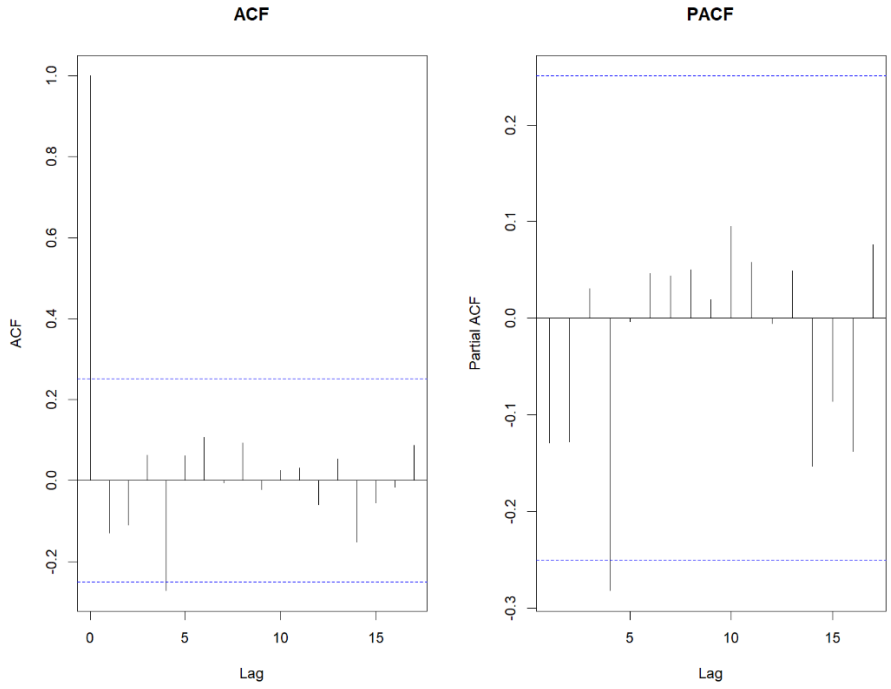
Appendix D - ACF and PAC

The macroeconomic forecasting data was split into 80:20 training and testing sets. The ARIMA parameters are determined through examining the autocorrelation function for the AR(p) term and partial autocorrelation function for the MA(q) term, refer to **(see below).** Finally, the following ARIMA models were selected: Inflation - ARIMA(3,1,5), One Year Spot - ARIMA(4,1,9) and Ten Year Spot - ARIMA(4,1,3).

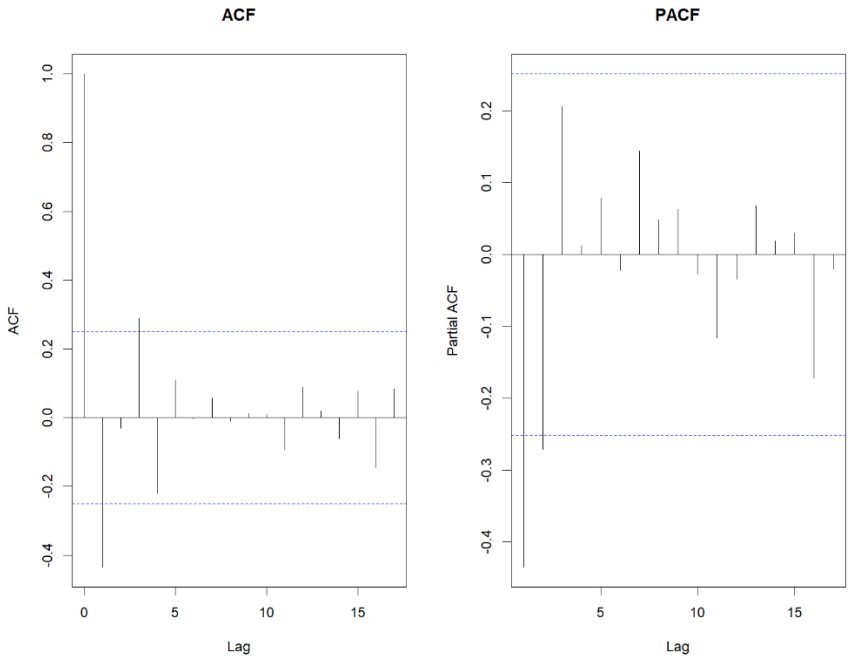
Inflation



One Year Spot Rate



Ten Year Spot Rate



Appendix E: Weighted Average of technical prices by current in-force policies

Product	Average Yearly Technical Premium	Increase (Reduction) in Premium
No Intervention	10784	0
Intervention Costs, No utilisation	10907.5	123.5006
Low Utilisation Assumed	10813.01	29.00851
Central Estimate of Utilisation Assumed	10540.07	(243.937)
High Utilisation Assumed	10260.15	(523.855)

Appendix F: Expected Lifetime by Age Group, Policy and Smoking Status

Age Group	Smoker Status	Expected Lifetime with No Intervention	Low Utilisation Expected Lifetime	Central Estimate Utilisation Expected Lifetime	High Utilisation Expected Lifetime
<30	NS	54.63924	54.83813	55.42671	56.05335
<30	S	37.201	37.40805	38.02029	38.67097
30-34	NS	46.41579	46.61019	47.1859	47.7995
30-34	S	29.74963	29.94174	30.51081	31.11727
35-40	NS	41.81438	42.00585	42.57319	43.17837
35-40	S	23.929	24.10953	24.64531	25.21796
40-44	NS	37.05924	37.24675	37.8027	38.39629
40-44	S	20.31691	20.48611	20.98896	21.52748
45-49	NS	32.40836	32.59077	33.13204	33.71066
45-49	S	17.26877	17.42622	17.89472	18.39739
50-54	NS	27.87877	28.05458	28.57683	29.136
50-54	S	13.89643	14.03883	14.46333	14.92003
55-59	NS	23.52458	23.69183	24.18933	24.72311
55-59	S	10.69817	10.82283	11.19529	11.59742
60-64	NS	19.40255	19.55892	20.02492	20.52629
60-64	S	7.945234	8.050165	8.364523	8.705318
65-69	NS	16.97434	17.123	17.56659	18.04482

65-69	S	5.59868	5.683031	5.936554	6.212774
70-74	NS	11.74222	11.86975	12.25177	12.66599
70-74	S	3.596451	3.660915	3.85545	4.068731
75-79	NS	9.752517	9.870357	10.22404	10.60868
75-79	S	2.5589	2.612323	2.773998	2.952027

Appendix G: Sensitivity Testing Results

Sensitivity Testing Results When Priced for No Utilisation

Level of Utilisation	Best Estimate	Lower Bound Inflation, Lower Bound Investment Return	Upper Bound Inflation, Upper Bound Investment Return	Lower Bound Inflation, Upper Bound Investment Return	Upper Bound Inflation, Lower Bound Investment Return
No Utilisation	-4.34219	-80263.1	83666.05	1770334	-5218.54
Low Utilisation	1905.66	-78161.6	84688.03	1780043	-4284.41
Central Utilisation	7474.933	-71996.1	87638.42	1808594	-1584.65
High Utilisation	13268.72	-65518.1	90660.02	1838686	1185.259

Sensitivity Testing Results When Priced for Low Utilisation

Level of Utilisation	Best Estimate	Lower Bound Inflation, Lower Bound Investment Return	Upper Bound Inflation, Upper Bound Investment Return	Lower Bound Inflation, Upper Bound Investment Return	Upper Bound Inflation, Lower Bound Investment Return
No Utilisation	-1910.47	-82541.4	82208.48	1755166	-5874.35
Low Utilisation	-4.16291	-80450.1	83228.79	1764814	-4940.97
Central Utilisation	5554.378	-74314.8	86174.35	1793185	-2243.36
High Utilisation	11337.08	-67868.8	89191.04	1823086	524.3357

Sensitivity Testing Results When Priced for Central Estimate of Utilisation

Level of Utilisation	Best Estimate	Lower Bound Inflation, Lower Bound Investment Return	Upper Bound Inflation, Upper Bound Investment Return	Lower Bound Inflation, Upper Bound Investment Return	Upper Bound Inflation, Lower Bound Investment Return
No Utilisation	-7426.57	-89138.2	77994.01	1711097	-7769.38
Low Utilisation	-5531.01	-87076.5	79009.46	1720567	-6838.17
Central Utilisation	-3.64734	-81028.9	81941.05	1748411	-4146.83
High Utilisation	5746.835	-74676.3	84943.45	1777757	-1385.53

Sensitivity Testing Results When Priced for High Utilisation

Level of Utilisation	Best Estimate	Lower Bound Inflation, Lower Bound Investment Return	Upper Bound Inflation, Upper Bound Investment Return	Lower Bound Inflation, Upper Bound Investment Return	Upper Bound Inflation, Lower Bound Investment Return
No Utilisation	-13099.8	-95928.4	73665.2	1665493	-9713.91
Low Utilisation	-5720.27	-87940.7	77592.79	1702075	-6100.08
Central Utilisation	-11215.4	-93897.4	74675.65	1674777	-8784.95
High Utilisation	-3.12284	-81685	80580.43	1730844	-3345.38

Appendix H: Past 20 years mortality testing results

All policies recorded in the in force dataset were projected over the time frame 2004 - 2023 to find expected deaths and outgo using hazard rates under no interventions, low intervention utilisation, and high intervention utilisation assumptions. The expected outgo was adjusted for inflation to 2023 Lumarian.

Expected claims and expenses outgo without interventions:

Group	Claims	Initial Expense	Renewal Expense	Claim Expense	Total Expenses	Total Outgo
total	43110.69	462.57	1,570.22	165.83	2,198.62	45,309.31
Under 30	4840.04	468.95	1,684.66	26.46	2,180.07	7,020.10
30 - 39	10430.99	459.59	1,644.94	47.13	2,151.66	12,582.64
40 - 44	19841.49	462.48	1,594.72	82.69	2,139.89	21,981.38
45 - 49	31,307.04	462.18	1,585.69	125.16	2,173.03	33,480.06
50 - 54	48,953.67	462.27	1,565.44	193.23	2,220.94	51,174.61
55 - 59	101,825.76	455.57	1,453.67	372.95	2,282.20	104,107.96
60 - 64	182,938.15	481.43	1,234.20	669.04	2,384.67	185,322.82
65 +	276,712.33	451.73	1,233.33	955.62	2,640.68	279,353.01

Expected claims and expenses outgo with low utilisation of interventions:

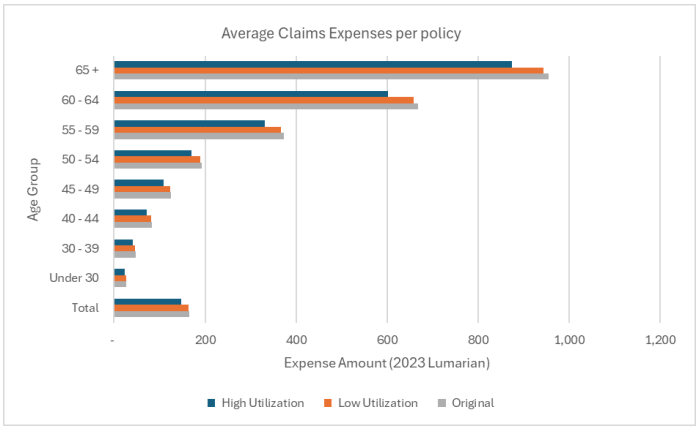
Group	Claims	Initial Expense	Renewal Expense	Claim Expense	Total Expenses	Total Outgo
total	42,409.70	462.57	1,570.87	163.04	2,196.48	44,606.17
Under 30	4,744.49	468.95	1,684.78	25.93	2,179.66	6,924.15
30 - 39	10,226.89	459.59	1,645.14	46.21	2,150.93	12,377.82
40 - 44	19,460.18	462.48	1,595.07	81.10	2,138.65	21,598.82
45 - 49	30,721.86	462.18	1,586.21	122.80	2,171.19	32,893.05
50 - 54	48,074.87	462.27	1,566.23	189.73	2,218.23	50,293.10
55 - 59	100,182.75	455.57	1,455.15	366.74	2,277.46	102,460.21
60 - 64	180,415.70	481.43	1,236.60	659.28	2,377.31	182,793.02

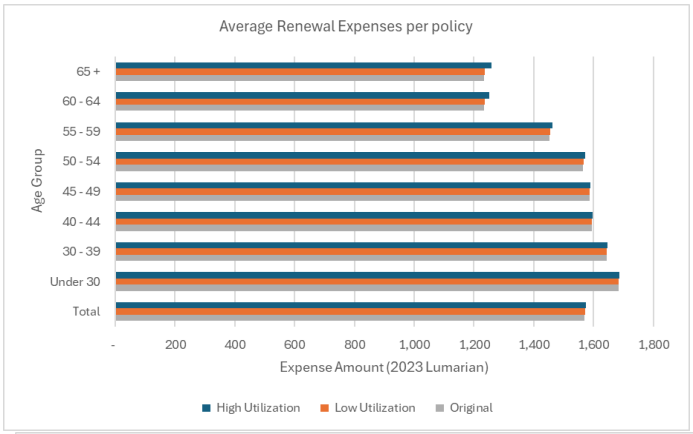
65 +	273,568.13	451.73	1,236.85	943.76	2,632.35	276,200.48

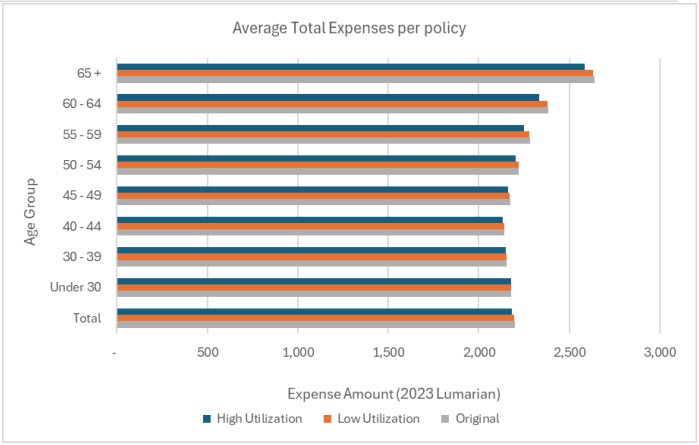
Expected claims and expenses outgo with high utilisation of interventions:

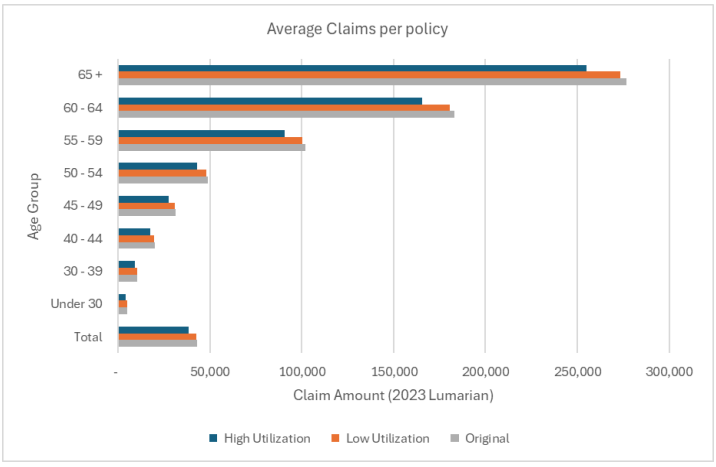
Group	Claims	Initial Expense	Renewal Expense	Claim Expense	Total Expenses	Total Outgo
total	38,355.32	462.57	1,574.64	146.91	2,184.12	40,539.43
Under 30	4,200.37	468.95	1,685.45	22.96	2,177.36	6,377.72
30 - 39	9,063.23	459.59	1,646.28	40.95	2,146.82	11,210.05
40 - 44	17,281.27	462.48	1,597.03	72.02	2,131.53	19,412.80
45 - 49	27,367.42	462.18	1,589.16	109.32	2,160.65	29,528.08
50 - 54	43,016.54	462.27	1,570.76	169.57	2,202.60	45,219.14
55 - 59	90,644.63	455.57	1,463.66	330.76	2,249.99	92,894.62
60 - 64	165,656.84	481.43	1,250.62	602.34	2,334.39	167,991.23
65 +	254,990.90	451.73	1,257.62	874.05	2,583.41	257,574.31

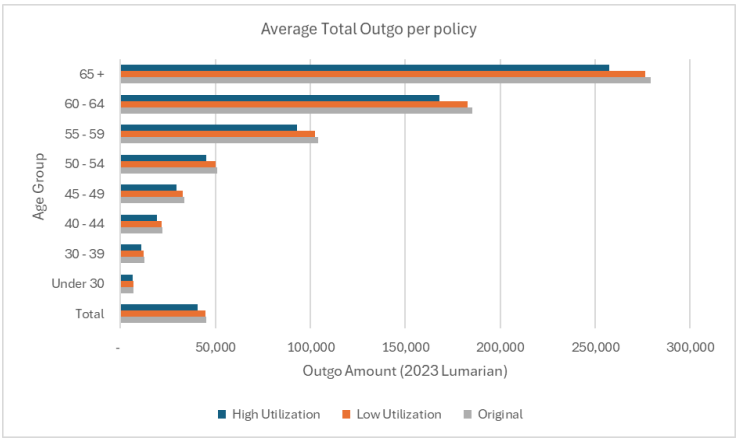
Graphs:




Average Renewal Expenses per policy
65 +
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
30 - 39
Under 30
Total
Age Group
-
200
400
600
800
1,000
1,200
1,400
1,600
1,800
Expense Amount (2023 Lumarian)
High Utilization
Low Utilization
Original


Average Total Expenses per policy
65 +
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
30 - 39
Under 30
Total
Age Group
-
500
1,000
1,500
2,000
2,500
3,000
Expense Amount (2023 Lumarian)
High Utilization
Low Utilization
Original


Average Claims per policy
65 +
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
30 - 39
Under 30
Total
Age Group
-
50,000
100,000
150,000
200,000
250,000
300,000
Claim Amount (2023 Lumarian)
High Utilization
Low Utilization
Original


Average Total Outgo per policy
65 +
60 - 64
55 - 59
50 - 54
45 - 49
40 - 44
30 - 39
Under 30
Total
Age Group
-
50,000
100,000
150,000
200,000
250,000
300,000
Outgo Amount (2023 Lumarian)
High Utilization
Low Utilization
Original

Change in Claims and Expenses by age group:

Claims outgo reductions:

	Total	Under 30	30 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
Low Utilisation	1.63%	1.97%	1.96%	1.92%	1.87%	1.80%	1.61%	1.38%	1.14%
High Utilisation	11.03%	13.22%	13.11%	12.90%	12.58%	12.13%	10.98%	9.45%	7.85%

Total expenses reductions:

	Total	Under 30	30 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
Low Utilisation	0.10%	0.02%	0.03%	0.06%	0.08%	0.12%	0.21%	0.31%	0.32%
High Utilisation	0.66%	0.12%	0.22%	0.39%	0.57%	0.83%	1.41%	2.11%	2.17%

Renewal Expenses increases:

	Total	Under 30	30 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
Low Utilisation	0.04%	0.01%	0.01%	0.02%	0.03%	0.05%	0.10%	0.19%	0.29%
High Utilisation	0.28%	0.05%	0.08%	0.14%	0.22%	0.34%	0.69%	1.33%	1.97%

Claims Expenses reductions:

	Total	Under 30	30 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
Low Utilisation	1.69%	1.98%	1.96%	1.92%	1.88%	1.81%	1.67%	1.46%	1.24%
High Utilisation	11.41%	13.23%	13.11%	12.90%	12.66%	12.25%	11.31%	9.97%	8.54%

Total Outgo (Claims + Expenses) reductions:

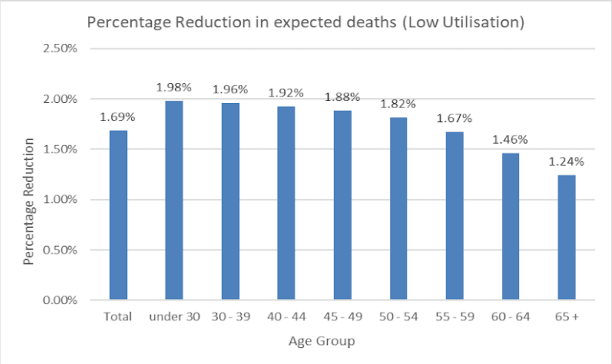
	Total	Under 30	30 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
Low Utilisation	1.55%	1.37%	1.63%	1.74%	1.75%	1.72%	1.58%	1.37%	1.13%
High Utilisation	10.53%	9.15%	10.91%	11.69%	11.80%	11.64%	10.77%	9.35%	7.80%

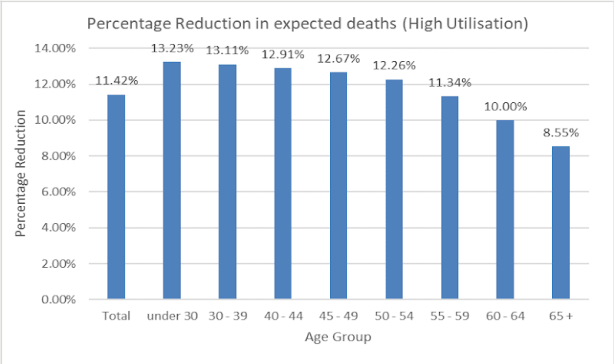
Total expected deaths in the in force dataset with and without interventions:

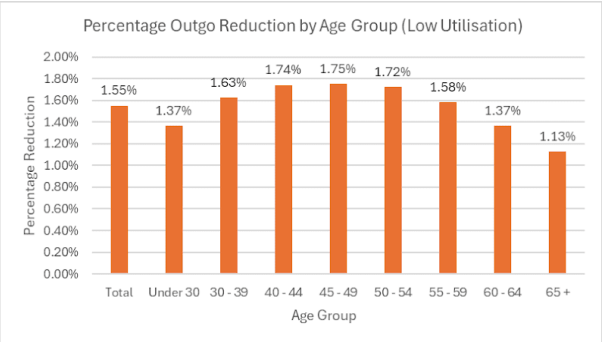
	No Intervention		Low Utilisation		High Utilisation	
	Total expected deaths	Average deaths per policy	Total expected deaths	Average deaths per policy	Total expected deaths	Average deaths per policy
Total	32,988.86	0.0337	32,432.23	0.0331	29,220.08	0.0299
Under 30	417.83	0.0054	409.57	0.0053	362.53	0.0047
30 - 39	2,505.90	0.0096	2,456.87	0.0094	2,177.35	0.0083
40 - 44	2,701.67	0.0168	2,649.72	0.0164	2,352.89	0.0146
45 - 49	4,079.92	0.0254	4,003.10	0.0249	3,563.09	0.0222
50 - 54	6,309.44	0.0392	6,194.81	0.0385	5,535.79	0.0344
55 - 59	6,328.56	0.0758	6,222.88	0.0746	5,611.01	0.0672
60 - 64	8,159.43	0.1362	8,040.06	0.1342	7,343.83	0.1225
65 +	2,486.12	0.1959	2,455.23	0.1935	2,273.58	0.1792

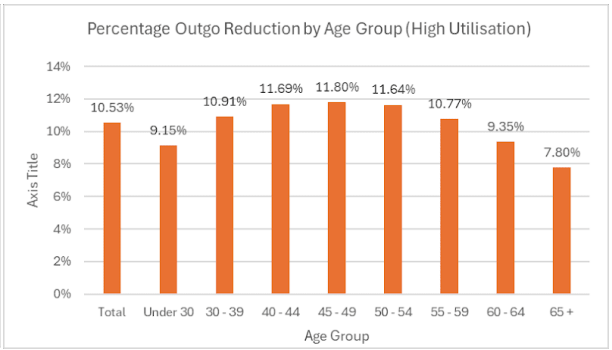
Percentage in reduction of expected deaths from utilisation of interventions, split by age group:

	Total	Under 30	30 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 +
Low Utilisation	1.69%	1.98%	1.96%	1.92%	1.88%	1.82%	1.67%	1.46%	1.24%
High Utilisation	11.42%	13.23%	13.11%	12.91%	12.67%	12.26%	11.34%	10.00%	8.55%






Percentage Outgo Reduction by Age Group (Low Utilisation)
Percentage Reduction
2.00%
1.80%
1.60%
1.40%
1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
1.55%
1.37%
1.63%
1.74%
1.75%
1.72%
1.58%
1.37%
1.13%
Total
Under 30
30 - 39
40 - 44
45 - 49
50 - 54
55 - 59
60 - 64
65 +
Age Group


Percentage Outgo Reduction by Age Group (High Utilisation)
Axis Title
14%
12%
10%
8%
6%
4%
2%
0%
10.53%
9.15%
10.91%
11.69%
11.80%
11.64%
10.77%
9.35%
7.80%
Total
Under 30
30 - 39
40 - 44
45 - 49
50 - 54
55 - 59
60 - 64
65 +
Age Group

Appendix I: Selected Interventions From SuperLife's Provided Research

Intervention Name	Description	Approximate Impact on Mortality Rates	Approximate Per Capita Cost	Average Cost-to-Impact
Well-being Apps	Recommend and support the use of apps focused on mental and physical well-being.	2-4% reduction in mortality	Č10-Č35 per app	Č7.50
Sun Safety Awareness	Educate on sun safety to prevent skin cancer and other related conditions.	2-4% reduction in mortality	Č10-Č35 per campaign	Č7.50
Hiking and Outdoor Activities Groups	Facilitate outdoor activities groups to promote physical activity.	3-6% reduction in mortality	Č20-Č85 per group	Č13.13

Upper Bound Impact = (1-4%) * (1-4%) *(1-6%) => 1 - 86.6% = 13.37% total reduction

Lower Bound Impact = 2% total reduction