Lumaria

SuperLife Saving Lives

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Prepared By
Team: ActuaInsight Consulting
Members:
Anoushay Khan
Arneet Kalra
Karan Deshwal
Luis Alvarez Rodriguez
Tom Mihaljevic

Table of Contents

Executive Summary

ActualInsight, an actuarial consulting firm, has been engaged by SuperLife, a life insurance agency, to enhance its policyholders' expected mortality. In response, our team has devised four incentive programs: a smoking cessation program, annual health screenings, an active aging initiative, and a fitness tracking program. The primary objectives of these programs are to incentivize healthy behaviours, decrease expected mortality, increase sales, improve marketability, and add economic value to SuperLife.

The proposed program design is rooted in data analysis at the policyholder level, ensuring tailored interventions for maximum effectiveness. Short-term and long-term evaluations have been delineated for each incentive to gauge program efficacy, participant engagement, and health outcomes over time.

Mortality rates were calculated for four cohorts: male smokers, male non-smokers, female smokers, and female non-smokers, providing essential insights for premium determination. Premium calculations were executed in R, followed by financial modelling in Excel.

Risk and risk mitigation considerations have been intricately woven into the report to proactively address potential challenges and uncertainties. Given the inherent limitations and uncertainties of the data, various assumptions were made based on internal data and supplementary research, with detailed rationale and analysis provided in the Appendix. These measures ensure a robust and resilient program implementation strategy.

1. Objectives

1.1 Background

The proposed targeted health incentives in SuperLife's life insurance policies are designed to ensure that SuperLife's policyholders have an improved expected mortality after the policyholder has purchased a life insurance policy. The health interventions/incentives aim to increase healthy behaviours through participation, decrease expected mortality and add economic value to SuperLife through improved marketability and competitiveness as that would increase sales of their long-term life insurance products. More details are below:

1.2 Objectives

A) Incentivise healthy behaviours through the product design.

- Smoking Cessation Program
- Annual Health Screenings (includes Heart Health, Lung Health, and Cancer Prevention Initiatives)
- Active Ageing
- Fitness Tracking Program
- Decrease expected mortality rates.
- Healthy behaviours from incentives should lead to lower mortality rates.
- Increased healthy behaviours leads to reductions in policyholder mortality
- Enhance product marketability and competitiveness.
- Promotion of health programs improves marketability.
- Decreased expected mortality rates would lead to more competitive premiums.

B) Increase sales of life insurance policies.

- Improvements in marketability and competitiveness should lead to increased sales of life insurance policies.

C) Add economic value to SuperLife's offerings.

- More policies imply more premiums and hence sustained profits in the long term.

1.3 Program Metrics

The program's success will be assessed using the following targets:

Incentive Participation Rates	Customer Satisfaction Surveys	Increases in SuperLife's Economic Value
Claims Frequency	Policy Sales	Reduced Mortality Rates

2. Product Design

The primary objective of life insurance is to protect policyholders from the risk of premature death. The team at ActualInsight has carefully designed the following programs to ensure that SuperLife is not only covering policyholders from such risks but also to actively mitigate risk. The product design incorporates four primary interventions/incentives, meticulously derived from data-driven insights based on policyholder-level data analysis.

Due to the distinct nature of the two products offered by SuperLife, certain programs may be more applicable for either policy type. However, due to the unknown nature of applicability, the program intervention currently assumes equal effectiveness and participation across both policy types. This assumption is a key consideration in the Short Term and Long-Term monitoring processes.

2.1 Smoking Cessation Program

Cigarette smoking can have adverse impacts on the human body in the long term and opens avenues for multiple diseases that can be of great severity. According to the National Library of Medicine (2020), smoking causes a 70% increase in risk for adverse health conditions. This is evident in the data as the death rate for smokers is approximately 8x higher than non-smokers as seen in Figure 2.

SuperLife's Smoking Cessation Program will work with qualified professionals to help their policyholders quit smoking for the better. Research reports have demonstrated that smoking cessation improves well-being, including higher quality of life and improved health status. Smoking cessation reduces mortality as it lowers the risk of smoking-induced health complications (National Library of Medicine, 2020). The most common causes of death for smokers are diseases of the circulatory and respiratory system (86% of smoker deaths) as seen in Appendix Figure 4 while the most common causes of death for non-smokers are Neoplasms and external causes (60% of non-smoker deaths) as seen in Appendix Figure 5. It is evident that through a smoking cessation program, the likelihood of deaths due to diseases in the circulatory/respiratory system can be significantly reduced.

In terms of participation, it is estimated that 81% (*Tobacco in Australia, 2020*) of smokers in a developed country attempted to quit smoking. Considering behavioural bias and assuming a person who insures themselves from premature death would also take steps to reduce the risk, the 81% can be inflated. By providing an avenue within the policy such that the policyholders have access to free expert services, we believe this would incentivise policyholders to participate in the program. Quitting smoking has been proven to result in improved well-being and health status, allowing policyholders to live happier and longer lives (in expectation).

Policyholders who participate in the program will go through a structured approach, optimising their aim to quit smoking.

- Counselling from health professionals - giving further reasons to quit that could be specific to the policyholder and their medical condition.
- Cessation medications (if required) to overcome the addiction.
- Continuous follow-up support to avoid relapse from a care team ensures efficiency and a coordinated care approach.

Finally, from SuperLife's perspective, currently, all smokers are classified as moderate to high risk in the Underwriting Classifications as seen in Figure 3 Underwriting Class Distribution by Smoking Class. Through the Smoking Cessation Program, SuperLife will be able to reduce their high frequency and high severity risks. This allows the program to be mutually beneficial, assisting both parties.

Short-Term and Long-Term Program Evaluations

- **Short-term Evaluation (1-2 years):** The program can be evaluated based on metrics such as attendance rates and reported smoking cessation rates, which would demonstrate effectiveness. This timeframe allows for assessing initial program effectiveness with data available on a potentially new cohort of policyholders and allows identification of any challenges and requirements based on stakeholder experience.
- **Long-term Evaluation (5-7 years):** Long-term evaluation is essential for measuring sustained behaviour change and its impact on mortality rates as they are assumed to be refreshed every 4 years. Tracking participants over a longer period allows for observing long-term smoking cessation outcomes and determining the program's overall effectiveness in reducing mortality associated with smoking-related illnesses.

2.2 Annual Health Screenings

Annual health screenings, particularly focusing on cardiovascular and oncological prevention, are pivotal in mitigating mortality rates. Empirical evidence underscores the efficacy of regular health screenings in reducing mortality. A study conducted on a Korean cohort (pg. 19-25, Preventative Medicine, 2015) observed a marked decrease in all-cause mortality and cardiovascular disease (CVD) rates among participants of regular health screenings. Notably, this study reported an increased detection rate of CVD-related conditions and a subsequent reduction in long-term healthcare utilisation and costs, an objective of SuperLife.

SuperLife's Annual Health Examination Program aims to collaborate with healthcare facilities to offer comprehensive screenings, assessment, and risk stratification. This initiative focuses on early detection of neoplasms (both benign and malignant), and conditions related to the circulatory and respiratory systems, among other non-lethal health issues. These conditions are among the leading causes of fatality in the data presented in Figure 4 and Figure 5, and approximately 63% of policyholders who died from the above conditions are situated in the moderate to high-risk bracket. By facilitating early-stage intervention, the program aims to prevent the progression of these diseases.

An integral component of the initiative is to offer subsidised medical coverage for early-stage oncological interventions, emphasising the surgical removal of neoplastic growths to halt their progression and thereby significantly enhance patient survival rates, as depicted in the American Journal of Managed Care (2019).

Furthermore, the program enriches patient care with follow-up check-ups and a suite of support services, including disease abstinence programs. This initiative is critical for enhancing treatment plan adherence, fostering healthier lifestyles, and improving the overall quality of life for participants.

Policyholders who participate in this program will have access to the following incentives:

- **Affordable Health Screenings:** The program aims to overcome economic barriers and the impact of the COVID-19 pandemic on medical systems, ensuring widespread access to crucial health services.
- **Comprehensive Screening Facilities:** Offering wide-ranging disease and risk factor screenings, the program supports early health issue detection through a holistic assessment approach, aimed at preventing and managing health conditions effectively.

- **Enhanced Longevity through Early Detection:** Focused on early detection, intervention, and preventive measures, the program aims to improve quality of life, individual health status and extend life expectancy by reducing the risk of disease progression and mortality.

Short-Term and Long-Term Program Evaluations

- **Short-Term Evaluations (1-3 Years):** Within the initial 1 to 3 years, the focus would be on metrics like participation rates, satisfaction surveys and early detection rates that can provide immediate feedback on the program's operational effectiveness and its early impact on participant health behaviours. This is critical for identifying areas of success and opportunities for improvement in the program's design and delivery. See Appendix 8.1.2 Annual Health Screenings for further details.
- **Long-Term Evaluations (6-8 Years):** Over a longer horizon of 6 to 8 years, the evaluation shifts towards assessing the program's overarching goal of reducing mortality and morbidity rates among participants, healthcare utilisation and cost analysis, the broader health behaviour changes at the population level and monitoring prevalence of conditions detected through the program's screenings. See Appendix 8.1.2 Annual Health Screenings for further details.

2.3 Active Ageing

During the later phases of life, it is imperative to remain active as it keeps one physically and mentally fit. Regular exercise has also shown to reduce the probability of a person contracting cardiovascular diseases by 60-70%. Furthermore, regular exercise has also assisted in lowering the risk of cancer due to the regulation of hormones like insulin which implies a reduced exposure to potential carcinogens.

From the explanatory analysis it was found that the top three causes of death for policyholder's aged 55 and over were: Neoplasms (potentially cancerous) (36%), Diseases of the Circulatory System (32%) and Diseases of the Respiratory System (8%) as seen in Figure 6. These deaths also account for approximately two-thirds of all deaths.

Further analysis has also shown that almost two-thirds of the policies were issued for policyholders between the ages of 35 and 55, as shown in Figure 7. As such, it was realised that the introduction of an Active Ageing Program will be able to transition majority (assuming high participation) of the policyholders into lower risk classes as they age and surpass the age of 55. Resultantly, the mortality is expected to decline by proactively mitigating or averting the predominant causes of mortality among the aging demographic, thereby extending life expectancy significantly.

Active ageing programs not only promote physical activity but also increase social engagement and mental stimulation. Given the demographic of Lumaria where approximately 90% of the population works in the industry or services sector it is assumed that a program like active ageing will have high perceived benefits and thus a high level of participation within both the rural and urban demographic.

The programs key features would include:

- Voluntary participation through registrations for free/subsidised classes with industry partners and government organisations. This allows of rural and urban availability.
- An emphasis on physical activity, active learning and supportive environments facilitating positive attitudes and wellbeing.
- Promotion of health, maintenance, and independence through learning within the classes.

Overall, these program features would allow the ageing policyholders to be physically fit and aware of their bodies. This would tie in with the healthcare program that SuperLife would offer based on our advice creating a holistic system of healthcare.

Monitoring the effectiveness of the program would require an assessment of various metrics and outcomes in both the short term and the long term.

Short-Term (6 months - 1 year): In the short-term SuperLife should investigate the participation rates and how actively policyholders are enrolling for the program. Additionally, utilising the annual healthcare program offered simultaneously would allow SuperLife to assess any immediate benefits in policyholder health. Surveys are to be conducted to measure policyholder satisfaction with program features, allowing for adjustments to be made.

Long Term (>1 Year): In the long term it would be important for SuperLife to assess the exact health outcomes by looking at potential improvements in parameters like fitness levels, and chronic disease risks. Additionally, a strong part of the program is to improve policyholder wellbeing and thus it would be important to monitor and measure perceived wellbeing improvements. Finally, risk reduction, cost savings and retention rates are important factors to evaluate program effectiveness.

2.4 Fitness Tracking Program

The relative risk of death is approximately 20-35% lower for people who are physically active and fit compared to sedentary people (*National Library of Medicine, 2012*). As such, the final incentive that is part of the program design is the fitness tracking program which will provide rewards for policyholders using fitness trackers to monitor and improve physical activity. The program primarily aims to reach out to the current/future young demographic of Lumaria and incentivise healthy behaviours using technology. Additionally, the program allows both the urban and rural populations to stay healthy and get rewarded at their own ease.

Some key features of the program include:

- Policyholders who participate will have to provide SuperLife access to their health data through their personal devices.
    - Would include metrics like physical activity (through exercise regime), heart rate and sleep cycle.
    - Such data will allow SuperLife to obtain a clear image of policyholder lifestyle and their likelihood of developing any adverse illness.
- Policyholders will be able to choose their goals and will be rewarded accordingly (relative to what their initial health status might be).
    - Currently, the rewarding system is consistent for all policyholders, however, this is planned to change post the initial monitoring phase.

Even though the program is designed for the younger generation, it was also found that approximately two-thirds of the population in each of Lumaria's regions are classified as living in an urban area (inforce data) as seen in Figure 8. As such, it is expected that the program is more effective in the urban areas where the likelihood of wearing/owning devices to track everyday health is assumed to be higher.

3 Pricing/Costs

3.1 Mortality Savings

From our mortality calculations, we observe a decline in the overall mortality rates for both males and females in the presence of incentives within the policy calculations, across all cohorts of smokers and non-smokers. This trend is illustrated in Appendix Table 5 w**Error!**

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Table 1: Average mortality savings for all ages based on scenarios for SPWL

Average Mortality saving (ages 1 to 120)				
	MNS	MS	FNS	FS
Low Cost	- Č 26,307	- Č 96,681	- Č 15,455	- Č 61,072
Average Cost	- Č 14,780	- Č 95,594	- Č 12,778	- Č 60,712
High Cost	- Č 7,912	- Č 94,887	- Č 11,185	- Č 60,464

Table 2: Average mortality savings for all ages based on scenarios for T20

Average Mortality saving (ages 1 to 120)				
	MNS	MS	FNS	FS
Low Cost	- Č 2,482.67	- Č 12,478.98	- Č 1,624.42	- Č 10,269.04
Average Cost	- Č 2,494.60	- Č 12,277.19	- Č 1,642.62	- Č 10,029.02
High Cost	- Č 2,498.87	- Č 12,052.69	- Č 1,652.72	- Č 9,771.81

Error! Reference source not found. and **Error! Reference source not found.** illustrate the average mortality savings across all ages (1 to 120) based on four cohorts for T20 and WLI policies. For calculation details, see Appendix 8.2.3 Mortality difference (Baseline vs Incentive). Our model examines three distinct cost scenarios and juxtaposes the mortality savings with three corresponding cost profiles associated with the incentives: lower, average, and maximum costs derived from each implemented incentive within our policy framework.

While the values are negative, from the company's standpoint, these signify the savings accrued to policyholders due to program incentives. This is attributable to the following reasons:

1. Mortality saving through Pure Premiums: Decreases in mortality rates directly impact the pure premium component of our insurance policies. As policyholders enjoy extended lifespans, the associated mortality risk diminishes, prompting a downward adjustment in pure premium rates to reflect this reduced risk exposure. Lower mortality rates require smaller allocation of funds to cover potential payouts, and lead to more competitive pricing.

2. Mortality saving through Profit: Lower mortality rates have the potential to increase the profitability of insurance firms. The anticipation of fewer payouts due to prolonged policyholder lifespans enables the retention of a larger share of premium income as profit. Despite the apparent negativity in both profit figures, the introduction of incentives results in an overall profit increase. The negative profit metric is contingent upon various factors including investment returns, administrative overheads, and prevailing market competition.

3.2 Economic Value of Proposed Program

For the economic value of the proposed program into the future, we have looked at how policies will reduce the pure premium of SuperLife's insurance products and whether costs of the program will be able to be subsidized by the premiums.

We have projected ahead by 20 years, to 2043 and have considered the following factors:

1. **Increases in number of policyholders:** Analysing historical data on the yearly acquisition of new policyholders allows for the prediction of future growth in the total number of policyholders.
2. **Changes to participation rates:** It is expected that participation rates will increase as policyholders move to take advantage of the benefits that come with their policy and also allows us to stress test whether the programs are economically viable.
3. **Different cost scenarios:** Three different scenarios have been examined, each with different assumptions regarding costs per policyholder.

On average pure premiums are found to be reduced by Č 9412 for WLI and Č 3186.55 for T20 policies. The expected reduction in premium due to the program intervention enables the adjustment of base premiums to cover program costs, whilst still being lower than the original premium. Policyholders will experience a reduction in their premiums while also enjoying the benefits of the program.

Table 3: T20 and WLI New Premium + Costs Difference

	WLI	T20
Low Cost	Č 9066.56	Č 2842.17
Average Cost	Č 8443.82	Č 2220.76
High Cost	Č 7821.08	Č 1599.36

This analysis indicates that the value of policy benefits with the program surpasses the value of policy benefits without the program, demonstrating the economic viability of the design.

3.3 Pricing Changes

The following recommendations aim to optimise sales and policy value by implementing strategic pricing adjustments within the insurance company's financial model.

1. Profit Margin Assessment: Examine the current profit margin of our existing policies and pricing structure with the goal to identify where adjustment can be made to boost profitability while still staying competitive and retaining our valued customers. This can be done through the evaluation of the loss ratio of each policy by dividing incurred claims by earned premiums. If the loss ratio is higher than desired or expenses are excessive, then premiums might need to be increased to improve profitability.

2. Value-Based Pricing: Implementing value-based pricing methods involves aligning insurance policy premiums with the perceived value to customers, considering factors like coverage scope, service quality, brand reputation, and supplementary benefits. One way to do this is by estimating the price elasticity of demand. We can use econometric models like linear or log-linear regression, which analyse baseline premiums, sales data, and additional variables to project price elasticity of demand. This comprehensive approach enables informed pricing decisions, optimizing market performance by ensuring premiums accurately reflect customer value and drive policy sales.

4. Assumptions

The following mortality and model assumptions had the most significant impact on analysis as they directly affect the pricing and profitability of the program design.

4.1 Mortality Assumptions

Mortality analysis in Lumaria is essential in understanding policyholder characteristics and behaviours, enabling SuperLife to price products with precision, particularly in relation to sex and smoker status. Due to the inherent limitations of the available data which solely represents the base population of Lumaria, it was necessary to make assumptions that give insight into the diverse risk profiles associated with policyholders. By performing this analysis and recognising the impact of important risk factors, SuperLife can enhance its pricing strategy to adjust insurance products that align closely with policyholder needs whilst maintaining a competitive advantage.

Gender and smoking cohorts: For mortality modelling, policyholders are categorised into 4 cohorts to accurately capture mortality differences that arise due to the universal variables of sex and smoker status: Male Smokers, Male Non-Smokers, Female Smokers, Female Non-Smokers.

Age Bracketing: Individuals under the legal age of 18 are presumed non-smokers. During this period, the influence of sex on mortality is considered minimal, and all cohorts exhibit uniform base mortality rates from ages 0 to 17.

Mortality Loading Factors: From the ages of 18 onwards, each cohort is assigned a mortality loading factor, which when applied to the base population mortality at each age yields a new mortality rate. This factor reflects the differential impact of smoking and gender on mortality:

Table 4 Mortality Loading Factor Assumptions

Cohort	Male Smokers	Female Smokers	Male Non-Smokers	Female Non-Smokers
Gender impact	1.52	0.91	1.52	0.91
Empirical estimation	4.08	10.12	0.697	0.74
Loading Factor	6.91	9.16	1.06	0.67

See Appendix 8.2.2 Loading Factors Methodology' for the Calculation.

- **Uniform smoking intensity:** All smokers in Lumaria exhibit a uniform level of smoking intensity, leading to a consistent adverse mortality impact among the smoking cohorts. This assumption allows smoking to be treated as a homogeneous risk factor, irrespective of individual smoking habits.
- **No Cohort Effects:** The mortality of individuals is not affected by factors relating to their circumstances (birth year, socio-economic status, region etc.).

4.2 Pricing Model Assumptions

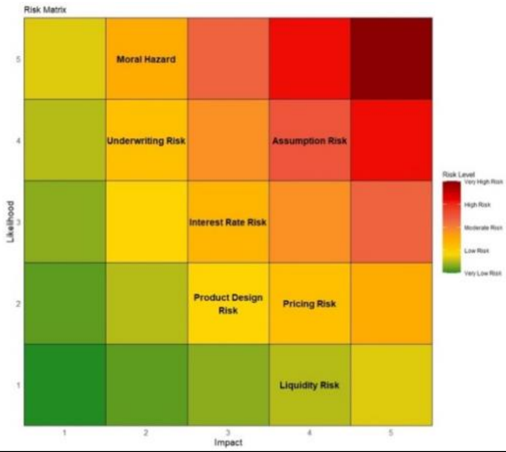
The financial model for the Single Premium Whole Life Insurance (SPWL) and 20-Year Term Insurance products hinges on several pivotal assumptions.

- **Lapse Rate:** Assumed to be 0% for SPWL insurance as none of the SPWL policyholders in the in-force dataset lived through the duration of the policy. However, for the 20-year term policy, the lapse rate was computed based on each issue age and issue year. See Appendix 8.3.1 Pricing Model Assumptions for the formula utilised.
- **Death Benefit Amount:** The death benefit was calculated through a weighted average of the percentage of policyholders with the face value for both the 20-year term and SPWL policies. This was fixated to provide a conservative approach for the calculation of the profit.
- **Expense Loading:** The amount added to the premium to cover the insurer's expenses, calculated using the highest and lowest averages from the economy sheet.
- **Surrender Value:** For the SPWL insurance policy, we assumed there would be a surrender rate as some policyholders may want to withdraw from the insurance before the end of the policy and it was assumed to be the highest average percentage from the economy sheet. See Appendix 8.3.1 Pricing Model Assumptions for the formula utilised.
- **Reserves:**
  - For the SPWL policy, the reserves were based on the probabilities of survival and death directly to ensure the reserves were an accurate representation of the scenario at hand. See Appendix 8.3.1 Pricing Model Assumptions for the formula utilised.
  - In the 20-year term policy, the reserves were calculated using the APRA and BASEL III frameworks. A loss ratio was fixated using multiple resources and reports available online, see Appendix 8.3.1 Pricing Model Assumptions for a snapshot of the calculation methodology and the formula utilised. It was decided to keep the reserves fixed for a conservative approach, across the model, despite the introductions of the incentives.

See Appendix 8.3.1 Pricing Model Assumptions for the remaining assumptions made.

5. Risk and Risk Mitigation Considerations

The most significant risks to the program are displayed in Figure 1 as a risk matrix. These risks arise from data limitations, uncertainty faced during mortality and program analysis, and projection of future claims cost.



Risk	Explanation	Risk Mitigation
Assumption Risk	Foundational for modelling and ideally help simplify complex procedures. If they are incorrect, the model can produce inaccurate results, leading to poor decision making.	Follow the challenge, validate, review procedure regularly. Apply appropriate modelling techniques like: - Bayesian: update based on experience. This would assist in reducing uncertainty and improve accuracy of results. - Ensemble: allow for the usage of multiple models and combining them. Allows us to not rely on one single assumption.
Product Design Risk	SuperLife is looking to introduce new elements to their already existing long term life insurance products. There is a risk that the product might not be perceived beneficial, issues in management and potential obsolescence by going backwards rather than forwards.	SuperLife should look at testing the proposed changes through pilot testing and look at marketing and distribution channels to analyse market properly. Should also ensure the changes are drafted as desired in legal documents. Finally, have an implementation plan is in place to ensure product launch is well managed.
Pricing Risk	Pricing risk may occur when the expected claims, lapse rates, expenses and investments are inaccurately estimated. Could result in heavy financial losses.	Scenario Testing to identify impacts of each variable considered in pricing. Practicing this regularly would allow for monitoring and updating based on any deviations.
Underwriting Risk	Keeping required data to ensure that that SuperLife is only taking on risks they are capable of can be challenging and may lead to adverse selection.	Being a developed country, Government of Lumaria should allow SuperLife to access relevant health data through their universal healthcare system. This would allow a proper assessment for everyone.
Liquidity Risk	During a Black Swan event, such as a pandemic, SuperLife faces the risk of simultaneous claims surpassing reserves and capital, potentially destabilizing the company. Moreover, sudden withdrawals or surrenders by customers may occur if they perceive the insurer as financially vulnerable.	SuperLife should aim to maintain strong capital positions and ensure that they are conducting stress testing and cash flow projections on an ongoing basis. Furthermore, it would also be viable to ensure close management and optimal asset allocation to mitigate liquidity risk.

Interest rate risk	There is always a risk of discounting our future premiums and payouts whilst pricing, as the future interest rate is not certain.	This is mitigated using historical data to project future interest rates. It would also be viable to use financial instruments like futures and forwards to hedge against the interest rate risk.
Moral Hazard	Participants inappropriately filing claims and misuse of program features will inflate costs associated with the program.	Assumptions of program participation and effectiveness to be monitored during implementation stages and adjusted accordingly.

6. Data and Data Limitations

Data Limitation	**Assumption**	**Justification**
Lack of complete data availability for mortality tables (35 to 65 for SPWL and 26 to 55 for T20).	Assumed policyholders for both policies have similar mortalities when finding loading factors from policyholder data. Usage of external data from developed countries like USA and Australia.	Maximise data availability for more accurate loading factors. Developed countries like USA and Australia are similar to Lumaria's in terms of operations and have been considered as ideal replacements.
Lumaria's pricing regulations are unspecified, with no available guidelines.	It is assumed that policies can be priced based on sex and smoking status.	Legal in countries like Australia (base location of ActuaInsight), however, is a limitation since it is illegal in Europe (pricing based on gender).
No information on competitors in the life insurance market.	Assumed that the program will make significant impact on existing policyholders and incentivise prospective clients to purchase products.	Program impact and its incentives cannot be valued against competitors in the existing life insurance market. This puts SuperLife at a strategic disadvantage.
No data relating to company expenses or existing capital.	Assumptions related to the pricing model, including expenses, reserves.	This data limitation reduces the accuracy of pricing modelling.

7. Final Recommendations & Conclusion

ActuaInsight has found that through the implementation of our 4 incentive programs, a significant decrease in expected mortality can be achieved by encouraging healthier lifestyles. The reductions in mortality lead to lower pure premiums and allow SuperLife to cover the costs of the programs while still reducing the overall premiums for customers. This provides a competitive advantage for SuperLife and mutual benefits to them and their customers. Considerations with regards to potential risks and data limitations have also been addressed with potential methods to mitigate and deal with these issues. Additionally, ActuaInsight has provided metrics for monitoring the effectiveness of these incentive programs into the future.

8 Appendix

8.1 Product Design

8.1.1 Smoking Cessation

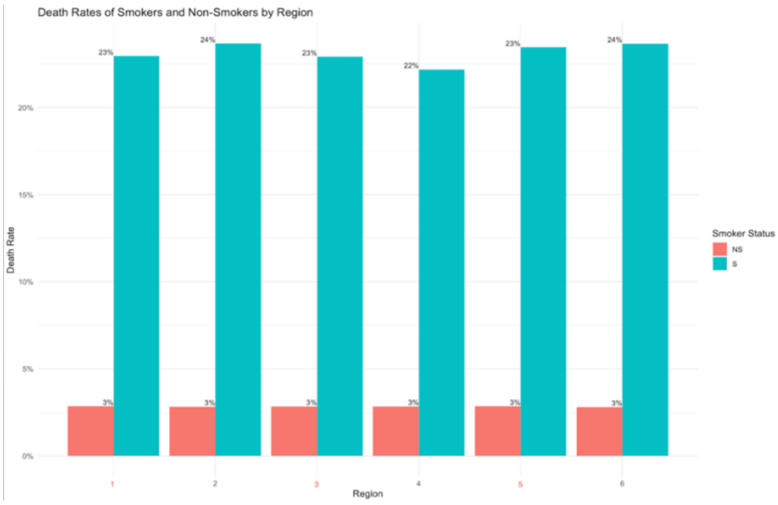


Figure 2 Death Rates of Smokers and Non-Smokers by Region

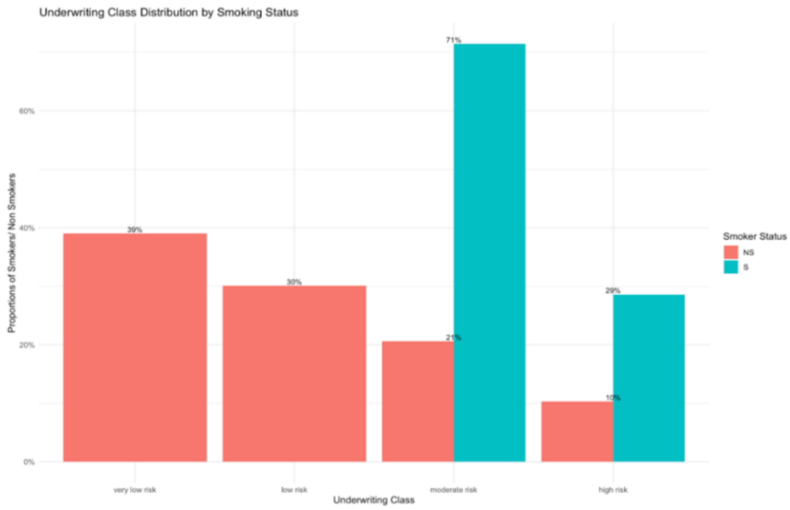


Figure 3 Underwriting Class Distribution by Smoking Class

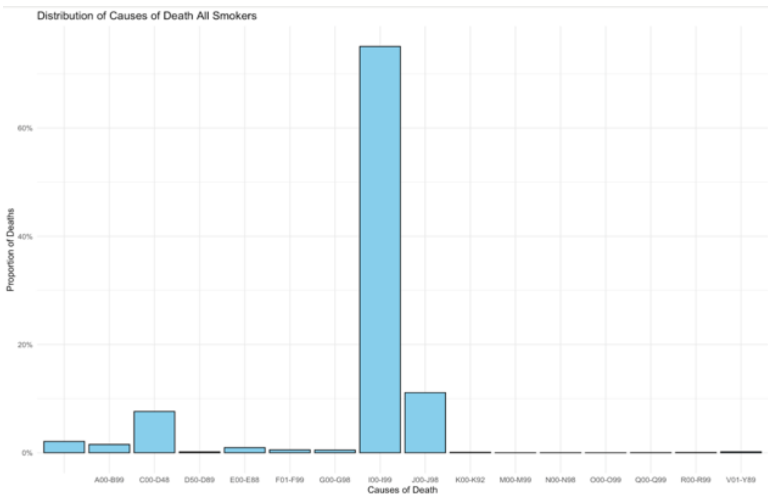


Figure 4 Distribution of Causes of Death All Smokers

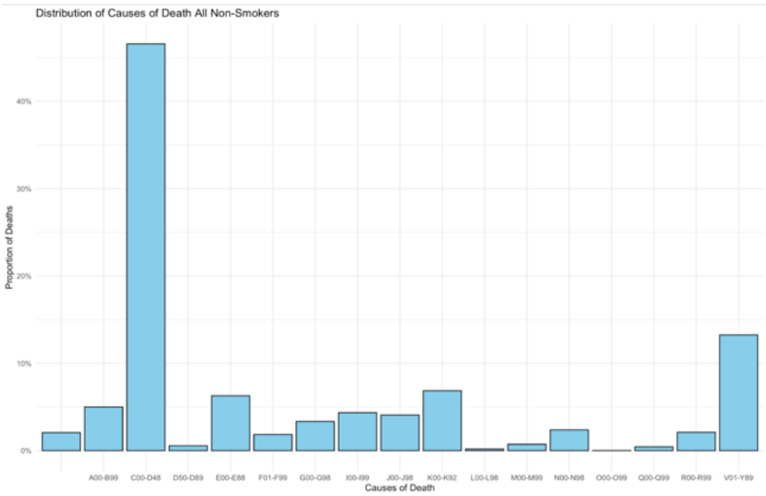


Figure 5 Distribution of Causes of Death All Non-Smokers

8.1.2 Annual Health Screenings

Short-Term Evaluations (1-3 Years): Within the initial 1 to 3 years, the focus would be to receive immediate feedback on the program's operational effectiveness and its early impact on participant health behaviours. This is critical for identifying areas of success and opportunities for improvement in the program's design and delivery. The metrics that can be utilised include:

- **Participation Rates:** Measure the number of policyholders enrolling in and actively participating in the health screenings, indicating the program's accessibility and appeal to the target demographic.
- **Satisfaction Surveys:** Conduct periodic surveys among participants to gauge satisfaction with various aspects of the program. This will identify refinements needed to enhance user experience and engagement.
- **Early Detection Rates:** Analyse data on the early detection of conditions targeted by the program, particularly CVD, cancer, and respiratory conditions.

Long-Term Evaluations (6-8 Years): Over a longer horizon of 6 to 8 years, the evaluation shifts towards assessing the program's overarching goal of reducing mortality and morbidity rates among participants, as well as the broader health behaviour changes at the population level. The metrics that can be used include:

- **Mortality and Morbidity Rates:** Analysing mortality and morbidity rates among participants, focusing on conditions targeted by the health screenings and baseline comparisons.
- **Healthcare Utilisation and Cost Analysis:** Evaluate changes in healthcare utilisation patterns and associated costs among participants, particularly in hospital admissions for advanced-stage diseases and chronic condition management.
- **Changes in Health Behaviours and Lifestyles:** Assess shifts in lifestyle and health behaviours among participants (e.g. improved diet, increased exercise, etc.)
- **Prevalence of Detected Conditions:** Monitor changes in the prevalence of conditions detected through the program's screenings over time.

8.1.3 Active Ageing

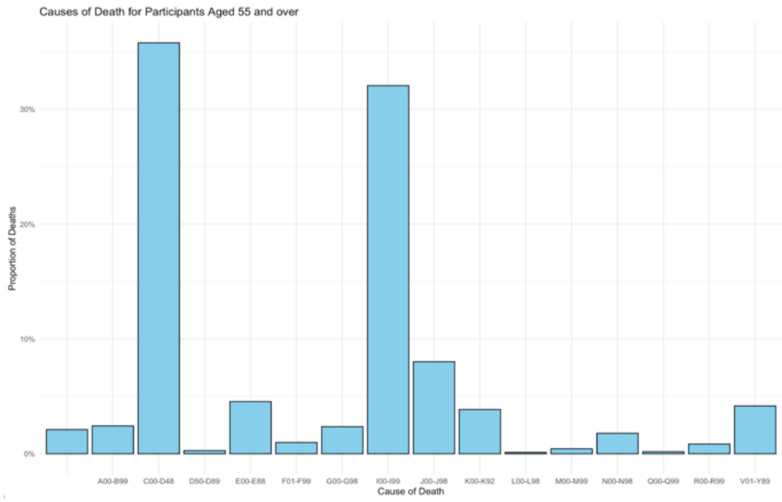


Figure 6 Causes of Death for Participants Aged 55 and Over

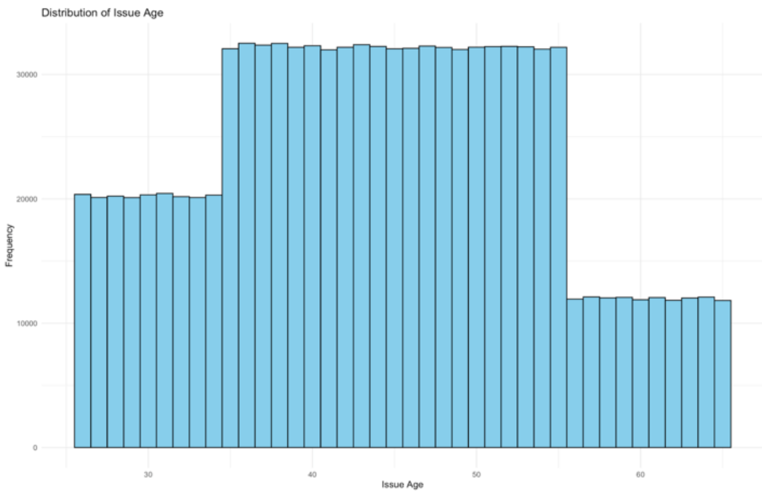


Figure 7 Distribution of Issue Age

8.1.4 Fitness Tracking

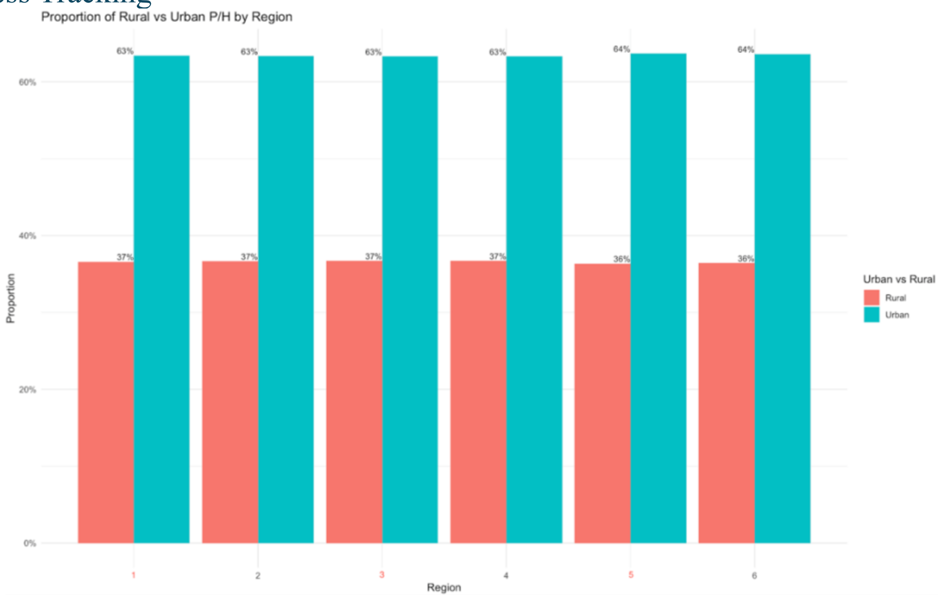


Figure 8 Proportion of Rural vs Urban P/H by Region

8.2 Pricing/Costs

8.2.1 Mortality table

		Baseline - Population				Incentive Mortality			
Age	Mortality Rate (BASE)	MS	FS	MNS	FNS	MS	FS	MNS	FNS
1	0.0035	0.0035	0.0035	0.0035	0.0035	0.0035	0.0035	0.0035	0.0035
2	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
3	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
4	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
6	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
9	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
10	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
11	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
12	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
13	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
14	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
15	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
16	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
17	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
18	0.0004	0.0023	0.0034	0.0004	0.0003	0.0017	0.0025	0.0004	0.0002
19	0.0004	0.0026	0.0039	0.0004	0.0003	0.0019	0.0028	0.0004	0.0003
20	0.0005	0.0028	0.0042	0.0005	0.0003	0.0020	0.0030	0.0004	0.0003
21	0.0005	0.0031	0.0045	0.0005	0.0003	0.0022	0.0032	0.0005	0.0003
22	0.0005	0.0032	0.0048	0.0006	0.0004	0.0023	0.0034	0.0005	0.0003
23	0.0005	0.0033	0.0049	0.0006	0.0004	0.0024	0.0035	0.0005	0.0003
24	0.0005	0.0034	0.0050	0.0006	0.0004	0.0024	0.0036	0.0005	0.0003
25	0.0005	0.0034	0.0050	0.0006	0.0004	0.0024	0.0036	0.0005	0.0003
26	0.0006	0.0034	0.0051	0.0006	0.0004	0.0025	0.0036	0.0005	0.0003
27	0.0006	0.0035	0.0052	0.0006	0.0004	0.0025	0.0037	0.0005	0.0003

28	0.0006	0.0036	0.0053	0.0006	0.0004	0.0026	0.0038	0.0006	0.0004
29	0.0006	0.0037	0.0055	0.0006	0.0004	0.0027	0.0039	0.0006	0.0004
30	0.0006	0.0038	0.0057	0.0007	0.0004	0.0027	0.0041	0.0006	0.0004
31	0.0007	0.0040	0.0060	0.0007	0.0004	0.0029	0.0043	0.0006	0.0004
32	0.0007	0.0043	0.0063	0.0007	0.0005	0.0030	0.0045	0.0007	0.0004
33	0.0007	0.0045	0.0066	0.0008	0.0005	0.0032	0.0047	0.0007	0.0004
34	0.0008	0.0048	0.0070	0.0008	0.0005	0.0034	0.0050	0.0007	0.0005
35	0.0008	0.0051	0.0075	0.0009	0.0006	0.0034	0.0050	0.0008	0.0005
36	0.0009	0.0054	0.0080	0.0009	0.0006	0.0036	0.0053	0.0008	0.0005
37	0.0010	0.0059	0.0087	0.0010	0.0006	0.0039	0.0058	0.0009	0.0006
38	0.0010	0.0064	0.0095	0.0011	0.0007	0.0043	0.0063	0.0010	0.0006
39	0.0011	0.0070	0.0104	0.0012	0.0008	0.0046	0.0069	0.0011	0.0007
40	0.0012	0.0076	0.0112	0.0013	0.0008	0.0050	0.0074	0.0012	0.0008
41	0.0013	0.0083	0.0122	0.0014	0.0009	0.0055	0.0081	0.0013	0.0008
42	0.0014	0.0090	0.0133	0.0015	0.0010	0.0060	0.0088	0.0014	0.0009
43	0.0016	0.0097	0.0144	0.0017	0.0011	0.0065	0.0095	0.0015	0.0010
44	0.0017	0.0106	0.0157	0.0018	0.0012	0.0070	0.0104	0.0016	0.0010
45	0.0019	0.0115	0.0170	0.0020	0.0013	0.0086	0.0127	0.0018	0.0011
46	0.0020	0.0125	0.0184	0.0021	0.0014	0.0093	0.0137	0.0019	0.0012
47	0.0022	0.0136	0.0201	0.0023	0.0015	0.0102	0.0150	0.0021	0.0014
48	0.0024	0.0149	0.0221	0.0025	0.0016	0.0111	0.0165	0.0023	0.0015
49	0.0026	0.0163	0.0241	0.0028	0.0018	0.0122	0.0180	0.0025	0.0016
50	0.0029	0.0178	0.0264	0.0030	0.0019	0.0133	0.0197	0.0028	0.0018
51	0.0031	0.0195	0.0288	0.0033	0.0021	0.0145	0.0215	0.0030	0.0019
52	0.0034	0.0214	0.0316	0.0036	0.0023	0.0159	0.0235	0.0033	0.0021
53	0.0038	0.0235	0.0348	0.0040	0.0026	0.0175	0.0259	0.0037	0.0023
54	0.0042	0.0259	0.0383	0.0044	0.0028	0.0193	0.0285	0.0040	0.0026
55	0.0046	0.0286	0.0423	0.0049	0.0031	0.0213	0.0315	0.0045	0.0028
56	0.0051	0.0316	0.0468	0.0054	0.0034	0.0245	0.0362	0.0048	0.0030
57	0.0056	0.0348	0.0515	0.0059	0.0038	0.0270	0.0398	0.0053	0.0033
58	0.0062	0.0382	0.0565	0.0065	0.0041	0.0296	0.0437	0.0058	0.0036
59	0.0068	0.0419	0.0621	0.0072	0.0045	0.0325	0.0480	0.0063	0.0040

60	0.0075	0.0464	0.0687	0.0079	0.0050	0.0360	0.0531	0.0070	0.0044
61	0.0083	0.0512	0.0758	0.0087	0.0055	0.0397	0.0586	0.0077	0.0049
62	0.0090	0.0560	0.0828	0.0096	0.0061	0.0434	0.0641	0.0085	0.0053
63	0.0099	0.0612	0.0906	0.0105	0.0066	0.0474	0.0701	0.0092	0.0059
64	0.0108	0.0668	0.0989	0.0114	0.0072	0.0518	0.0764	0.0101	0.0064
65	0.0118	0.0730	0.1080	0.0125	0.0079	0.0566	0.0836	0.0110	0.0070
66	0.0130	0.0802	0.1186	0.0137	0.0087	0.0642	0.0948	0.0121	0.0076
67	0.0142	0.0878	0.1300	0.0150	0.0095	0.0703	0.1039	0.0132	0.0083
68	0.0155	0.0960	0.1420	0.0164	0.0104	0.0768	0.1135	0.0144	0.0091
69	0.0170	0.1051	0.1556	0.0180	0.0114	0.0842	0.1243	0.0158	0.0100
70	0.0187	0.1155	0.1709	0.0198	0.0125	0.0924	0.1365	0.0174	0.0110
71	0.0206	0.1273	0.1883	0.0218	0.0138	0.1019	0.1505	0.0191	0.0121
72	0.0228	0.1409	0.2085	0.0241	0.0153	0.1128	0.1667	0.0212	0.0134
73	0.0253	0.1567	0.2318	0.0268	0.0170	0.1254	0.1853	0.0235	0.0149
74	0.0283	0.1754	0.2595	0.0300	0.0190	0.1404	0.2074	0.0264	0.0166
75	0.0318	0.1970	0.2915	0.0337	0.0213	0.1577	0.2330	0.0296	0.0187
76	0.0358	0.2218	0.3282	0.0380	0.0240	0.1776	0.2623	0.0333	0.0210
77	0.0405	0.2505	0.3707	0.0429	0.0271	0.2005	0.2962	0.0377	0.0238
78	0.0456	0.2825	0.4181	0.0484	0.0306	0.2262	0.3341	0.0425	0.0268
79	0.0514	0.3182	0.4709	0.0545	0.0344	0.2547	0.3763	0.0478	0.0302
80	0.0577	0.3571	0.5285	0.0612	0.0387	0.2859	0.4224	0.0537	0.0339
81	0.0646	0.3999	0.5918	0.0685	0.0433	0.3202	0.4730	0.0601	0.0379
82	0.0724	0.4481	0.6631	0.0767	0.0485	0.3587	0.5299	0.0674	0.0425
83	0.0811	0.5022	0.7431	0.0860	0.0544	0.4020	0.5939	0.0755	0.0476
84	0.0910	0.5632	0.8334	0.0964	0.0610	0.4509	0.6661	0.0847	0.0534
85	0.1016	0.6291	0.9310	0.1077	0.0681	0.5036	0.7440	0.0946	0.0597
86	0.1128	0.6980	1.0000	0.1195	0.0756	0.5588	0.7992	0.1049	0.0662
87	0.1249	0.7732	1.0000	0.1324	0.0837	0.6190	0.7992	0.1162	0.0734
88	0.1380	0.8544	1.0000	0.1463	0.0925	0.6840	0.7992	0.1284	0.0811
89	0.1525	0.9439	1.0000	0.1616	0.1022	0.7556	0.7992	0.1419	0.0895
90	0.1685	1.0000	1.0000	0.1786	0.1129	0.8005	0.7992	0.1568	0.0989
91	0.1844	1.0000	1.0000	0.1954	0.1235	0.8005	0.7992	0.1715	0.1083

92	0.2015	1.0000	1.0000	0.2136	0.1350	0.8005	0.7992	0.1875	0.1183
93	0.2195	1.0000	1.0000	0.2326	0.1471	0.8005	0.7992	0.2042	0.1289
94	0.2380	1.0000	1.0000	0.2523	0.1595	0.8005	0.7992	0.2215	0.1398
95	0.2580	1.0000	1.0000	0.2734	0.1728	0.8005	0.7992	0.2400	0.1515
96	0.2785	1.0000	1.0000	0.2952	0.1866	0.8005	0.7992	0.2591	0.1635
97	0.3002	1.0000	1.0000	0.3182	0.2011	0.8005	0.7992	0.2793	0.1763
98	0.3231	1.0000	1.0000	0.3425	0.2165	0.8005	0.7992	0.3007	0.1898
99	0.3465	1.0000	1.0000	0.3673	0.2322	0.8005	0.7992	0.3224	0.2035
100	0.3710	1.0000	1.0000	0.3932	0.2486	0.8005	0.7992	0.3452	0.2179
101	0.3956	1.0000	1.0000	0.4193	0.2650	0.8005	0.7992	0.3681	0.2323
102	0.4198	1.0000	1.0000	0.4450	0.2813	0.8005	0.7992	0.3906	0.2465
103	0.4446	1.0000	1.0000	0.4713	0.2979	0.8005	0.7992	0.4137	0.2611
104	0.4698	1.0000	1.0000	0.4980	0.3148	0.8005	0.7992	0.4371	0.2759
105	0.4953	1.0000	1.0000	0.5250	0.3319	0.8005	0.7992	0.4609	0.2909
106	0.5209	1.0000	1.0000	0.5522	0.3490	0.8005	0.7992	0.4847	0.3059
107	0.5467	1.0000	1.0000	0.5795	0.3663	0.8005	0.7992	0.5086	0.3210
108	0.5726	1.0000	1.0000	0.6069	0.3836	0.8005	0.7992	0.5328	0.3363
109	0.5985	1.0000	1.0000	0.6345	0.4010	0.8005	0.7992	0.5569	0.3515
110	0.6244	1.0000	1.0000	0.6619	0.4183	0.8005	0.7992	0.5810	0.3667
111	0.6544	1.0000	1.0000	0.6937	0.4384	0.8005	0.7992	0.6089	0.3843
112	0.6842	1.0000	1.0000	0.7253	0.4584	0.8005	0.7992	0.6367	0.4018
113	0.7139	1.0000	1.0000	0.7567	0.4783	0.8005	0.7992	0.6642	0.4192
114	0.7433	1.0000	1.0000	0.7879	0.4980	0.8005	0.7992	0.6916	0.4365
115	0.7724	1.0000	1.0000	0.8188	0.5175	0.8005	0.7992	0.7187	0.4536
116	0.8014	1.0000	1.0000	0.8495	0.5369	0.8005	0.7992	0.7457	0.4706
117	0.8304	1.0000	1.0000	0.8802	0.5564	0.8005	0.7992	0.7726	0.4877
118	0.8594	1.0000	1.0000	0.9109	0.5758	0.8005	0.7992	0.7996	0.5047
119	0.8884	1.0000	1.0000	0.9417	0.5952	0.8005	0.7992	0.8266	0.5217
120	1.0000	1.0000	1.0000	1.0000	0.6700	0.8005	0.7992	0.8778	0.5873

8.2.2 Loading Factors Methodology

1. Data split into Male and Female cohorts such that smoking and non-smoking death and policies issued data is available from 2001 to 2023.
2. Calculate empirical mortality rates for each year of issue:

$$Cohort\ Mortality = \frac{No.\ cohort\ deaths\ of\ policies\ issued\ in\ year\ x}{No.\ policies\ issued\ in\ year\ x}$$

3. Now using the baseline mortality table calculate the loading factor for smokers and non-smokers. For example, for smokers:

$$Smoker\ Factor = \frac{\text{Smoker Cohort } Mortality}{Baseline\ mortality}$$

4. Average all these factors for each year giving us a final factor for non-smoker and smoker mortality.
5. This factor is multiplied by the provided mortality to then calculate mortality for specific cohorts. Note, as mentioned before this is done for Males and Females and hence there are 4 mortality tables to exist.
6. Finally, the same procedure is followed for the male and female loading factor where, for example, for male loading factor, the male mortality would be divided by the overall mortality.

8.2.3 Mortality difference (Baseline vs Incentive)

Mortality difference is calculated as the following:

- Calculate the difference between profit with and without incentive for all four cohorts.
- Multiply the profit difference with for No incentive premium levels calculated in R.

Table 5 Mortality Difference by Gender

	Mortality difference (Baseline vs Incentive)			
Age Group	MS	FS	MNS	FNS
0 to 14	0.000	0.000	0.000	0.000
15 to 24	0.006	0.009	0.000	0.000
25 to 54	0.081	0.121	0.004	0.003
55 to 64	0.104	0.154	0.009	0.006
65+	7.900	8.616	2.236	1.433

8.2.4 Pricing Calculations

The whole life model is calculated using assumptions and financial calculations.

Item	Calculation
Premium	Calculation as per R code
Commission	$Premuim \times Commission$
Expensive	$Fixed\ Expense + incentive\ expense\ per\ policy$
Death benefit	$Weighted\ average\ of\ face\ value\ per\ cohort\ wise$
SV per 1000	$\dfrac{1000 * NPV(Surrender\ Rate,\ Mortality\ Rate\ in\ Each\ Year\ for\ Age\ x) - Loading\ Factor * (survival\ rate\ at\ the\ next\ year + NPV(Surrender\ Rate, Survival\ Rate\ in\ Each\ Year\ for\ Age\ x))}{Survival\ Rate}$
Reserve per 1000	$\dfrac{1000 * NPV(Reserve\ Rate,\ Mortality\ Rate\ in\ Each\ Year\ for\ Age\ x) - Loading\ Factor * (Survival\ rate\ at\ the\ next\ year + NPV(Reserve\ Rate, Survival\ Rate\ in\ Each\ Year\ for\ Age\ x))}{Survival\ Rate}$
Withdrawal Benefit	$(SV\ per\ 1000 \times reserve\ per\ 1000)/1000$
Reserve	$(Death\ Benefit \times Rerserve\ per\ 1000)/1000$
Mortality rate per 1000	$Mortality\ Rate \times 1000$
Lapse rate	$lapse\ rate = \dfrac{No.\ policyholders\ lapsed\ at\ age\ x\ in\ year\ y}{No.\ policyholders\ issued\ at\ age\ x\ in\ year\ y}$
In Force (sop)	$year\ y - 1\ In\ Force(eop)\ is\ In\ Force(sop) in\ year\ y$
Deaths	$(Mortality\ rate\ per\ 1000) \times In\ Force\ (sop))/1000$
Lapse	$lapse\ rate = \dfrac{No.\ policyholders\ lapsed\ at\ age\ x\ in\ year\ y}{No.\ policyholders\ issued\ at\ age\ x\ in\ year\ y}$
In Force (eop)	$In\ Force\ (sop) - death\ rate - lapse\ rate$
Reserve (sop)	$Year\ X\ balue\ of\ Reserve\ (eop)\ as\ year\ (X+1)\ value\ for\ Reseve\ (sop)$
Capital (sop)	$year\ y - 1\ Capital\ (eop)\ is\ Capital\ (sop)\ in\ year\ y$
Reserve (eop)	$In\ Force\ (eop) \times Reserve$
Capital (eop)	Required Capital (per 1000 death benefit) × In Force (eop) ×Death Benefit
Premium (sop)	In Force (eop) × premium
Commision (sop)	Negative In Force (eop) ×commission
Expense (eop)	Negative In Force (eop) ×Expenses
death benefit (eop)	Death rate×death benefit
Withdrawals (eop)	Lapse rate×withdrawal Benefit
Cash Flow	Premium (sop) + Commision (sop) + Expense (eop) + death benefit (eop)
Reserve Increase	Reserve (sop) – Reserve (eop)
Interest	(Premium (sop) + Commision (sop)+capital (sop)+reserve (sop))* Investment Earnings Rate
Profit	Cash flow + reserve interest + interest

Calculation of net present value of profit: net present value of all the profit with the discount rate

Appendix showing all the pricing calculations performed:

The 20 year term insurance model is calculated using assumptions and financial calculations.

Item	***Calculation***
Premium	Calculation as per R code
Commission	$Premuim \times Commission$
Expensive	$Fixed\ Expense + incentive\ expense\ per\ policy$
Death benefit	$Weighted\ average\ of\ face\ value\ per\ cohort\ wise$
Reserve per 1000	$Assumption\ based$
Capital	Required Capital (per 1000) rate × Death benefit/1000
Reserve	Death Benefit × Reserve per 1000/1000
Mortality rate per 1000	Mortality rate × 1000
Lapse rate	$lapse\ rate = \frac{No.\ \ policyholders\ \ lapsed\ \ at\ age\ x\ in\ \ year\ \ y}{No.\ \ policyholders\ issued\ \ at\ age\ x\ in\ \ year\ \ y}$
In Force (sop)	$year\ y-1\ In\ Force(eop)\ is\ In\ Force(sop) in\ year\ y$
Deaths	Mortality rate per 1000 × (In Force (sop)/1000)
In Force (eop)	$In\ Force\ (sop) - death\ rate - lapse\ rate$
Reserve (sop)	Year y value of Reserve (eop) as year y+1 value for Reserve (sop)
Capital (sop)	$year\ y-1\ Capital\ (eop)\ is\ Capital\ (sop) in\ year\ y$
Reserve (eop)	In Force (eop) × Reserve
Capital (eop)	Required Capital (per 1000 death benefit) ×In Force (eop) ×Death Benefit
Premium (sop)	In Force (eop) × premium
Commision (sop)	Negative In Force (eop) × commission
Expense (eop)	Negative In Force (eop) × Expenses
Claims (eop)	Death rate × death benefit
Cash Flow	Premium (sop) + Commision (sop) + Expense (eop) + death benefit (eop)
Reserve Increase	Reserve (sop) – Reserve (eop)
Interest	(Premium (sop) + Commision (sop)+capital (sop)+reserve (sop)) × Investment Earnings Rate
Profit	Cash flow + reserve interest + interest

Calculation of net present value of profit: net present value of all the profit with the discount rate

8.2.5 Single Premium Whole Life Insurance Model

Single Premium Whole-Life Insurance

Age	35	<--- change input
Current Year	2023	
Gender	M	
Smoker	S	
Incentive/No Incentive	Incentive	
Incentive Loading	4%	
Expense Loading	11%	

Sensitivity Testing	Low	<-- change this to either Low, mid, high for sensitivity testing
		Low
		Mid
		High
Sheet name	Age_35	
Scenario	SPWL_MS	
Avg premium per scenario	141021.6358	
Premium:	150,523.82	

Assumptions

Investment Earnings Rate:	5.7%	
Discount Rate:	11.0%	**Refer to the Economy Sheet however, for discounting, 10 year average + inflation
Lapse Rate:	0%	**No one lapses but some may surrender
Death Benefit Amount:	640019	**Check spwl with incentive premiums workbook

Required Capital (per 1000 death benefit):		
	Age	Rate
less than	40	0.01
greater than and equal	40	0.02

https://www.apra.gov.au/capital-explained
https://www.legislation.gov.au/F2023L00673/asmade/text

Commissions (as % premium):		
	Duration	Rate
	1	70%
	2+	5%

Fixed Expenses (per policy):		
	Duration	Amount
	1	100
	2+	20

Incentives Expenses (per policy):		
	Duration	Amount
Low	1	85
	2+	15
Mid	1	115
	2	40
High	1	170
	2	50

	Amounts without Decrements								Decrement Information						Reserves & Capital (Decremented)			
Year	Premium	Commission	Expenses	Death Benefit	SV per 1000	Reserves per 1000	Withdrawal Benefit	Reserve	Mortality Rate per 1000	Lapse Rate	In Force(sop)	Deaths	Lapses	In Force(eop)	Reserve(sop)	Capital(sop)	Reserve(eop)	Capital(eop)
0	150,524	105,367	185	640,019	-	44.876	-	28,722			1.00000			1.00000			28,722	6,400
1	0.00	-		640,019	-	59.222	-	37,903	3.361	0%	1.00000	0.00336	-	0.99664	28,722	6,400	37,776	6,379
2	0.00	-	35	640,019	-	74.021	-	47,375	3.591	0%	0.99664	0.00358	-	0.99306	37,776	6,379	47,046	6,356
3	0.00	-	35	640,019	10.639	89.222	6,809	57,104	3.908	0%	0.99306	0.00388	-	0.98918	47,046	6,356	56,486	6,331
4	0.00	-	35	640,019	22.950	104.809	14,688	67,080	4.274	0%	0.98918	0.00423	-	0.98495	56,486	6,331	66,070	6,304
5	0.00	-	35	640,019	35.784	120.804	22,902	77,317	4.649	0%	0.98495	0.00458	-	0.98037	66,070	6,304	75,799	6,275
6	0.00	-	35	640,019	49.170	137.221	31,470	87,824	5.043	0%	0.98037	0.00494	-	0.97543	75,799	6,275	85,666	6,243
7	0.00	-	35	640,019	63.101	154.042	40,386	98,590	5.500	0%	0.97543	0.00536	-	0.97006	85,666	6,243	95,638	6,209
8	0.00	-	35	640,019	77.633	171.305	49,687	109,639	5.953	0%	0.97006	0.00577	-	0.96429	95,638	6,209	105,723	6,172
9	0.00	-	35	640,019	92.763	188.995	59,370	120,960	6.471	0%	0.96429	0.00624	-	0.95805	105,723	6,172	115,886	6,132
10	0.00	-	35	640,019	108.517	207.118	69,453	132,560	7.030	0%	0.95805	0.00674	-	0.95131	115,886	6,132	126,106	6,089
11	0.00	-	35	640,019	124.080	224.940	79,414	143,966	8.584	0%	0.95131	0.00817	-	0.94315	126,106	6,089	135,781	6,036
12	0.00	-	35	640,019	140.206	243.134	89,735	155,610	9.310	0%	0.94315	0.00878	-	0.93437	135,781	6,036	145,397	5,980
13	0.00	-	35	640,019	156.853	261.651	100,389	167,462	10.165	0%	0.93437	0.00950	-	0.92487	145,397	5,980	154,880	5,919
14	0.00	-	35	640,019	173.987	280.448	111,355	179,492	11.145	0%	0.92487	0.01031	-	0.91456	154,880	5,919	164,156	5,853
15	0.00	-	35	640,019	191.634	299.541	122,649	191,712	12.180	0%	0.91456	0.01114	-	0.90342	164,156	5,853	173,197	5,782
16	0.00	-	35	640,019	209.794	318.914	134,272	204,111	13.318	0%	0.90342	0.01203	-	0.89139	173,197	5,782	181,943	5,705
17	0.00	-	35	640,019	228.484	338.574	146,234	216,694	14.538	0%	0.89139	0.01296	-	0.87843	181,943	5,705	190,351	5,622
18	0.00	-	35	640,019	247.655	358.466	158,504	229,425	15.943	0%	0.87843	0.01401	-	0.86443	190,351	5,622	198,321	5,532
19	0.00	-	35	640,019	267.258	378.539	171,050	242,272	17.543	0%	0.86443	0.01516	-	0.84926	198,321	5,532	205,752	5,435
20	0.00	-	35	640,019	287.272	398.763	183,860	255,216	19.313	0%	0.84926	0.01640	-	0.83286	205,752	5,435	212,559	5,330
21	0.00	-	35	640,019	307.635	419.081	196,892	268,220	21.324	0%	0.83286	0.01776	-	0.81510	212,559	5,330	218,626	5,217
22	0.00	-	35	640,019	327.668	438.917	209,714	280,915	24.491	0%	0.81510	0.01996	-	0.79514	218,626	5,217	223,366	5,089
23	0.00	-	35	640,019	347.939	458.756	222,688	293,613	26.956	0%	0.79514	0.02143	-	0.77370	223,366	5,089	227,169	4,952
24	0.00	-	35	640,019	368.464	478.606	235,824	306,317	29.594	0%	0.77370	0.02290	-	0.75081	227,169	4,952	229,985	4,805
25	0.00	-	35	640,019	389.211	498.439	249,103	319,011	32.501	0%	0.75081	0.02440	-	0.72640	229,985	4,805	231,730	4,649
26	0.00	-	35	640,019	409.979	518.085	262,395	331,584	35.979	0%	0.72640	0.02613	-	0.70027	231,730	4,649	232,198	4,482
27	0.00	-	35	640,019	430.784	537.561	275,710	344,049	39.686	0%	0.70027	0.02779	-	0.67248	232,198	4,482	231,366	4,304
28	0.00	-	35	640,019	451.800	557.010	289,161	356,497	43.380	0%	0.67248	0.02917	-	0.64331	231,366	4,304	229,337	4,117
29	0.00	-	35	640,019	473.012	576.414	302,737	368,916	47.442	0%	0.64331	0.03052	-	0.61279	229,337	4,117	226,067	3,922
30	0.00	-	35	640,019	494.487	595.826	316,481	381,340	51.764	0%	0.61279	0.03172	-	0.58107	226,067	3,922	221,584	3,719
31	0.00	-	35	640,019	516.206	615.224	330,382	393,755	56.575	0%	0.58107	0.03287	-	0.54819	221,584	3,719	215,854	3,509
32	0.00	-	35	640,019	537.046	633.715	343,720	405,590	64.181	0%	0.54819	0.03518	-	0.51301	215,854	3,509	208,071	3,283
33	0.00	-	35	640,019	557.920	652.044	357,080	417,321	70.311	0%	0.51301	0.03607	-	0.47694	208,071	3,283	199,036	3,052
34	0.00	-	35	640,019	578.936	670.297	370,530	429,003	76.823	0%	0.47694	0.03664	-	0.44030	199,036	3,052	188,889	2,818
35	0.00	-	35	640,019	600.058	688.442	384,049	440,616	84.156	0%	0.44030	0.03705	-	0.40324	188,889	2,818	177,676	2,581
36	0.00	-	35	640,019	621.255	706.454	397,615	452,144	92.427	0%	0.40324	0.03727	-	0.36597	177,676	2,581	165,473	2,342
37	0.00	-	35	640,019	642.455	724.278	411,184	463,552	101.892	0%	0.36597	0.03729	-	0.32868	165,473	2,342	152,362	2,104
38	0.00	-	35	640,019	663.560	741.837	424,691	474,790	112.813	0%	0.32868	0.03708	-	0.29160	152,362	2,104	138,451	1,866
39	0.00	-	35	640,019	684.473	759.058	438,076	485,812	125.405	0%	0.29160	0.03657	-	0.25504	138,451	1,866	123,899	1,632
40	0.00	-	35	640,019	704.936	775.749	451,173	496,494	140.404	0%	0.25504	0.03581	-	0.21923	123,899	1,632	108,845	1,403
41	0.00	-	35	640,019	724.806	791.810	463,890	506,774	157.704	0%	0.21923	0.03457	-	0.18465	108,845	1,403	93,578	1,182
42	0.00	-	35	640,019	743.948	807.148	476,141	516,590	177.569	0%	0.18465	0.03279	-	0.15187	93,578	1,182	78,452	972
43	0.00	-	35	640,019	762.154	821.622	487,793	525,854	200.518	0%	0.15187	0.03045	-	0.12141	78,452	972	63,846	777
44	0.00	-	35	640,019	779.380	835.214	498,818	534,553	226.176	0%	0.12141	0.02746	-	0.09395	63,846	777	50,223	601
45	0.00	-	35	640,019	795.597	847.921	509,198	542,686	254.734	0%	0.09395	0.02393	-	0.07002	50,223	601	37,999	448
46	0.00	-	35	640,019	810.916	859.841	519,002	550,315	285.903	0%	0.07002	0.02002	-	0.05000	37,999	448	27,516	320
47	0.00	-	35	640,019	825.439	871.065	528,297	557,499	320.164	0%	0.05000	0.01601	-	0.03399	27,516	320	18,951	218
48	0.00	-	35	640,019	839.119	881.569	537,052	564,221	358.707	0%	0.03399	0.01219	-	0.02180	18,951	218	12,300	140
49	0.00	-	35	640,019	851.885	891.310	545,223	570,456	402.021	0%	0.02180	0.00876	-	0.01304	12,300	140	7,436	83
50	0.00	-	35	640,019	863.522	900.143	552,671	576,109	450.871	0%	0.01304	0.00588	-	0.00716	7,436	83	4,124	46
51	0.00	-	35	640,019	874.038	908.086	559,401	581,193	503.640	0%	0.00716	0.00361	-	0.00355	4,124	46	2,065	23
52	0.00	-	35	640,019	883.737	915.375	565,609	585,858	558.778	0%	0.00355	0.00199	-	0.00157	2,065	23	918	10
53	0.00	-	35	640,019	892.540	921.959	571,243	590,072	618.971	0%	0.00157	0.00097	-	0.00060	918	10	352	4
54	0.00	-	35	640,019	900.164	927.630	576,122	593,701	683.990	0%	0.00060	0.00041	-	0.00019	352	4	112	1
55	0.00	-	35	640,019	904.195	930.617	578,702	595,613	755.634	0%	0.00019	0.00014	-	0.00005	112	1	27	0
56	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00005	0.00004	-	0.00001	27	0	5	0
57	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00001	0.00001	-	0.00000	5	0	1	0
58	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	1	0	0	0
59	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
60	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
61	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
62	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
63	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
64	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
65	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
66	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
67	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
68	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
69	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
70	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
71	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
72	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
73	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
74	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
75	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
76	0.00	-	35	640,019	904.195	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
77	0.00	-	35	640,019	904.194	930.617	578,702	595,613	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
78	0.00	-	35	640,019	904.193	930.616	578,701	595,612	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
79	0.00	-	35	640,019	904.187	930.609	578,697	595,608	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
80	0.00	-	35	640,019	904.156	930.572	578,677	595,584	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
81	0.00	-	35	640,019	903.989	930.379	578,571	595,461	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
82	0.00	-	35	640,019	903.092	929.372	577,996	594,816	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
83	0.00	-	35	640,019	898.294	924.108	574,926	591,447	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
84	0.00	-	35	640,019	872.620	896.579	558,494	573,828	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
85	0.00	-	35	640,019	721.386	738.313	461,701	472,535	800.539	0%	0.00000	0.00000	-	0.00000	0	0	0	0
86	0.00	-	35	640,019	-	0.000	-	-	800.539	0%	0.00000	0.00000	-	0.00000	0	0	-	0

Amounts with Decrements								
P_t	C_t	E_t	DB_t	W_t		CR_t	I_t	PR_t
Premium(sop)	Commission(sop)	Expenses(eop)	Death Benefits(eop)	Withdrawals(eop)	Cash Flow	Reserve Increase	Interest	Profit
150,524	(105,367)	(185)			44,972	(28,722)		16,251
-	-	-	(2,151)	-	(2,151)	(9,054)	1,995	(9,210)
-	-	(35)	(2,291)	-	(2,326)	(9,270)	2,508	(9,088)
-	-	(35)	(2,484)	-	(2,519)	(9,440)	3,033	(8,925)
-	-	(34)	(2,706)	-	(2,740)	(9,584)	3,568	(8,757)
-	-	(34)	(2,930)	-	(2,965)	(9,729)	4,111	(8,583)
-	-	(34)	(3,165)	-	(3,199)	(9,867)	4,662	(8,403)
-	-	(34)	(3,434)	-	(3,468)	(9,972)	5,221	(8,219)
-	-	(34)	(3,696)	-	(3,729)	(10,085)	5,785	(8,029)
-	-	(34)	(3,994)	-	(4,027)	(10,163)	6,356	(7,834)
-	-	(33)	(4,311)	-	(4,344)	(10,220)	6,931	(7,633)
-	-	(33)	(5,227)	-	(5,260)	(9,675)	7,509	(7,426)
-	-	(33)	(5,620)	-	(5,652)	(9,616)	8,056	(7,213)
-	-	(32)	(6,079)	-	(6,111)	(9,483)	8,599	(6,995)
-	-	(32)	(6,597)	-	(6,629)	(9,276)	9,134	(6,772)
-	-	(32)	(7,130)	-	(7,161)	(9,040)	9,657	(6,544)
-	-	(31)	(7,700)	-	(7,732)	(8,746)	10,167	(6,311)
-	-	(31)	(8,294)	-	(8,325)	(8,408)	10,659	(6,074)
-	-	(30)	(8,964)	-	(8,994)	(7,970)	11,132	(5,832)
-	-	(30)	(9,705)	-	(9,735)	(7,431)	11,580	(5,587)
-	-	(29)	(10,498)	-	(10,527)	(6,807)	11,996	(5,337)
-	-	(29)	(11,367)	-	(11,395)	(6,067)	12,377	(5,085)
-	-	(28)	(12,776)	-	(12,804)	(4,740)	12,715	(4,830)
-	-	(27)	(13,718)	-	(13,745)	(3,803)	12,977	(4,571)
-	-	(26)	(14,655)	-	(14,681)	(2,816)	13,185	(4,311)
-	-	(25)	(15,618)	-	(15,643)	(1,746)	13,337	(4,052)
-	-	(25)	(16,727)	-	(16,751)	(468)	13,427	(3,792)
-	-	(24)	(17,787)	-	(17,810)	833	13,444	(3,534)
-	-	(23)	(18,670)	-	(18,693)	2,029	13,387	(3,277)
-	-	(21)	(19,533)	-	(19,555)	3,270	13,261	(3,024)
-	-	(20)	(20,302)	-	(20,322)	4,483	13,064	(2,775)
-	-	(19)	(21,040)	-	(21,059)	5,730	12,798	(2,531)
-	-	(18)	(22,518)	-	(22,536)	7,783	12,460	(2,293)
-	-	(17)	(23,086)	-	(23,102)	9,035	12,006	(2,062)
-	-	(15)	(23,450)	-	(23,465)	10,147	11,479	(1,839)
-	-	(14)	(23,715)	-	(23,729)	11,213	10,890	(1,626)
-	-	(13)	(23,854)	-	(23,867)	12,203	10,239	(1,424)
-	-	(12)	(23,866)	-	(23,878)	13,111	9,532	(1,234)
-	-	(10)	(23,732)	-	(23,742)	13,911	8,774	(1,057)
-	-	(9)	(23,405)	-	(23,414)	14,551	7,970	(892)
-	-	(8)	(22,918)	-	(22,926)	15,054	7,131	(741)
-	-	(6)	(22,127)	-	(22,134)	15,267	6,262	(604)
-	-	(5)	(20,986)	-	(20,991)	15,126	5,383	(482)
-	-	(4)	(19,490)	-	(19,494)	14,606	4,512	(376)
-	-	(3)	(17,576)	-	(17,579)	13,623	3,671	(285)
-	-	(2)	(15,318)	-	(15,320)	12,224	2,887	(209)
-	-	(2)	(12,812)	-	(12,814)	10,483	2,184	(148)
-	-	(1)	(10,246)	-	(10,247)	8,566	1,581	(100)
-	-	(1)	(7,804)	-	(7,805)	6,651	1,089	(65)
-	-	(0)	(5,609)	-	(5,609)	4,863	707	(39)
-	-	(0)	(3,762)	-	(3,762)	3,312	427	(22)
-	-	(0)	(2,307)	-	(2,307)	2,059	237	(12)
-	-	(0)	(1,271)	-	(1,271)	1,147	119	(6)
-	-	(0)	(621)	-	(621)	566	53	(2)
-	-	(0)	(261)	-	(261)	240	20	(1)
-	-	(0)	(91)	-	(91)	85	6	(0)
-	-	(0)	(24)	-	(24)	22	2	(0)
-	-	(0)	(5)	-	(5)	4	0	(0)
-	-	(0)	(1)	-	(1)	1	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	(0)
-	-	(0)	(0)	-	(0)	0	0	0
-	-	(0)	(0)	-	(0)	0	0	(0)
Total: 150,524	(105,367)	(1,213)	(640,019)	-	(596,075)	0	406,250	#######
Present Value at 5.68%: 150,524	(105,367)	(628)	(137,784)	-	(93,255)	(117,623)	122,646	(88,232)
Present Value at 11.03%: 150,524	(105,367)	(443)	(50,116)	-	(5,402)	(101,382)	55,237	(51,547)

Present Value of Profit: (51,547)

4.29%	17.021	0.29917	14.9399	
6.74%	13.136	0.17077	14.7748	
Year	Lives	Deaths	Reserve	SV
0	1.000000	-	44.876	-
1	1.000000	0.003361	59.222	-
2	0.996639	0.003579	74.021	-
3	0.993060	0.003881	89.222	10.639
4	0.989179	0.004228	104.809	22.950
5	0.984951	0.004579	120.804	35.784
6	0.980372	0.004944	137.221	49.170
7	0.975428	0.005365	154.042	63.101
8	0.970063	0.005774	171.305	77.633
9	0.964288	0.006240	188.995	92.763
10	0.958049	0.006735	207.118	108.517
11	0.951313	0.008166	224.940	124.080
12	0.943147	0.008781	243.134	140.206
13	0.934366	0.009498	261.651	156.853
14	0.924868	0.010308	280.448	173.987
15	0.914561	0.011140	299.541	191.634
16	0.903421	0.012031	318.914	209.794
17	0.891390	0.012959	338.574	228.484
18	0.878431	0.014005	358.466	247.655
19	0.864425	0.015164	378.539	267.258
20	0.849261	0.016402	398.763	287.272
21	0.832859	0.017760	419.081	307.635
22	0.815099	0.019963	438.917	327.668
23	0.795137	0.021434	458.756	347.939
24	0.773703	0.022897	478.606	368.464
25	0.750806	0.024402	498.439	389.211
26	0.726404	0.026135	518.085	409.979
27	0.700269	0.027791	537.561	430.784
28	0.672478	0.029172	557.010	451.800
29	0.643306	0.030520	576.414	473.012
30	0.612786	0.031720	595.826	494.487
31	0.581066	0.032874	615.224	516.206
32	0.548192	0.035184	633.715	537.046
33	0.513009	0.036070	652.044	557.920
34	0.476938	0.036640	670.297	578.936
35	0.440299	0.037054	688.442	600.058
36	0.403245	0.037271	706.454	621.255
37	0.365974	0.037290	724.278	642.455
38	0.328684	0.037080	741.837	663.560
39	0.291604	0.036569	759.058	684.473
40	0.255036	0.035808	775.749	704.936
41	0.219228	0.034573	791.810	724.806
42	0.184655	0.032789	807.148	743.948
43	0.151866	0.030452	821.622	762.154
44	0.121414	0.027461	835.214	779.380
45	0.093953	0.023933	847.921	795.597
46	0.070020	0.020019	859.841	810.916
47	0.050001	0.016009	871.065	825.439
48	0.033993	0.012193	881.569	839.119
49	0.021799	0.008764	891.310	851.885
50	0.013035	0.005877	900.143	863.522
51	0.007158	0.003605	908.086	874.038
52	0.003553	0.001985	915.375	883.737
53	0.001568	0.000970	921.959	892.540
54	0.000597	0.000409	927.630	900.164
55	0.000189	0.000143	930.617	904.195
56	0.000046	0.000037	930.617	904.195
57	0.000009	0.000007	930.617	904.195
58	0.000002	0.000001	930.617	904.195
59	0.000000	0.000000	930.617	904.195
60	0.000000	0.000000	930.617	904.195
61	0.000000	0.000000	930.617	904.195
62	0.000000	0.000000	930.617	904.195
63	0.000000	0.000000	930.617	904.195
64	0.000000	0.000000	930.617	904.195
65	0.000000	0.000000	930.617	904.195
66	0.000000	0.000000	930.617	904.195
67	0.000000	0.000000	930.617	904.195
68	0.000000	0.000000	930.617	904.195
69	0.000000	0.000000	930.617	904.195
70	0.000000	0.000000	930.617	904.195
71	0.000000	0.000000	930.617	904.195
72	0.000000	0.000000	930.617	904.195
73	0.000000	0.000000	930.617	904.195
74	0.000000	0.000000	930.617	904.195
75	0.000000	0.000000	930.617	904.195
76	0.000000	0.000000	930.617	904.195
77	0.000000	0.000000	930.617	904.194
78	0.000000	0.000000	930.616	904.193
79	0.000000	0.000000	930.609	904.187
80	0.000000	0.000000	930.572	904.156
81	0.000000	0.000000	930.379	903.989
82	0.000000	0.000000	929.372	903.092
83	0.000000	0.000000	924.108	898.294
84	0.000000	0.000000	896.579	872.620
85	0.000000	0.000000	738.313	721.386
86	0.000000	0.000000		

8.2.6 20 Year Term Life Insurance Model

20 Year Term Life Insurance

Age		42	<--- change input 65,525.17
Current Year		2023	
Gender		M	
Risk Level		Moderate	
Smoker		NS	
Incentive/No Incentive		Incentive	
Incentive Loading		4%	
Expense Loading		11%	

Assumptions

Death Benefit		639170	**Check t_20 with base premiums workbook
Investment Earning Rate		5.7%	**Assumption based on average 1 year risk free spot rate
Discount Rate		11%	Refer to the economy sheet, 1 year spot rate however, for discounting, 10 year average + inflation

Required Capital (per 1000 death benefit):			
	Age	Rate	
less than	40	0.01	https://www.apra.gov.au/capital-explained
greater than and equal	40	0.02	https://www.legislation.gov.au/F2023L00673/asmade/text

Fixed Expenses (per policy)		**Assumption
	Duration	Amount
	1	100
	2+	20

Commission as a % of premium		
**Assumption	Duration	Rate
	1	60%
	2+	5%

Incentives Expenses (per policy):		
	Duration	Amount
Low	1	85
	2+	15
Mid	1	115
	2	40
High	1	170
	2	50

Sensitivity Testing	Low	<-- change this to either Low, mid, high for sensitivity testing
		Mid
		High

Sheet name	Age_42
Scenario	T20_MNS
Avg premium per sce	19932.802
Premium:	21275.90

Amounts without Decrements

Year	Premium	Commission	Expenses	Death Benefit	Reserves per 1000	Reserve	Capital
0	21275.895	12765.537	185	639170	0.935	597.624	12.8
1				639170	0.561	358.574	12.8
2	21275.895	1063.795	35	639170	0.842	537.861	12.8
3	21275.895	1063.795	35	639170	0.757	484.075	12.8
4	21275.895	1063.795	35	639170	0.682	435.668	12.8
5	21275.895	1063.795	35	639170	0.613	392.101	12.8
6	21275.895	1063.795	35	639170	0.552	352.891	12.8
7	21275.895	1063.795	35	639170	0.497	317.602	12.8
8	21275.895	1063.795	35	639170	0.447	285.842	12.8
9	21275.895	1063.795	35	639170	0.402	257.257	12.8
10	21275.895	1063.795	35	639170	0.362	231.532	12.8
11	21275.895	1063.795	35	639170	0.326	208.379	12.8
12	21275.895	1063.795	35	639170	0.293	187.541	12.8
13	21275.895	1063.795	35	639170	0.264	168.787	12.8
14	21275.895	1063.795	35	639170	0.238	151.908	12.8
15	21275.895	1063.795	35	639170	0.214	136.717	12.8
16	21275.895	1063.795	35	639170	0.193	123.045	12.8
17	21275.895	1063.795	35	639170	0.173	110.741	12.8
18	21275.895	1063.795	35	639170	0.156	99.667	12.8
19	21275.895	1063.795	35	639170	0.140	89.700	12.8
20	21275.895	1063.795	35	639170	0.126	80.730	12.8

Decrement Information

Mortality Rate per 1000	Lapse Rate	Inforce (sop)	Deaths	Lapse	Inforce (eop)
		0.976			0.965
1.391	0.114	0.965	0.001	0.110	0.853
1.513	0.114	0.853	0.001	0.097	0.755
1.643	0.114	0.755	0.001	0.086	0.667
1.794	0.114	0.667	0.001	0.076	0.590
1.946	0.114	0.590	0.001	0.067	0.522
2.125	0.114	0.522	0.001	0.060	0.461
2.329	0.114	0.461	0.001	0.053	0.407
2.546	0.114	0.407	0.001	0.046	0.360
2.784	0.114	0.360	0.001	0.041	0.318
3.039	0.114	0.318	0.001	0.036	0.281
3.332	0.114	0.281	0.001	0.032	0.248
3.667	0.114	0.248	0.001	0.028	0.218
4.037	0.114	0.218	0.001	0.025	0.193
4.457	0.114	0.193	0.001	0.022	0.170
4.771	0.114	0.170	0.001	0.019	0.150
5.251	0.114	0.150	0.001	0.017	0.132
5.765	0.114	0.132	0.001	0.015	0.116
6.332	0.114	0.116	0.001	0.013	0.102
7.009	0.114	0.102	0.001	0.012	0.090
7.731	0.114	0.090	0.001	0.010	0.079

Reserves & Capital (Decremented)

Reserve(sop)	Capital(sop)	Reserve(eop)	Capital(eop)
		576.591	12.334
576.591	12.334	306.006	10.909
306.006	10.909	405.950	9.648
405.950	9.648	323.073	8.532
323.073	8.532	257.073	7.543
257.073	7.543	204.521	6.668
204.521	6.668	162.678	5.893
162.678	5.893	129.367	5.207
129.367	5.207	102.851	4.600
102.851	4.600	81.748	4.062
81.748	4.062	64.956	3.586
64.956	3.586	51.596	3.165
51.596	3.165	40.969	2.793
40.969	2.793	32.517	2.463
32.517	2.463	25.796	2.171
25.796	2.171	20.457	1.913
20.457	1.913	16.214	1.685
16.214	1.685	12.844	1.483
12.844	1.483	10.168	1.304
10.168	1.304	8.043	1.146
8.043	1.146	6.357	1.007

Amounts with Decrements

	P_t Premium(sop)	C_t Commission(sop)	E_t Expenses(eop)	CL_t Claims(eop)	Cash Flow	CR_t Reserve Increase	I_t Interest	PR_t Profit	Present Value of Profit:
	20527.129	-12316.277	-178.489		8032.362	-576.591		7455.771	65,525.17
	0.000	0.000	0.000	-858.081	-858.081	270.585	33.453	-554.043	
	16057.931	-802.897	-26.416	-825.086	14403.533	-99.944	884.535	15188.124	
	14199.606	-709.980	-23.359	-792.799	12673.468	82.876	789.860	13546.204	
	12554.198	-627.710	-20.652	-765.378	11140.457	66.000	696.298	11902.755	
	11097.549	-554.877	-18.256	-733.899	9790.517	52.552	613.888	10456.957	
	9807.931	-490.397	-16.135	-708.337	8593.062	41.842	541.261	9176.166	
	8666.167	-433.308	-14.256	-686.377	7532.225	33.312	477.227	8042.765	
	7655.442	-382.772	-12.594	-662.820	6597.257	26.516	420.754	7044.527	
	6760.778	-338.039	-11.122	-640.179	5771.438	21.103	370.935	6163.476	
	5968.945	-298.447	-9.819	-617.171	5043.508	16.792	326.976	5387.276	
	5268.100	-263.405	-8.666	-597.556	4398.473	13.360	288.176	4700.008	
	4647.784	-232.389	-7.646	-580.301	3827.447	10.628	253.919	4091.994	
	4098.790	-204.939	-6.743	-563.641	3323.467	8.452	223.669	3555.588	
	3612.920	-180.646	-5.943	-548.816	2877.514	6.721	196.951	3081.185	
	3183.510	-159.175	-5.237	-517.850	2501.247	5.339	173.380	2679.966	
	2803.608	-140.180	-4.612	-502.235	2156.580	4.243	152.562	2313.384	
	2467.601	-123.380	-4.059	-485.587	1854.574	3.370	134.176	1992.120	
	2170.466	-108.523	-3.571	-469.368	1589.005	2.676	117.939	1709.619	
	1907.640	-95.382	-3.138	-457.022	1352.098	2.125	103.594	1457.816	
	1675.263	-83.763	-2.756	-443.075	1145.669	1.686	90.924	1238.279	
Total:	145131.36	-18546.49	-383.47	-12455.58	113745.82	-6.36	6890.47	120629.94	
Present Value at 5.68%:	105283.06	-16554.07	-317.92	-7794.42	80616.64	-127.16	4702.68	85192.16	
Present Value at 11.03%:	83487.77	-15464.31	-282.06	-5519.14	62222.26	-200.54	3503.46	65525.17	

T20	
Year	Reserve % per 1000
0	0.935
1	0.561
2	0.842
3	0.757
4	0.682
5	0.613
6	0.552
7	0.497
8	0.447
9	0.402
10	0.362
11	0.326
12	0.293
13	0.264
14	0.238
15	0.214
16	0.193
17	0.173
18	0.156
19	0.140
20	0.126

** Calculations are located in the capital reserve spreadsheet

8.2.7 R Code

Whole Life Insurance Base:

```
# Setting Up --------------------------------------------------------------
cat("\014") # Clear console
rm(list=ls()) # Clear Environment

# Directory --------------------------------------------------------------
setwd("") #change to your own

# Packages --------------------------------------------------------------
# install.packages('tidyverse')
# install.packages('dplyr')
# install.packages('readxl')
# install.packages('openxlsx')

library(tidyverse)
library(dplyr)
library(readxl)
library(tidyr)
library(openxlsx)

# Read in the Data (files in the drive) -----------------------------------
inforce_data <- read.csv("inforce_data.csv", header = TRUE)
intervention_data <- read.csv("intervention_data.csv", header = TRUE)
eco_data <- read.csv("economy_data.csv", header = TRUE)
mortality_data <- read.csv("mortality_data.csv", header = TRUE)
mortality_modified <- read.csv("base_mortmod.csv", header = TRUE)

# Split the Inforce Data -----------------------------------------------
splitbypolicytype <- split(inforce_data, inforce_data$Policy.type)

t_20 <- splitbypolicytype[["T20"]]
spwl <- splitbypolicytype[["SPWL"]]

# Base Mortality Table Calculation ----------------------------------------
#Removing the additional column
#mortality_data <- mortality_data[,-c(1)]
#finding the probability of survival at each age
#mortality_data$p_x <- 1- mortality_data$Mortality.Rate

#Renaming the Header
colnames(mortality_modified) <- c("Age","MS", "FS", "MNS", "FNS")

#Calculating the survival p_x
mortality_modified$MS.p_x <- 1 - mortality_modified$MS
mortality_modified$FS.p_x <- 1 - mortality_modified$FS
mortality_modified$MNS.p_x <- 1 - mortality_modified$MNS
mortality_modified$FNS.p_x <- 1 - mortality_modified$FNS
```

```
# Average Spot Rate -----------------------------------------------------
average_spot_rate <- mean(eco_data[,4])
#This is used, if current year is past 2023

# Whole Life Function ---------------------------------------------------
whole_life <- function(x, issue_year, face_value, gender, s_status) {
 max_age <- max(which(!is.na(mortality_modified$MS.p_x)))
 n_years <- max_age - x

 # Calculate survival probabilities (kpx)
 if(gender == "M" & s_status == "S") {
  MS.kpx <- numeric(n_years + 1)
  MS.kpx[1] <- 1 # Initial survival probability is 1
  for (i in 2:length(MS.kpx)) {
   MS.kpx[i] <- MS.kpx[i-1] * mortality_modified$MS.p_x[x + i - 2] # Corrected to use actual
survival rates
  }
 } else if(gender == "F" & s_status == "S") {
  FS.kpx <- numeric(n_years + 1)
  FS.kpx[1] <- 1 # Initial survival probability is 1
  for (i in 2:length(FS.kpx)) {
   FS.kpx[i] <- FS.kpx[i-1] * mortality_modified$FS.p_x[x + i - 2] # Corrected to use actual
survival rates
  }
  } else if(gender == "M" & s_status == "NS"){
   MNS.kpx <- numeric(n_years + 1)
   MNS.kpx[1] <- 1 # Initial survival probability is 1
   for (i in 2:length(MNS.kpx)) {
    MNS.kpx[i] <- MNS.kpx[i-1] * mortality_modified$MNS.p_x[x + i - 2] # Corrected to use
actual survival rates
   }
  }else if(gender == "F" & s_status == "NS") {
   FNS.kpx <- numeric(n_years + 1)
   FNS.kpx[1] <- 1 # Initial survival probability is 1
   for (i in 2:length(FNS.kpx)) {
    FNS.kpx[i] <- FNS.kpx[i-1] * mortality_modified$FNS.p_x[x + i - 2] # Corrected to use actual
survival rates
   }
  }

 # Calculate spot rates for each year
 spot_rate_x <- rep(average_spot_rate, n_years) # Default to average if no data available
 for (i in 1:n_years) {
  current_year <- issue_year + i - 1
  if (current_year <= 2023) { # Assuming you have spot rate data up to 2023
   spot_rate_x[i] <- ifelse(is.na(eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year ==
current_year]), average_spot_rate,
eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year == current_year])
  }
```

```
  }

  # Calculate present value factors (discount factors)
  v <- 1 / (1 + spot_rate_x) # Direct calculation of discount factors

  # Calculate the values (present value of expected benefits)
  value <- numeric(n_years)
  for(i in 1:n_years) { if (gender == "M" & s_status == "S") {
    value[i] <- MS.kpx[i] * mortality_modified$MS[x+i-1] * prod(v[1:i])
  } else if (gender == "F" & s_status == "S") {
    value[i] <- FS.kpx[i] * mortality_modified$FS[x+i-1] * prod(v[1:i])
  } else if (gender == "M" & s_status == "NS") {
    value[i] <- MNS.kpx[i] * mortality_modified$MNS[x+i-1] * prod(v[1:i])
  } else if (gender == "F" & s_status == "NS") {
    value[i] <- FNS.kpx[i] * mortality_modified$FNS[x+i-1] * prod(v[1:i])
  }
  }

  final_value <- face_value*sum(value)
  return(final_value)
}

whole_life(54,2001, 1000000, 'F', 'S')

# Finding the Premiums for the SPWL Dataset -------------------------------
premiums <- mapply(whole_life, spwl$Issue.age, spwl$Issue.year, spwl$Face.amount,
spwl$Sex, spwl$Smoker.Status)

spwl$prem_at_issue_year <- premiums


# Discount/Accumulate to 2004 --------------------------------------------
adjustment_factor <- function(issueYear, prem_wli) {
  if (issueYear > 2004) {
    # Policy issued after 2004: Calculate discount factor
    years <- 2004:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2004) {
    # Policy issued before 2004: Calculate accumulation factor
    years <- issueYear:2003
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
  } else {
    # Issue year is 2004, no adjustment needed
    factor <- 1
  }
  value <- prem_wli*factor
  return(value)
```

```r
}

premiums_at2004 <- mapply(adjustment_factor, spwl$Issue.year, spwl$prem_at_issue_year)

spwl$prem_at_2004 <- premiums_at2004

# Discount/Accumulate to 2023 ---------------------------------------------
adjustment_factor2 <- function(issueYear, prem_wli) {
  if (issueYear > 2023) {
    # Policy issued after 2023: Calculate discount factor
    years <- 2023:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2023) {
    # Policy issued before 2023: Calculate accumulation factor
    years <- issueYear:2023
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
  } else {
    # Issue year is 2023, no adjustment needed
    factor <- 1
  }
  value2 <- prem_wli*factor
  return(value2)
}

premiums_at2023 <- mapply(adjustment_factor2, spwl$Issue.year,
spwl$prem_at_issue_year)

spwl$prem_at_2023 <- premiums_at2023

# Exporting the premiums for the SPWL ------------------------------------
write_csv(spwl, "spwl_with_premiums.csv")
```

Whole Life Insurance Incentive:

```r
# Setting Up ---------------------------------------------------------------
cat("\014") # Clear console
rm(list=ls()) # Clear Environment

# Directory ----------------------------------------------------------------
setwd("") #change to your own

# Packages -----------------------------------------------------------------
# install.packages('tidyverse')
# install.packages('dplyr')
# install.packages('readxl')
# install.packages('openxlsx')

library(tidyverse)
```

```
library(dplyr)
library(readxl)
library(tidyr)
library(openxlsx)

# Read in the Data (files in the drive) ----------------------------------
inforce_data <- read.csv("inforce_data.csv", header = TRUE)
eco_data <- read.csv("economy_data.csv", header = TRUE)
mortality_modified <- read.csv("incentive_modmort.csv", header = TRUE)

# Split the Inforce Data ------------------------------------------------
splitbypolicytype <- split(inforce_data, inforce_data$Policy.type)

t_20 <- splitbypolicytype[["T20"]]
spwl <- splitbypolicytype[["SPWL"]]

# Base Mortality Table Calculation ---------------------------------------
#Removing the additional column
#mortality_data <- mortality_data[,-c(1)]
#finding the probability of survival at each age
#mortality_data$p_x <- 1- mortality_data$Mortality.Rate

#Renaming the Header
colnames(mortality_modified) <- c("Age","MS", "FS", "MNS", "FNS")

#Calculating the survival p_x
mortality_modified$MS.p_x <- 1 - mortality_modified$MS
mortality_modified$FS.p_x <- 1 - mortality_modified$FS
mortality_modified$MNS.p_x <- 1 - mortality_modified$MNS
mortality_modified$FNS.p_x <- 1 - mortality_modified$FNS


# Average Spot Rate -----------------------------------------------------
average_spot_rate <- mean(eco_data[,4])
#This is used, if current year is past 2023

# Whole Life Function ---------------------------------------------------
whole_life <- function(x, issue_year, face_value, gender, s_status) {
 max_age <- max(which(!is.na(mortality_modified$MS.p_x)))
 n_years <- max_age - x

 # Calculate survival probabilities (kpx)
 if(gender == "M" & s_status == "S") {
  MS.kpx <- numeric(n_years + 1)
  MS.kpx[1] <- 1 # Initial survival probability is 1
  for (i in 2:length(MS.kpx)) {
   MS.kpx[i] <- MS.kpx[i-1] * mortality_modified$MS.p_x[x + i - 2] # Corrected to use actual
survival rates
  }
```

```
 } else if(gender == "F" & s_status == "S") {
   FS.kpx <- numeric(n_years + 1)
   FS.kpx[1] <- 1 # Initial survival probability is 1
   for (i in 2:length(FS.kpx)) {
     FS.kpx[i] <- FS.kpx[i-1] * mortality_modified$FS.p_x[x + i - 2] # Corrected to use actual
survival rates
   }
   } else if(gender == "M" & s_status == "NS"){
     MNS.kpx <- numeric(n_years + 1)
     MNS.kpx[1] <- 1 # Initial survival probability is 1
     for (i in 2:length(MNS.kpx)) {
       MNS.kpx[i] <- MNS.kpx[i-1] * mortality_modified$MNS.p_x[x + i - 2] # Corrected to use
actual survival rates
     }
   }else if(gender == "F" & s_status == "NS") {
     FNS.kpx <- numeric(n_years + 1)
     FNS.kpx[1] <- 1 # Initial survival probability is 1
     for (i in 2:length(FNS.kpx)) {
       FNS.kpx[i] <- FNS.kpx[i-1] * mortality_modified$FNS.p_x[x + i - 2] # Corrected to use actual
survival rates
     }
   }

 # Calculate spot rates for each year
 spot_rate_x <- rep(average_spot_rate, n_years) # Default to average if no data available
 for (i in 1:n_years) {
   current_year <- issue_year + i - 1
   if (current_year <= 2023) { # Assuming you have spot rate data up to 2023
     spot_rate_x[i] <- ifelse(is.na(eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year ==
current_year]), average_spot_rate,
eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year == current_year])
   }
 }

 # Calculate present value factors (discount factors)
 v <- 1 / (1 + spot_rate_x) # Direct calculation of discount factors

 # Calculate the values (present value of expected benefits)
 value <- numeric(n_years)
 for(i in 1:n_years) { if (gender == "M" & s_status == "S") {
   value[i] <- MS.kpx[i] * mortality_modified$MS[x+i-1] * prod(v[1:i])
 } else if (gender == "F" & s_status == "S") {
   value[i] <- FS.kpx[i] * mortality_modified$FS[x+i-1] * prod(v[1:i])
 } else if (gender == "M" & s_status == "NS") {
   value[i] <- MNS.kpx[i] * mortality_modified$MNS[x+i-1] * prod(v[1:i])
 } else if (gender == "F" & s_status == "NS") {
   value[i] <- FNS.kpx[i] * mortality_modified$FNS[x+i-1] * prod(v[1:i])
 }
 }
```

```
  final_value <- face_value*sum(value)
  return(final_value)
}

whole_life(54,2001, 1000000, 'F', 'S')

# Finding the Premiums for the SPWL Dataset ------------------------------
premiums <- mapply(whole_life, spwl$Issue.age, spwl$Issue.year, spwl$Face.amount,
spwl$Sex, spwl$Smoker.Status)

spwl$prem_at_issue_year <- premiums

# Discount/Accumulate to 2004 -------------------------------------------
adjustment_factor <- function(issueYear, prem_wli) {
  if (issueYear > 2004) {
    # Policy issued after 2004: Calculate discount factor
    years <- 2004:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2004) {
    # Policy issued before 2004: Calculate accumulation factor
    years <- issueYear:2003
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
  } else {
    # Issue year is 2004, no adjustment needed
    factor <- 1
  }
  value <- prem_wli*factor
  return(value)
}

premiums_at2004 <- mapply(adjustment_factor, spwl$Issue.year, spwl$prem_at_issue_year)

spwl$prem_at_2004 <- premiums_at2004

# Discount/Accumulate to 2023 -------------------------------------------
adjustment_factor2 <- function(issueYear, prem_wli) {
  if (issueYear > 2023) {
    # Policy issued after 2023: Calculate discount factor
    years <- 2023:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2023) {
    # Policy issued before 2023: Calculate accumulation factor
    years <- issueYear:2023
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
```

```
  } else {
    # Issue year is 2023, no adjustment needed
    factor <- 1
  }
  value2 <- prem_wli*factor
  return(value2)
}

premiums_at2023 <- mapply(adjustment_factor2, spwl$Issue.year,
spwl$prem_at_issue_year)

spwl$prem_at_2023 <- premiums_at2023

# Exporting the premiums for the SPWL ------------------------------------
write_csv(spwl, "spwl_with_incentivepremiums.csv")
```

Term Insurance Base:

```
# Setting Up ------------------------------------------------------------
cat("\014") # Clear console
rm(list=ls()) # Clear Environment

# Directory -------------------------------------------------------------
setwd("") #change to your own

# Packages --------------------------------------------------------------
# install.packages('tidyverse')
# install.packages('dplyr')
# install.packages('readxl')
# install.packages('openxlsx')

library(tidyverse)
library(dplyr)
library(readxl)
library(tidyr)
library(openxlsx)


# Read in the Data (files in the drive) ----------------------------------
inforce_data <- read.csv("inforce_data.csv", header = TRUE)
eco_data <- read.csv("economy_data.csv", header = TRUE)
mortality_modified <- read.csv("incentive_modmort.csv", header = TRUE)

# Split the Inforce Data ------------------------------------------------
splitbypolicytype <- split(inforce_data, inforce_data$Policy.type)

t_20 <- splitbypolicytype[["T20"]]
spwl <- splitbypolicytype[["SPWL"]]
```

```
# Base Mortality Table Calculation ----------------------------------------
#Removing the additional column
# mortality_data <- mortality_data[,-c(1)]
# #finding the probability of survival at each age
# mortality_data$p_x <- 1- mortality_data$Mortality.Rate

colnames(mortality_modified) <- c("Age", "MS", "FS", "MNS", "FNS")

mortality_modified$MS.p_x <- 1 - mortality_modified$MS
mortality_modified$FS.p_x <- 1 - mortality_modified$FS
mortality_modified$MNS.p_x <- 1 - mortality_modified$MNS
mortality_modified$FNS.p_x <- 1 - mortality_modified$FNS

mortality_modified <- mortality_modified[-c(121:998), ]

# Average Spot Rate -------------------------------------------------------
average_spot_rate <- mean(eco_data[,4])
#This is used, if current year is past 2023


# 20 Year Term Life Function ----------------------------------------------
insurance_20_year <- function (x, issue_year, face_value, gender, s_status) {

 if(gender == "M" & s_status == "S") {
  MS.kpx <- rep(0,20)
  MS.kpx[1] <- mortality_modified$MS.p_x[x]
  for(i in 2:20) {
   MS.kpx[i] <- prod(MS.kpx[i-1], mortality_modified$MS.p_x[x+i-1])
  }
 } else if(gender == "F" & s_status == "S") {
  FS.kpx <- rep(0,20)
  FS.kpx[1] <- mortality_modified$FS.p_x[x]
  for(i in 2:20) {
   FS.kpx[i] <- prod(FS.kpx[i-1], mortality_modified$FS.p_x[x+i-1])
  }
 } else if(gender == "M" & s_status == "NS") {
  MNS.kpx <- rep(0,20)
  MNS.kpx[1] <- mortality_modified$MNS.p_x[x]
  for(i in 2:20) {
   MNS.kpx[i] <- prod(MNS.kpx[i-1], mortality_modified$MNS.p_x[x+i-1])
  }
 } else if(gender == "F" & s_status == "NS") {
  FNS.kpx <- rep(0,20)
  FNS.kpx[1] <- mortality_modified$FNS.p_x[x]
  for(i in 2:20) {
   FNS.kpx[i] <- prod(FNS.kpx[i-1], mortality_modified$FNS.p_x[x+i-1])
  }
 }
```

```
#Find kpx values, will use formula k|q_x=kpx*q_(x+k)

spot_rate_x <- rep(0,20)

#This checks if current year is less than 2023, if so, use spot rate, otherwise use average
for (i in 1:20) {
  current_year <- issue_year + i - 1
  if (length(eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year == current_year]) == 0)
{
    spot_rate_x[i] <- average_spot_rate
  } else {
    spot_rate_x[i] <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year ==
current_year]
  }
}

#This should generate a vector of (1+i,(1+i)^2,...,(1+i)^20)
effective_interest <- c(1+spot_rate_x[1])
for (i in 2:20) {
  effective_interest[i] <- prod(effective_interest[i-1], (1 + spot_rate_x[i]))
}

#Finding the components of the sum for the final value
# Using sum of v^(k+1)*kpx*q_(x+k)
value <- rep(0,20)

if(gender == "M" & s_status == "S"){
  value[1] <- prod(mortality_modified$MS[x], (1/(effective_interest[1])))
  for (i in 1:19) {
    value[i+1] <- prod(MS.kpx[i], mortality_modified$MS[x+i], (1/(effective_interest[i+1])))
  }
} else if(gender == "F" & s_status == "S"){
  value[1] <- prod(mortality_modified$FS[x], (1/(effective_interest[1])))
  for (i in 1:19) {
    value[i+1] <- prod(FS.kpx[i], mortality_modified$FS[x+i], (1/(effective_interest[i+1])))
  }
}else if(gender == "M" & s_status == "NS"){
  value[1] <- prod(mortality_modified$MNS[x], (1/(effective_interest[1])))
  for (i in 1:19) {
    value[i+1] <- prod(MNS.kpx[i], mortality_modified$MNS[x+i], (1/(effective_interest[i+1])))
  }
}else if(gender == "F" & s_status == "NS"){
  value[1] <- prod(mortality_modified$FNS[x], (1/(effective_interest[1])))
  for (i in 1:19) {
    value[i+1] <- prod(FNS.kpx[i], mortality_modified$FNS[x+i], (1/(effective_interest[i+1])))
  }
}

final <- face_value*sum(value)
```

```
 return(final)

}

insurance_20_year(40, 2000, 50000, 'M', 'S')

#Annuity

annuity_due_term <- function (x, issue_year, gender, s_status) {

 if(gender == "M" & s_status == "S") {
  MS.kpx <- rep(0,20)
  MS.kpx[1] <- mortality_modified$MS.p_x[x]
  for (i in 2:20) {
   MS.kpx[i] <- prod(MS.kpx[i-1], mortality_modified$MS.p_x)
  }
 } else if(gender == "F" & s_status == "S") {
  FS.kpx <- rep(0,20)
  FS.kpx[1] <- mortality_modified$FS.p_x[x]
  for (i in 2:20) {
   FS.kpx[i] <- prod(FS.kpx[i-1], mortality_modified$FS.p_x)
  }
 } else if(gender == "M" & s_status == "NS") {
  MNS.kpx <- rep(0,20)
  MNS.kpx[1] <- mortality_modified$MNS.p_x[x]
  for (i in 2:20) {
   MNS.kpx[i] <- prod(MNS.kpx[i-1], mortality_modified$MNS.p_x)
  }
 }else if(gender == "F" & s_status == "NS") {
  FNS.kpx <- rep(0,20)
  FNS.kpx[1] <- mortality_modified$FNS.p_x[x]
  for (i in 2:20) {
   FNS.kpx[i] <- prod(FNS.kpx[i-1], mortality_modified$FNS.p_x)
  }
 }

 spot_rate_x <- rep(0,19)

 #This checks if current year is less than 2023, if so, use spot rate, otherwise use average
 for (i in 1:19) {
  current_year <- issue_year + i - 1
  if (length(eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year == current_year]) == 0)
{
   spot_rate_x[i] <- average_spot_rate
  } else {
   spot_rate_x[i] <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year ==
current_year]
  }
 }
```

```
  #This should generate a vector of (1+i,(1+i)^2,...,(1+i)^20)
  effective_interest <- c(1+spot_rate_x[1])
  for (i in 2:19) {
    effective_interest[i] <- prod(effective_interest[i-1], (1 + spot_rate_x[i]))
  }

  value <- rep(0,20)
  value[1] <- 1

  if(gender == 'M' & s_status == 'S') {
    for (i in 1:19) {
      value[i+1] <- prod(MS.kpx[i], (1/effective_interest[i]))
    }
  } else if(gender == 'F' & s_status == 'S') {
    for (i in 1:19) {
      value[i+1] <- prod(FS.kpx[i], (1/effective_interest[i]))
    }
  } else if(gender == 'M' & s_status == 'NS') {
    for (i in 1:19) {
      value[i+1] <- prod(MNS.kpx[i], (1/effective_interest[i]))
    }
  } else if(gender == 'F' & s_status == 'NS') {
    for (i in 1:19) {
      value[i+1] <- prod(FNS.kpx[i], (1/effective_interest[i]))
    }
  }

  final <- sum(value)
  return(final)

}

insurance_20_year(54,2001,100000, 'M', 'S')/annuity_due_term(54,2001, 'M', 'S')

# Finding the Premiums for the t_20 Dataset -------------------------------
insurance <- mapply(insurance_20_year, t_20$Issue.age, t_20$Issue.year, t_20$Face.amount,
t_20$Sex, t_20$Smoker.Status)
annuity <- mapply(annuity_due_term, t_20$Issue.age, t_20$Issue.year, t_20$Sex,
t_20$Smoker.Status)
yearly.prem <- insurance/annuity

t_20$prem_at_issue_year <- yearly.prem


# Discount/Accumulate to 2004 --------------------------------------------
adjustment_factor <- function(issueYear, prem_t20) {
  if (issueYear > 2004) {
    # Policy issued after 2004: Calculate discount factor
```

```
    years <- 2004:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2004) {
    # Policy issued before 2004: Calculate accumulation factor
    years <- issueYear:2003
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
  } else {
    # Issue year is 2004, no adjustment needed
    factor <- 1
  }
  value <- prem_t20*factor
  return(value)
}

premiums_at2004 <- mapply(adjustment_factor, t_20$Issue.year, t_20$prem_at_issue_year)

t_20$prem_at_2004 <- premiums_at2004

# Discount/Accumulate to 2023 ---------------------------------------------
adjustment_factor2 <- function(issueYear, prem_t20) {
  if (issueYear > 2023) {
    # Policy issued after 2023: Calculate discount factor
    years <- 2023:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2023) {
    # Policy issued before 2023: Calculate accumulation factor
    years <- issueYear:2023
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
  } else {
    # Issue year is 2023, no adjustment needed
    factor <- 1
  }
  value2 <- prem_t20*factor
  return(value2)
}

basepremiums_at2023 <- mapply(adjustment_factor2, t_20$Issue.year,
t_20$prem_at_issue_year)

t_20$baseprem_at_2023 <- basepremiums_at2023

# Exporting the premiums for the t_20 -------------------------------------
write_csv(t_20, "t20_with_incentivepremiums.csv")
```

Term Insurance Incentive:

```
# Setting Up ---------------------------------------------------------------
cat("\014") # Clear console
rm(list=ls()) # Clear Environmen

# Directory ---------------------------------------------------------------
setwd("") #change to your own

# Packages ---------------------------------------------------------------
# install.packages('tidyverse')
# install.packages('dplyr')
# install.packages('readxl')
# install.packages('openxlsx')

library(tidyverse)
library(dplyr)
library(readxl)
library(tidyr)
library(openxlsx)

# Read in the Data (files in the drive) ----------------------------------
inforce_data <- read.csv("inforce_data.csv", header = TRUE)
intervention_data <- read.csv("intervention_data.csv", header = TRUE)
eco_data <- read.csv("economy_data.csv", header = TRUE)
mortality_data <- read.csv("mortality_data.csv", header = TRUE)
mortality_modified <- read.csv("base_mortmod.csv", header = TRUE)

# Split the Inforce Data ------------------------------------------------
splitbypolicytype <- split(inforce_data, inforce_data$Policy.type)

t_20 <- splitbypolicytype[["T20"]]
spwl <- splitbypolicytype[["SPWL"]]

# Base Mortality Table Calculation ---------------------------------------
#Removing the additional column
# mortality_data <- mortality_data[,-c(1)]
# #finding the probability of survival at each age
# mortality_data$p_x <- 1- mortality_data$Mortality.Rate

colnames(mortality_modified) <- c("Age", "MS", "FS", "MNS", "FNS")

mortality_modified$MS.p_x <- 1 - mortality_modified$MS
mortality_modified$FS.p_x <- 1 - mortality_modified$FS
mortality_modified$MNS.p_x <- 1 - mortality_modified$MNS
mortality_modified$FNS.p_x <- 1 - mortality_modified$FNS

mortality_modified <- mortality_modified[-c(121:998), ]

# Average Spot Rate -----------------------------------------------------
average_spot_rate <- mean(eco_data[,4])
```

```
#This is used, if current year is past 2023

# 20 Year Term Life Function ----------------------------------------------------
insurance_20_year <- function (x, issue_year, face_value, gender, s_status) {

  if(gender == "M" & s_status == "S") {
    MS.kpx <- rep(0,20)
    MS.kpx[1] <- mortality_modified$MS.p_x[x]
    for(i in 2:20) {
      MS.kpx[i] <- prod(MS.kpx[i-1], mortality_modified$MS.p_x[x+i-1])
    }
  } else if(gender == "F" & s_status == "S") {
    FS.kpx <- rep(0,20)
    FS.kpx[1] <- mortality_modified$FS.p_x[x]
    for(i in 2:20) {
      FS.kpx[i] <- prod(FS.kpx[i-1], mortality_modified$FS.p_x[x+i-1])
    }
  } else if(gender == "M" & s_status == "NS") {
    MNS.kpx <- rep(0,20)
    MNS.kpx[1] <- mortality_modified$MNS.p_x[x]
    for(i in 2:20) {
      MNS.kpx[i] <- prod(MNS.kpx[i-1], mortality_modified$MNS.p_x[x+i-1])
    }
  } else if(gender == "F" & s_status == "NS") {
    FNS.kpx <- rep(0,20)
    FNS.kpx[1] <- mortality_modified$FNS.p_x[x]
    for(i in 2:20) {
      FNS.kpx[i] <- prod(FNS.kpx[i-1], mortality_modified$FNS.p_x[x+i-1])
    }
  }

  #Find kpx values, will use formula k|q_x=kpx*q_(x+k)

  spot_rate_x <- rep(0,20)

  #This checks if current year is less than 2023, if so, use spot rate, otherwise use average
  for (i in 1:20) {
    current_year <- issue_year + i - 1
    if (length(eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year == current_year]) == 0)
{
      spot_rate_x[i] <- average_spot_rate
    } else {
      spot_rate_x[i] <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year ==
current_year]
    }
  }

  #This should generate a vector of (1+i,(1+i)^2,...,(1+i)^20)
  effective_interest <- c(1+spot_rate_x[1])
```

```
  for (i in 2:20) {
    effective_interest[i] <- prod(effective_interest[i-1], (1 + spot_rate_x[i]))
  }

  #Finding the components of the sum for the final value
  # Using sum of v^(k+1)*kpx*q_(x+k)
  value <- rep(0,20)

  if(gender == "M" & s_status == "S"){
    value[1] <- prod(mortality_modified$MS[x], (1/(effective_interest[1])))
    for (i in 1:19) {
      value[i+1] <- prod(MS.kpx[i], mortality_modified$MS[x+i], (1/(effective_interest[i+1])))
    }
  } else if(gender == "F" & s_status == "S"){
    value[1] <- prod(mortality_modified$FS[x], (1/(effective_interest[1])))
    for (i in 1:19) {
      value[i+1] <- prod(FS.kpx[i], mortality_modified$FS[x+i], (1/(effective_interest[i+1])))
    }
  }else if(gender == "M" & s_status == "NS"){
    value[1] <- prod(mortality_modified$MNS[x], (1/(effective_interest[1])))
    for (i in 1:19) {
      value[i+1] <- prod(MNS.kpx[i], mortality_modified$MNS[x+i], (1/(effective_interest[i+1])))
    }
  }else if(gender == "F" & s_status == "NS"){
    value[1] <- prod(mortality_modified$FNS[x], (1/(effective_interest[1])))
    for (i in 1:19) {
      value[i+1] <- prod(FNS.kpx[i], mortality_modified$FNS[x+i], (1/(effective_interest[i+1])))
    }
  }

  final <- face_value*sum(value)
  return(final)

}

insurance_20_year(40, 2000, 50000, 'M', 'S')

#Annuity

annuity_due_term <- function (x, issue_year, gender, s_status) {

  if(gender == "M" & s_status == "S") {
    MS.kpx <- rep(0,20)
    MS.kpx[1] <- mortality_modified$MS.p_x[x]
    for (i in 2:20) {
      MS.kpx[i] <- prod(MS.kpx[i-1], mortality_modified$MS.p_x)
    }
  } else if(gender == "F" & s_status == "S") {
    FS.kpx <- rep(0,20)
```

```
  FS.kpx[1] <- mortality_modified$FS.p_x[x]
  for (i in 2:20) {
   FS.kpx[i] <- prod(FS.kpx[i-1], mortality_modified$FS.p_x)
  }
 } else if(gender == "M" & s_status == "NS") {
  MNS.kpx <- rep(0,20)
  MNS.kpx[1] <- mortality_modified$MNS.p_x[x]
  for (i in 2:20) {
   MNS.kpx[i] <- prod(MNS.kpx[i-1], mortality_modified$MNS.p_x)
  }
 }else if(gender == "F" & s_status == "NS") {
  FNS.kpx <- rep(0,20)
  FNS.kpx[1] <- mortality_modified$FNS.p_x[x]
  for (i in 2:20) {
   FNS.kpx[i] <- prod(FNS.kpx[i-1], mortality_modified$FNS.p_x)
  }
 }

 spot_rate_x <- rep(0,19)

 #This checks if current year is less than 2023, if so, use spot rate, otherwise use average
 for (i in 1:19) {
  current_year <- issue_year + i - 1
  if (length(eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year == current_year]) == 0)
{
   spot_rate_x[i] <- average_spot_rate
  } else {
   spot_rate_x[i] <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year ==
current_year]
  }
 }

 #This should generate a vector of (1+i,(1+i)^2,...,(1+i)^20)
 effective_interest <- c(1+spot_rate_x[1])
 for (i in 2:19) {
  effective_interest[i] <- prod(effective_interest[i-1], (1 + spot_rate_x[i]))
 }

 value <- rep(0,20)
 value[1] <- 1

 if(gender == 'M' & s_status == 'S') {
  for (i in 1:19) {
   value[i+1] <- prod(MS.kpx[i], (1/effective_interest[i]))
  }
 } else if(gender == 'F' & s_status == 'S') {
  for (i in 1:19) {
   value[i+1] <- prod(FS.kpx[i], (1/effective_interest[i]))
  }
```

```
  } else if(gender == 'M' & s_status == 'NS') {
    for (i in 1:19) {
      value[i+1] <- prod(MNS.kpx[i], (1/effective_interest[i]))
    }
  } else if(gender == 'F' & s_status == 'NS') {
    for (i in 1:19) {
      value[i+1] <- prod(FNS.kpx[i], (1/effective_interest[i]))
    }
  }

  final <- sum(value)
  return(final)

}

insurance_20_year(54,2001,100000, 'M', 'S')/annuity_due_term(54,2001, 'M', 'S')

# Finding the Premiums for the t_20 Dataset ------------------------------
insurance <- mapply(insurance_20_year, t_20$Issue.age, t_20$Issue.year, t_20$Face.amount,
t_20$Sex, t_20$Smoker.Status)
annuity <- mapply(annuity_due_term, t_20$Issue.age, t_20$Issue.year, t_20$Sex,
t_20$Smoker.Status)
yearly.prem <- insurance/annuity

t_20$prem_at_issue_year <- yearly.prem

# Discount/Accumulate to 2004 ------------------------------------------
adjustment_factor <- function(issueYear, prem_t20) {
  if (issueYear > 2004) {
    # Policy issued after 2004: Calculate discount factor
    years <- 2004:(issueYear - 1)
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 / (1 + rates))
  } else if (issueYear < 2004) {
    # Policy issued before 2004: Calculate accumulation factor
    years <- issueYear:2003
    rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
    factor <- prod(1 + rates)
  } else {
    # Issue year is 2004, no adjustment needed
    factor <- 1
  }
  value <- prem_t20*factor
  return(value)
}

premiums_at2004 <- mapply(adjustment_factor, t_20$Issue.year, t_20$prem_at_issue_year)

t_20$prem_at_2004 <- premiums_at2004
```

```
# Discount/Accumulate to 2023 --------------------------------------------
adjustment_factor2 <- function(issueYear, prem_t20) {
 if (issueYear > 2023) {
  # Policy issued after 2023: Calculate discount factor
  years <- 2023:(issueYear - 1)
  rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
  factor <- prod(1 / (1 + rates))
 } else if (issueYear < 2023) {
  # Policy issued before 2023: Calculate accumulation factor
  years <- issueYear:2023
  rates <- eco_data$X1.yr.Risk.Free.Annual.Spot.Rate[eco_data$Year %in% years]
  factor <- prod(1 + rates)
 } else {
  # Issue year is 2023, no adjustment needed
  factor <- 1
 }
 value2 <- prem_t20*factor
 return(value2)
}

basepremiums_at2023 <- mapply(adjustment_factor2, t_20$Issue.year,
t_20$prem_at_issue_year)

t_20$baseprem_at_2023 <- basepremiums_at2023

# Exporting the premiums for the t_20 ------------------------------------
write_csv(t_20, "t20_with_premiums.csv")
```

8.3 Assumptions

8.3.1 Pricing Model Assumptions

There were an additional set of assumptions made in the pricing model, and they include:

- **Investment Earnings Rate:** Assumed to be 5.7% which is the average 1 year risk free spot rate for the last 60 years. It affects the expected return on the invested premiums.
- **Discount Rate:** Set at 11% and is based off the sum of the average of the 10-year spot rates and average inflation. It impacts the present value of future cash flows and is crucial for determining the profitability and pricing of both products.
- **Lapse Rate:** The formula we utilised was:

$$lapse\ rate = \frac{No.\,policyholders\ lapsed\ at\ age\ x\ in\ year\ y}{No.\,policyholders\ issued\ at\ age\ x\ in\ year\ y}$$

- **Commission Structure:** This outlines the percentage of premium that goes to the sales commission, which is significantly high in the first year at 70% for SPWL and 60% for the 20-year term and 5% in subsequent years for both.
- **Incentive Loading:** The amount of discount for the purchase of the incentive program. This is set at 4.3%, the average inflation of the last 60 years.
- **Fixed and Incentive Expenses**: These outline specific costs associated with policy management and the implementation of incentives and would be negative values.
- **Surrender Value:** The surrender was calculated by:

$$\frac{1000 * NPV(Surrender\ Rate,\ Mortality\ Rate\ in\ Each\ Year\ for\ Age\ x) - Loading\ Factor * (survival\ rate\ at\ the\ next\ year + NPV(Surrender\ Rate, Survival\ Rate\ in\ Each\ Year\ for\ Age\ x\ ))}{Survival\ Rate}$$

- **Reserves:**
  - For the SPWL insurance policy, the reserves were calculated using the following formula:

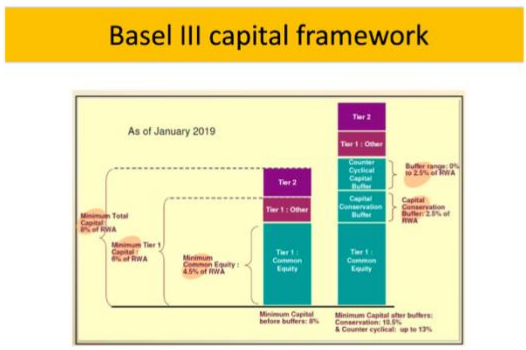
$$\frac{1000 * NPV(Reserve\ Rate,\ Mortality\ Rate\ in\ Each\ Year\ for\ Age\ x) - Loading\ Factor * (Survival\ rate\ at\ the\ next\ year + NPV(Reserve\ Rate, Survival\ Rate\ in\ Each\ Year\ for\ Age\ x\ ))}{Survival\ Rate}$$

  - For the 20-year term policy, the formula utilised was:

$$Reserve[x] = Reserve[x-1] * (1 - \frac{loss\ ratio}{2})$$

Basel III	minimum capital requirements with buffers is 13%			
Base Requirements	13%	https://www.apra.gov.au/sites/default/files/lagic-response-to-submissions-october-2012_0.pdf	https://www.apra.gov.au/capital-explained	https://www.legislation.gov.au/F2023L00673/asmade/text
Loss Ratio in Yr 1	0.4	**Assumption based on GI, with Life being on a lower scale https://www.apra.gov.au/news-and-publications/apra-releases-general-insurance-statistics-for-march-2022		
Loss Ratio in Yr 2 onwards	0.2	**Assumption with Losses (claim payments) being offsetted by customer base https://guidingmetrics.com/content/insurance-industrys-18-most-critical-metric	https://www.actuaries.asn.au/Library/Standards/LifeInsuranceWealth/2015/DNIBNRDec2014.pdf	
Prescribed Capital Requirements	2.05	https://kpmg.com/au/en/home/insights/2023/10/life-insurance-insights.html		

Year	T20	Reserve % per 1000
	0	94%
	1	56%
	2	84%
	3	76%
	4	68%
	5	61%
	6	55%
	7	50%
	8	45%
	9	40%
	10	36%
	11	33%
	12	29%
	13	26%
	14	24%
	15	21%
	16	19%
	17	17%
	18	16%
	19	14%
	20	13%



- **Sensitivity testing for expense assumptions:** model encompasses scenarios representing lowest, average, and highest costs, allowing for a comprehensive assessment of the potential impacts on policy profitability.
- **Required capital (per 1000 death benefit):** Policyholders less than age 40 face a rate of 0.01 and policyholder aged 40 or above face a rate of 0.02 as there is higher mortality risk associated with older age groups.

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