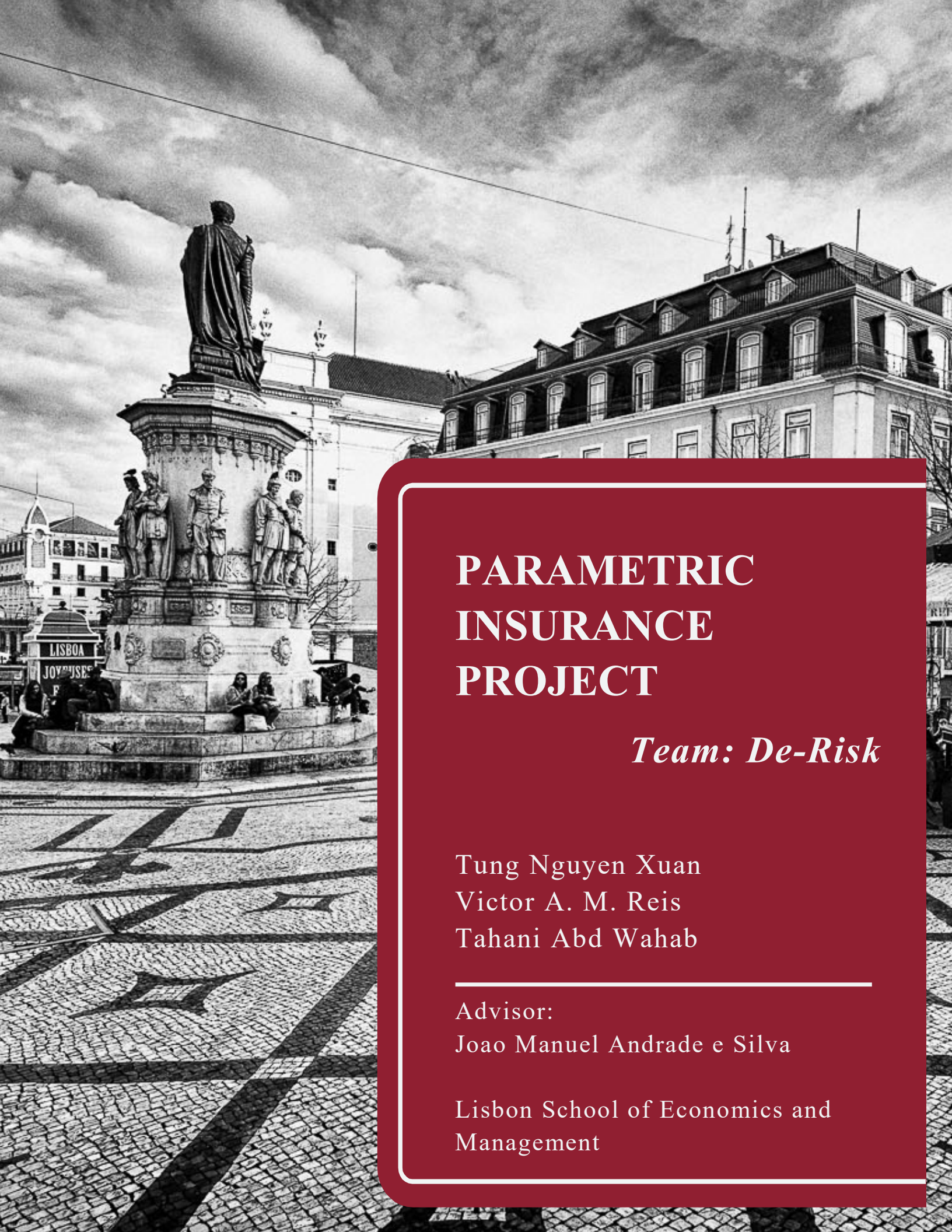

PARAMETRIC INSURANCE PROJECT

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EXECUTIVE SUMMARY

In recent years, there has been continuous increases in the occurrence of natural disasters around the globe and, combined with the diseases outbreaks that follow, cause uninterrupted damage to regional economies and general health quality of the population. These facts raise questions about the insurability of these events using traditional insurance products, because many different losses that happen are either uninsured or even not covered by existing contracts.

Our team, De-Risk, was hired by NEW WORLD to develop a range of parametric insurance products focused on economic losses related to global health risks in two countries, Ambernïa and Palòmïnïa. In this report, we analyze the insurance market in these countries and design parametric insurance products based on five risk factors related to health quality: Air Quality, Obesity, Hypertension, Alcohol consumption and Tobacco consumption. Additionally, long-term forecasts and marketing strategy guidelines for this project are also provided.

Our primary target market is small and medium insurance companies. By providing reinsurance-like products, we believe that NEW WORLD can provide a solution to reduce existing protection gaps, which will happen if the quality of the population health improves.

The main report will focus on:

- part II: Design consideration, where we illustrate why we choose these particular risk factors to build this new portfolio of products.
- part III: Implementation plan, where we provide "Top-down Approach" to show the potential market and how to successfully achieve it.

Since several assumptions were required to estimate the parameters in these products, in addition to part IV, Assumption and Data Limitation, part V, Risk Mitigation Strategies, part VI, Sensitivity Analysis, we attached the Appendix to show our calculations, as well as an Excel workbook.

PURPOSE AND OBJECTIVE

Prior to analyzing the target market, rising risks associated with health expenses in Ambernïa and Palòmïnïa need to be addressed. Figure 1 shows the evolution of the inflation-adjusted cost for health in both countries, which indicates a significant increase in Palòmïnïa and a slightly one in Ambernïa.

While researching relevant historical data for potential parametric products in these countries, we found out that the percentage of the population that has hypertension, diabetes or obesity increased in both countries. This could put more pressure on the health care system and health insurance companies. For the latter, especially those with low market share, when the number of unhealthy people increases sharply, it can lead to the rise of insurance expenses that can potentially damage the company's financial condition. Our purpose is to design parametric products that can address this issue related to current insurance products.

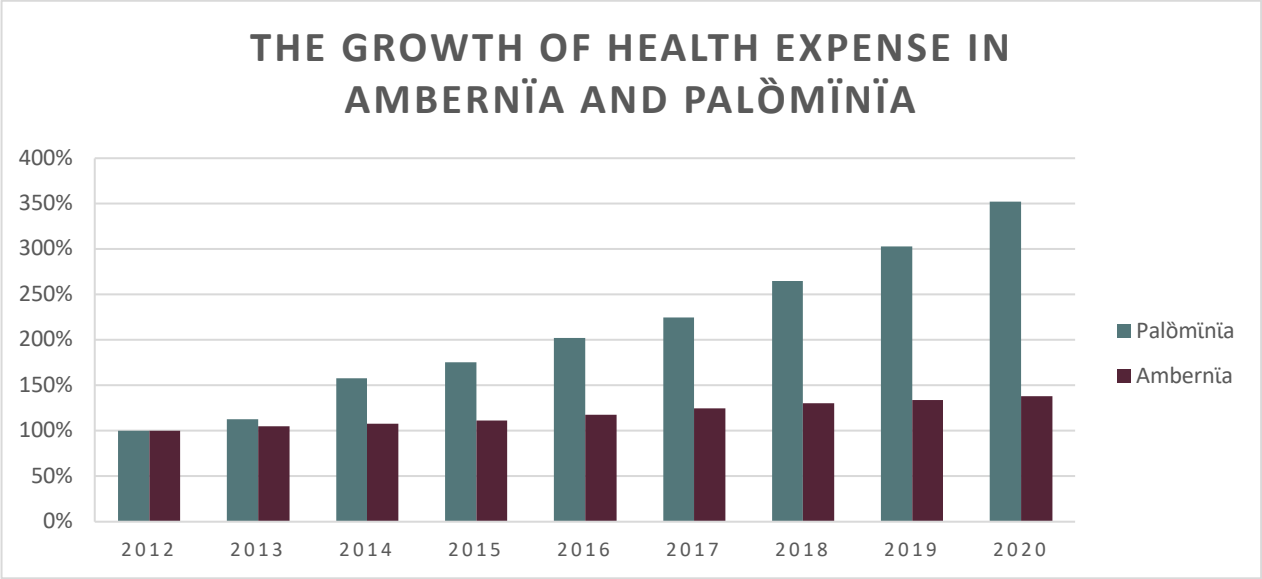

Figure 1: The growth of health expense in Ambernïa and Palòmïnïa

Therefore, we defined the main target market for NEW WORLD's parametric insurance portfolio as health insurance companies with low market share in both Ambernïa and Palòmïnïa. When these companies purchase products to their customers, they face the risk that the number of claims made in existing contracts could rise rapidly in the short term. This is because variations in some regional health parameters could steer dramatic increases in others. For example, an increase in the percentage of people in a country who is obese can lead to the surge of several other conditions: heart diseases, reproductive disorder, or different kinds of cancer among population. To address these problems and design appropriate products for our main target customers, advantages and disadvantages of parametric products are analyzed in Table 1.

Advantages	Disadvantages
• **Broad coverage provides wide protection range:** it only needs to have one parameter as trigger to address many types of risks. Pay happens with or without policyholder sustaining any damages or losses. • **Fast insurance payout:** can provide customer finance support on time, avoid illiquidity risk. • **Significantly fewer restrictions and exclusions:** reduced number of provisions, convenient for parties in insurance contracts	• **The economic losses of the insured could differ by any margin from the amount of coverage:** not a big deal while customers are insurance companies and losses can be capped. • **Need high standard level of data to build parameter:** base on five standard parameters.

Table 1: Advantages and Disadvantages of insurance parameter products

The most important difference between parametric and traditional products is that while traditional insurance products usually indemnify policyholders for actual incurred losses, parametric insurance, instead, covers predefined events and pays out according to a predefined event.

Consequently, we provide a set of parametric products that can be thought of as reinsurance, as it can help insurance companies to avoid additional risk to their operation if these parameters increase above a certain threshold. The premium will be paid at the offset of the contract and while the contract is valid through the following five years, the benefit will be paid for each year that the parameter is higher than that predefined constant threshold. By playing this reinsurer-like role, NEW WORLD can provide these smaller health insurers the financial instruments to balance their current portfolio and developing new products customized to their local markets.

In our case, insurance will cover risks from the following components: Air Quality, Obesity, Hypertension, Alcohol and Tobacco. Figure 2 shows the general health effects that happen when these parameters increase. It has been seen that if any of these parameters rises sharply, it can lead to many other health problems which increases the health expenses of insurance companies.

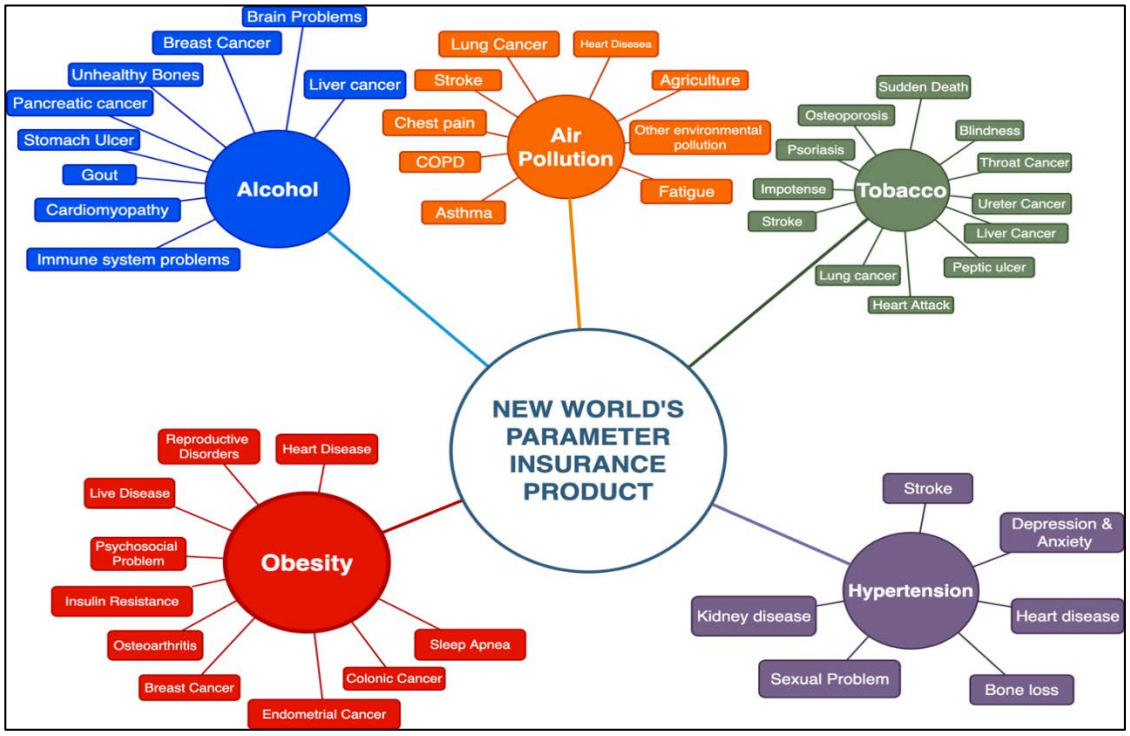

Figure 2: Insurability of NEW WORLD's parameter insurance product (Detail: Appendix C1)

DESIGN CONSIDERATIONS

Product Principles

To overcome the disadvantage of insurance parametric products, the design for NEW WORLD is based on three core principles: Customization, Convenience and Continuous Protection.

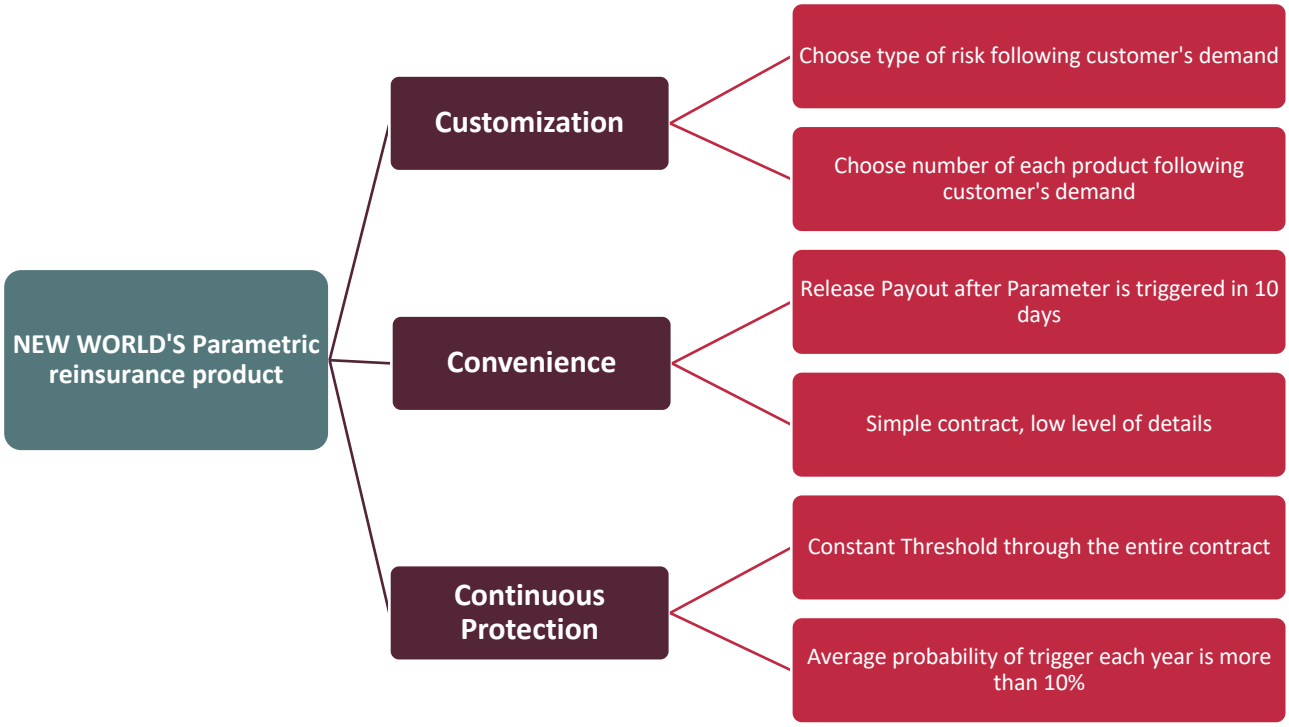

Figure 3: NEW WORLD's Parametric reinsurance product principals

Our potential customers, who are medium and small insurance companies, will buy a set of contracts that includes at least one contract of a parametric product. A contract is the unit of an insurance parametric product that has standard premium and standard payout. Customers who want higher coverage can purchase more contracts, according to their demand.

Parametric insurance allows NEW WORLD to reduce the complexity of insurance contracts and time to release money. Finally, our parametric insurance product can protect customers for

the duration of the contract, which means if any parameter is above the threshold for several years, the payout will happen for the whole time the contract is still active. Table 2 provides NEW WORLD insurance contracts' details.

Provision	*Definition*	*Justification*
Parameter	Name of products, customers can choose to purchase customized to their demand	There are five parameter products: Air Quality, Obesity, Hypertension, Alcohol and Tobacco
Threshold	The number to determine if the payout is active	There is one constant threshold for each parameter in each country, which will not change during the contract
Trigger	When a parameter is higher than its threshold, that parameter is triggered, and NEW WORLD need to pay to customers.	It is different between each parameter and each country. For each year that each parameter is triggered, customers will receive one payment. Trigger level will be calculated using data available until the month before the offset of the contract.
Contract	The minimum unit of product	Each contract has standard payout. Customers that want higher amounts of risk covered can buy more contracts
Premium per contract	Amount paid to the insurer by the insured for risk transfer.	Total premium is Ψ 100,000.00, paid only once, in the first year.
Term of contract	Number of years in each contract	5 years
Payout policy per contract	Payout is the amount that insured costumers are eligible for each contract.	For each year that parameters are triggered, customer will receive payout of Ψ 120, 000.00
Maximum Payout per contract in 5 years	Maximum amount that insured costumers are eligible in total term of contract	Ψ 600, 000.00, which will be achieved if parameters are triggered every year for five years
Timing each contract	Time of year to review if the parameters are higher than the threshold	Every 12 months after the contract started
Payout timeline	Time since parameter is triggered until payout is made	No more than 10 working days

Table 2: Detail of insurance contract's provisions

Parameter Thresholds

To address as many problems that our customers can face as possible, but with low number of parameters, we suggest five different parameters. We believe they will have a high impact on insurance health expenses: Air Quality, Obesity, Hypertension, Alcohol and Tobacco. Each year, NEW WORLD's Actuarial Department needs to estimate parameter again to provide an appropriate threshold for that year product.

Table 3 shows the index measures of the triggering events that was chosen since we foresee the ability for them to be sold in the market considering they are all highly important to the health sector and the economy of a country.

Triggering Events	Threshold in Palòmïnïa	Threshold in Ambernïa	Parameter Formula
Air Quality	25.96	10.10	Average of 2.5 Micrometers value over the year
Alcohol	0.095	0.177	75% Percent of Daily Consumption in Population + 25% Percent of Weekly Consumption in Population
Tobacco	0.284	0.288	Percent of Daily Smoker in Population
Hypertension	133.05	124.33	Average of percent of Male Systolic and Female Systolic in Population
Obesity	0.265	0.222	Percent of Obese in Population

*Table 3: Index measure for each triggering events in each country (Detail: **Appendix C2**)*

Furthermore, probability of contracts being triggered for each parameter in each country is obtained using normal distribution method with forecasted mean and standard deviation and confidence level is chosen based on how likely the purposed model can survive in the market. The detailed analysis for parameter selection and probability of each payout scenario can be found on Appendix C.

Since the data given is very limited, further assumptions are necessary. We chose to select other countries with similar characteristics. Palòmïnïa is considered an emerging market economy country and six countries were chosen: Brazil, China, India, Mexico, Pakistan and Russia; whereas for Ambernïa, we classified it as developed country. Thus, similar country chose are Australia, Germany, Norway, Portugal, South Korea and United States.

After analyzing these parameters, an implementation plan will be shown to estimate revenue, expenses and a marketing strategy for NEW WORLD.

IMPLEMENTATION PLAN

Pure Premium Project

To estimate the pure premium, the "Top down" Approach was used. Adjust factors were applied on total health care expenses on Ambernïa and Palòmïnïa. Our target is to estimate the amount of premium sold to potential customers for each Parametric Insurance Product in the fourth quarter of 2021.

Figure 4: Pure premium estimation methodology, using "Top down" Approach

According to our estimation, total health expenses in Ambernïa and Palòmïnïa will rise significantly during the next 5 years, which will lead to higher costs for health insurance companies. Therefore, our chosen adjust factors include:

- Target segment: our products will focus on expenses of Health Insurance Products of low and medium insurance companies

- Potential Market: Market share that can be achieved in our target segment
- Premium paid to each Parameter Insurance Product: Percentage in their expense willing to pay for product. We assume that this number is equal to the average probability that the event will be triggered during the term of the contracts.

In addition, for each of the five chosen parametric products: Air Quality, Obesity, Hypertension, Alcohol and Tobacco, we need to estimate the percentage of revenue. The revenue of a product will be high if insurance companies choose to pay more on coverage for that risk factor. To compare these five factors, we collected data that describes health care spending by risk factor. Figure 5 shows the percentage of each parameter of total revenue in 2021.

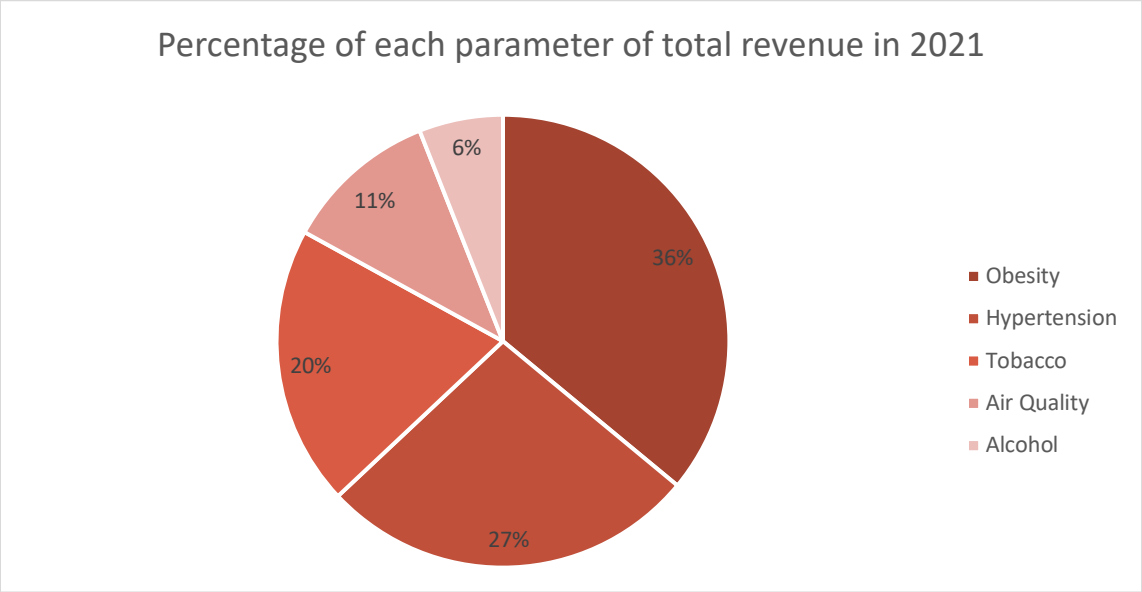

*Figure 5: Percentage of parameter in total revenue in 2021 (Source: **Appendix D1**)*

Table 4 and Table 5 show detail steps used to estimate revenue in each country.

Step 1, Step 2 and Step 3 in Developing pure Premium Projects					
	Variable	**Assumption/ Estimate**	**Calculation**	**Expected value in Ambernïa on 2021 (Million Ψ)**	**Expected value in Palǒmïnïa on 2021 (Million Ψ)**
Step 1	Health insurance expense in Palǒmïnïa and Ambernïa	Insurance rate is 55.67% in Palǒmïnïa and 80.07% in Ambernïa	Health expense * insurance rate	25405.6265	9462.1687
Step 2	Expense from Health Insurance Department in target segment (low and medium market share companies) (Exp_Low_Med)	Market share for target segment (low and medium companies) is 30% for both countries	Health insurance expense * Market share for low and medium companies	7621.6879	2838.6506
Step 3	Health insurance expense of estimate customer (Exp_Est_Cus)	Expected take up rate in 2021 is 4.6%	Exp_Low_Med * Take_up_rate	350.5976	130.5779

*Table 4: Steps in Developing pure Premium Projects (Source: **Appendix D2**)*

Step 4 and Step 5 in Developing pure Premium Projects						
Step 4	**Parameter**	**Obesity**	**Hypertension**	**Tobacco**	**Air Quality**	**Alcohol**
	Percentage of each Parameter	36%	27%	20%	11%	6%
	Exp_Est_Cus of each product in Ambernïa on 2021 (Million Ψ)	126.2152	94.6614	70.1195	38.5657	21.0359
	Exp_Est_Cus of each product in Palǒmïnïa on 2021 (Million Ψ)	47.0081	35.2560	26.1156	14.3636	7.8347
Step 5	Percentage of money for parameter insurance/ total expense for insurance	11.66%	12.27%	10.49%	11.81%	10.60%
	Amount of money customer will pay for each product in Ambernïa on 2021 (Million Ψ)	14.7118	11.6115	7.3555	4.5549	2.2293
	Amount of money customer will pay for each product in Palǒmïnïa on 2021 (Million Ψ)	5.4793	4.3246	2.7395	1.6964	0.8303

*Table 5: Step 4 and Step 5 in Developing pure Premium Projects (Source: **Appendix D2**)*

Based on the mentioned assumptions, we estimate that the expected value of revenue from this product in 2021 would be 56.66 million Ψ. However, since NEW WORLD only plans to launch this portfolio project on the fourth quarter, estimated revenue adjusted to this schedule is 13.8837 million Ψ. Based on the distribution of take-up-rate and percentage of money for a parametric insurance product for each potential client, a simulation of revenue was processed.

Figure 6 and Figure 7 illustrate the distribution (per thousand) of revenue and income in Q4, 2021.

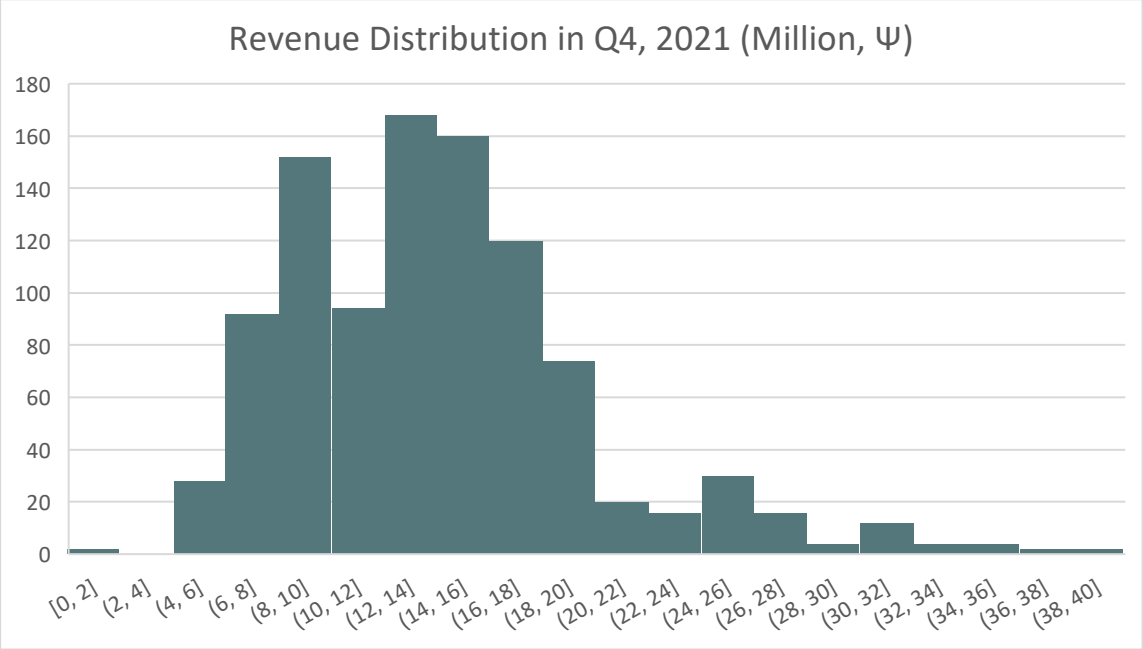

*Figure 6: Revenue Distribution in Q4 2021 (Million, Ψ) (Source: **Appendix A5**)*

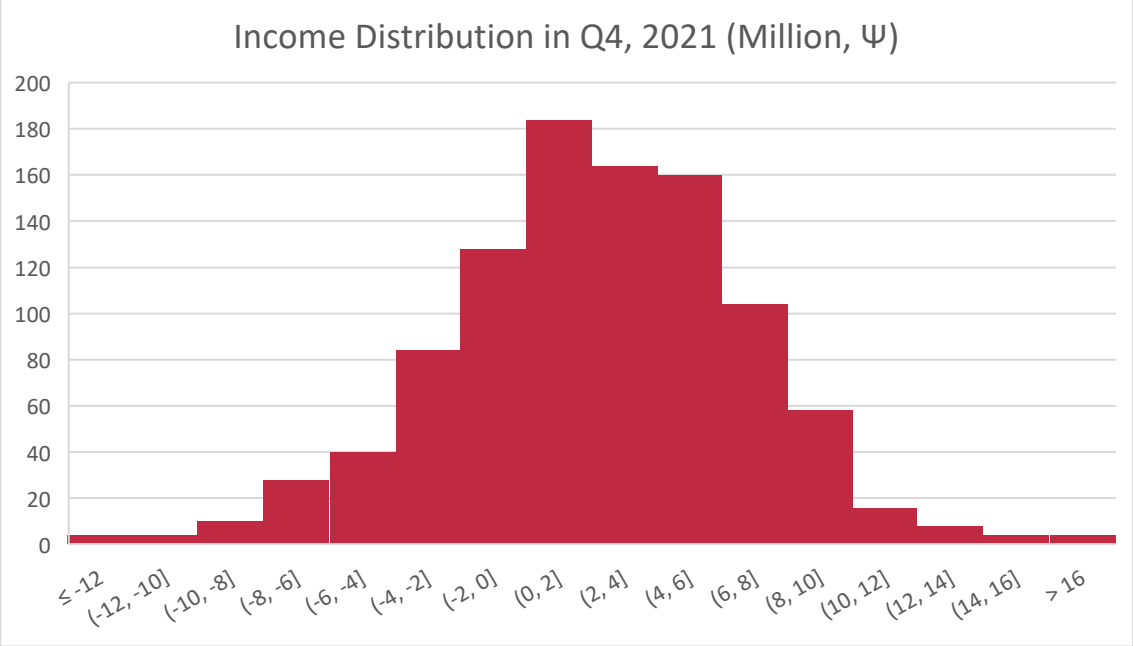

*Figure 7: Income Distribution in Q4 2021 (Million, Ψ) (Source: **Appendix A5**)*

Pure Payout Projection

The premium received for each contract is 100,000 Ψ. With the estimate of revenue each year, we calculate the distribution of number of contracts in 2021. The expected value of the number of contracts in Q4, 2021 in Ambernïa is 101.16, and that number in Palòmïnïa is 37.68.

To forecast the expected expenses of each parameter product, probabilities of trigger events are determined. For time-series parameters (Hypertension and Air Quality), the probability is calculated based on ARIMA model. With the non-time-series parameters (Obesity, Alcohol and Tobacco), we calculated based on the growth of groups of similar countries for both Ambernïa and Palòmïnïa. To calculate present value of expected payout, interest rate on next 5 years had been estimated.

Figure 8 shows the percentage of trigger events and expected value of expenses for each product. Meanwhile, the Table 6 illustrates the expected value of expenses for each product in Q4, 2021.

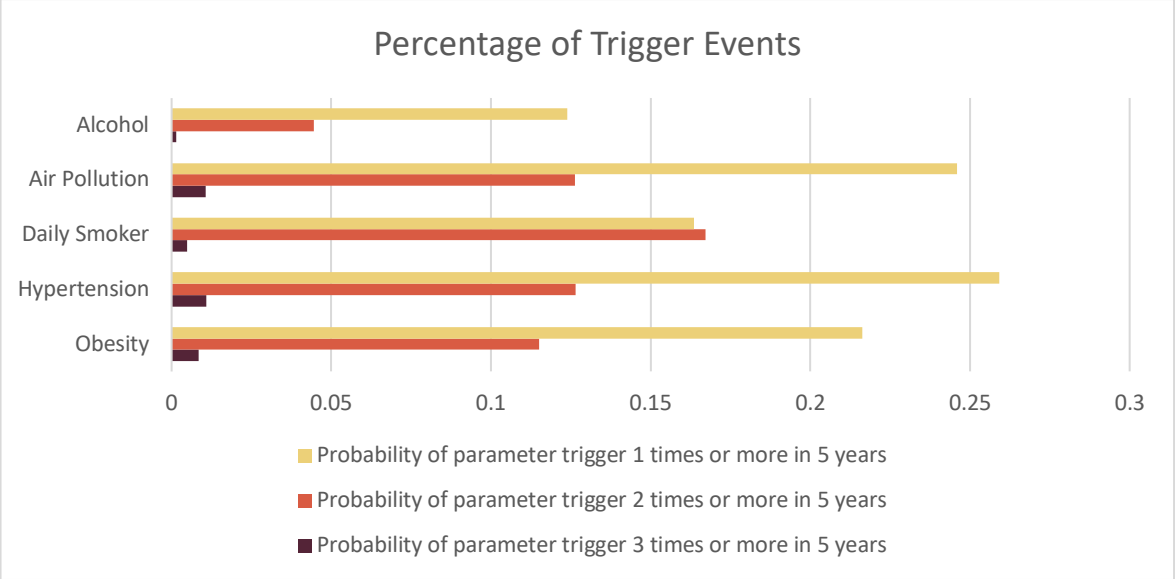

*Figure 8: Percentage of trigger events (Source: **Appendix D2**)*

	Expected value of Payout of one contract in term period (5 years) (Ψ)	Expected Number of Contract in Q4 2021	Expected payout of parameter products during each contract (5 years) (Million Ψ)	Present value of expected payout of parametric products (5 years) (Million Ψ)
Obesity	77200	50	3.8969	3.9099
Hypertension	81945	40	3.2647	3.2816
Tobacco	81460	25	2.0562	2.0225
Air Quality	79829	16	1.2476	1.2541
Alcohol	58857	8	0.4502	0.4474

*Table 6: Expected value of expense for each product (Source: **Appendix D2**)*

The present value of expected value for Payout in 2021 is Ψ11.0651 millions. We also provide two worse scenarios with lower probabilities, in case some parameters are triggered in two or even four consecutive years.

	Expected Value	**Two consecutive years for every Parameter**	**Four consecutive years for every Parameter**
$Present\ value\ of$ *Payout of project (Million Ψ)*	*10.9584*	21.7989	46.2505
Revenue of project (Million Ψ)	*13.8837*	*13.8837*	*13.8837*
$\frac{Present\ value\ of\ Payout\ of\ project}{Revenue\ of\ project}$	*78.93%*	*-157.01%*	*-333.13%*
$\frac{Present\ value\ of\ Payout\ of\ project}{NEW \cdot WORLD's\ total\ revenue\ on\ 2020}$	*0.30%*	0.60%	1.27%
$\frac{Present\ value\ of\ Payout\ of\ project}{NEW \cdot WORLD's\ total\ asset\ on\ 2020}$	*0.022%*	0.03%	0.07%

*Table 7: Present value of Expected Payout and worse scenarios (Source: **Appendix D2**)*

Five-year Premium Projections

We have provided NEW WORLD's with 5-year revenue and expense projections for these products, starting in 2021, with an estimate growth rate of health expenses in both countries of 10%. Figure 9 summarizes the total Revenue and Expenses for the following 5 years, while Table 8 illustrates the revenue for each component in the longer term, 10 years, with the same assumptions. Although total pure premium of the first year is low, it will be strongly boosted in the following 5 years. We estimate that for 5 years, the total revenue of NEW WORLD from this project will be 786.385 Million Ψ, which equals to 5.4% of total revenue in 2020.

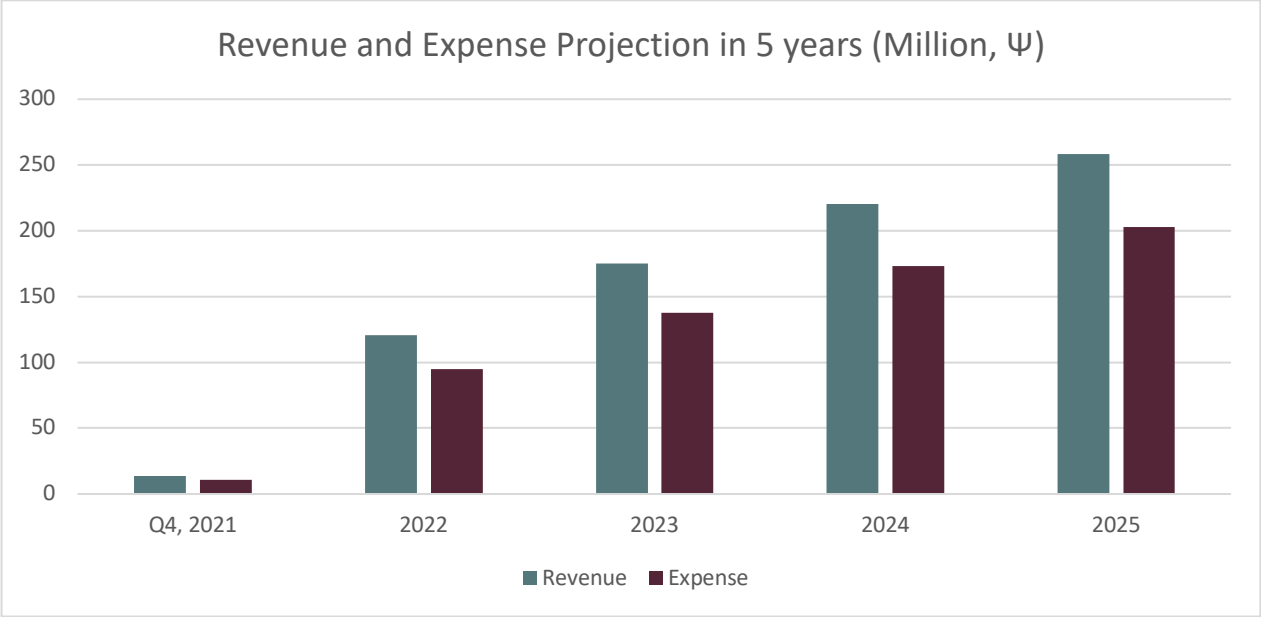

*Figure 9: Revenue and Expense Projection in 5 years (Million, Ψ) (Source: **Appendix D2**)*

Year	Obese	Hypertension	Daily Smoker	Air Pollution	Alcohol	Total Revenue
Q4 2021	4.9981	3.7486	2.7767	1.5272	0.8330	13.8837
2022	43.4621	32.5966	24.1456	13.2801	7.2437	120.7281
2023	63.0201	47.2650	35.0111	19.2561	10.5033	175.0557
2024	79.3184	59.4888	44.0658	24.2362	13.2197	220.3288
2025	92.9003	69.6752	51.6113	28.3862	15.4834	258.0563
2026	114.2402	85.6801	63.4668	34.9067	19.0400	317.3338
2027	132.4073	99.3055	73.5596	40.4578	22.0679	367.7981
2028	150.5745	112.9309	83.6525	46.0089	25.0957	418.2624
2029	168.7416	126.5562	93.7454	51.5599	28.1236	468.7268
2030	186.9088	140.1816	103.8382	57.1110	31.1515	519.1911

*Table 8: Revenue of project and component in the 10 years period (Million, Ψ) (Source: **Appendix D2**)*

Marketing Strategy

In this part, marketing strategy is used to promote the NEW WORLD's parametric insurance portfolio. In initial stages, the most important target of NEW WORLD will be to expand market share immediately, with the goal of 4.6% of market share for low and medium insurance companies in 2021 and 10.6% in 2022. After that, long term strategy is maintained by 5% growth rate market share each year. To implement the following marketing strategy, 4P analysis is applied.

Categories	Strategy
Product	• Suggest partner companies to expand their individual health coverage since they have an insurance in negative parameter scenarios. • Provide payout not more than 10 working days since parameters trigger. • Provide private customer care staff for each customer, since number of customer will be low. • Connect with Actuary Department of partner companies to help them build customize product.
Price	• Discount 5% for customer that join in Q4 2021 and 2022, with maximum of 10 contracts per customer. • Additional 5% discount for customer if they purchase one of these pair products together (Tobacco, Obesity) and (Alcohol, Hypertension)
Place	• Start with approaching the first Bottom 10% Market Share Insurance Companies, since they need to increase number of customer and quality of insurance product. • Approach does not only apply to Insurance Companies but also potential organization who prepare to enter the market. • Approach customers not only in Director Board but also the Actuarial, Risk Management and Insurance Product Department, by private or public channels. This strategy will help NEW WORLD in finding potential customers and expand branding of company's parametric insurance product.
Promotion	• Strongly promote the agreement between NEW WORLD and customers insurances companies in media. This is to help partner companies gain more individual insurance contracts, and expand branding of company's parametric insurance product in society. • Promote each parametric product independently. More focus given on Air Quality, Alcohol and Tobacco in Palòmïnïa whereas Obesity and Hypertension in Ambernïa. Although NEW WORLD's parametric reinsurance products is B2B (Business to Business) product, we suggest for NEW WORLD to promote in B2C (Business to Customer) strategy: In local media, Social network or Public advertisements. These strategies will help company to earn branding and build solid fundamental as first mover.

Table 9: Marketing strategy for NEW WORLD's reinsurance parameter project

ASSUMPTION AND DATA LIMITATION

In this report, it is important to note that the data given for NEW WORLD is divided into non-time series and time series data. Therefore, it is sufficient to evaluate trigger for Air Quality and Hypertension, but it does not deliver enough information to evaluate the growth rate of Tobacco, Alcohol and Obesity in the future. Thus, several assumptions are added to their growth rate. In addition, assumptions for take-up-rate of new insurance market share of Low and Medium capital companies were made. These assumptions are based on similar countries of Ambernïa (Australia, Germany, Norway, Portugal and United States) and Palòmïnïa (Brazil, China, India, Pakistan and Russia). Table 10 represents the estimated value and range of growth rates of Obesity, Tobacco and Alcohol in Ambernïa and Palòmïnïa.

	Palòmïnïa			Ambernïa		
	Mean	Upper 95%	Lower 95%	Mean	Upper 95%	Lower 95%
Obesity	0.04366	0.04527	0.04206	0.0227	0.0237	0.0217
Alcohol	0.0114	0.0440	-0.0212	-0.0047	0.0010	-0.0104
Daily Smoker	-0.0189	-0.0166	-0.0212	-0.0502	-0.0364	-0.0641

*Table 10: Ranges of Growth Rate of Parameter Assumption (Source: **Appendix Table B-1 to B-6**)*

Another important assumption when calculating the revenue is the take-up-rate of customers. Since parametric insurance is a new type of product, it is necessary to consider its take-up-rate by survey of customers. To assume the take-up-rate, 6 scenarios have been built and based on the percentage of companies will take-up in the first year and the growth of percentage each year. Likewise, the proportion of take-up-rate each year will be divided into 3 segments; low (2%), medium (5%) and high (10%), while growth rate will be divided into low (3%) and high (7%). In addition, an adjust "discount" on growth rate was added, which reduces by 20% each year since it cannot increase forever. Based on our research on effects of new products to the market, the take-

up in the first year will be between 0% and 20%, while the growth rate will be between -2% and 10%. Table 11 shows detail on Take-Up Rate and Growth Rate Assumption while Table 12 shows remaining assumptions.

Take-up first year	Growth rate	Percentage	2021	2022	2023	2024	2025
2%	3%	12.00%	2.00%	5.00%	7.50%	9.58%	11.32%
5%	3%	24.00%	5.00%	8.00%	10.50%	12.58%	14.32%
10%	3%	4.00%	10.00%	13.00%	15.50%	17.58%	19.32%
2%	7%	18.00%	2.00%	9.00%	14.83%	19.69%	23.75%
5%	7%	36.00%	5.00%	12.00%	17.83%	22.69%	26.75%
10%	7%	6.00%	10.00%	17.00%	22.83%	27.69%	31.75%
Expected take up rate			4.60%	10.00%	14.50%	18.25%	21.38%

Table 11: Take-Up Rate and Growth Rate Assumption

Assumption	Data Limitation	Justification
There are standard information provided by the government every month for Obesity, Tobacco, Alcohol, Hypertension and Air Quality.	No information about source of database	The source of these database vary for each country, monthly data for each parameter provided by the government is essential in designing the project.
Insurance rate is 55.67% in Palȍmïnïa and 80.07% in Ambernïa.	No information about Insurance expense in total health expense.	Average out-of-pocket expenditure of similar countries was calculated and insurance rate is obtained from that number.
Percentage of money for parametric insurance that customer willing to pay in total expense.	Insufficient financial information of insurance companies.	The percentage of parameter insurance in total expense calculated as the average percentage of trigger events in five years.
Number of health insurance company is more than 30 companies. Hence, reduced the monopoly.	No information about number of health insurance companies.	The number of insurance companies on similar countries were examined.
Economic variables: No strong fluctuation in interest rate and inflation.	Insufficient data about society.	Information in Economic and Population Data was considered and assumed that the condition is not strong fluctuation
No moral hazard	No information about risk of moral hazard	We consider that there is no moral hazard that can change the value of parameter

Table 12: Assumptions Summarization

RISK MITIGATION STRATEGIES

There are numbers of risk identified in building products using five main parameters and it is important for a company to reduce or mitigate the risk to ensure that company is not exposed to an excess of claims much higher than predicted. Table 13 shows the risk and risk mitigation of quantifiable and qualitative key risks. Then, elaborations on most important risk and correlation between parameters are presented.

Risk	Risk Mitigation
Correlation between parameter: High time series correlation between these pairs of products: • (Alcohol; Obesity) • (Tobacco; Hypertension) This can lead to increase dramatically number of claim. On the other hand, low correlation between these pairs: • (Hypertension; Air Pollution) • (Obesity; Tobacco)	The number of contracts in high correlation products will not be more than 60% of total contracts in next 5 years. 5% of discount for customer's premium will be provided if customer purchase a pair of low negative correlation products together.
Natural or Social Diaster: The outbreaks of disease or live condition can leads to dramatically increase in value of some parameters.	Parameters were chosen from different group: • Natural disaster (Air Pollution) • Psychosocial issues (Tobacco and Alcohol) • Human condition (Obesity and Hypertension) The timeline of a contract is 5 years and will be reviewed each year.
Low number of contract from customer: In Q4 2021 and 2022, the number of contract is lower than 30% of expected number. This can lead to fail of first mover target and reduce level of safe product.	Discount on customer's premium with maximum 20% of premium in first year, if number of contract is poor.
Rule of Law: The tax on Tobacco and Alcohol, or law of Air Pollution can have impact on parameters.	Threshold will be reviewed every year to forecast for appropriate value for new contract.
Internal Data Quality: Economic and Society Data will be change every year, with can lead to unappropriated threshold in the future	Internal Data should be monitored thoroughly and be valued as frequent as needed. This is important to ensure that the data used is accurate and verifiable.

Table 13: Risk Mitigation strategies summarization

The most important risk of this project is correlation between parameters. This is because NEW WORLD's will need to pay every contract if parameter triggers. Moreover, relationships between parameter to limit the probability to parameters are triggered at the same time. Figure 10 portrays the correlation between each risk factors.

	Obesity Ambernïa	Obesity Palǒmïnïa	Air Quality Ambernïa	Air Quality Palǒmïnïa	Alcohol Ambernïa	Alcohol Palǒmïnïa	Tobacco Ambernïa	Tobacco Palǒmïnïa	Hypertension Ambernïa	Hypertension Palǒmïnïa
Obesity Ambernïa	1.0000	0.9935	-0.0078	0.2033	0.0953	-0.0172	-0.0503	0.0027	0.0512	-0.0670
Obesity Palǒmïnïa	0.9935	1.0000	-0.0694	0.2594	0.1095	0.0223	-0.0282	0.0087	0.0045	-0.0941
Air Quality Ambernïa	-0.0078	-0.0694	1.0000	-0.0274	-0.5501	-0.7076	-0.0492	0.0718	0.5116	-0.1408
Air Quality Palǒmïnïa	0.2033	0.2594	-0.0274	1.0000	-0.5328	-0.5167	0.1262	0.1341	0.0314	-0.0075
Alcohol Ambernïa	0.0953	0.1095	-0.5501	-0.5328	1.0000	0.8981	0.4318	0.3550	-0.4945	0.3882
Alcohol Palǒmïnïa	-0.0172	0.0223	-0.7076	-0.5167	0.8981	1.0000	0.1175	-0.0067	-0.5165	0.0606
Tobacco Ambernïa	-0.0503	-0.0282	-0.0492	0.1262	0.4318	0.1175	1.0000	0.9851	-0.2945	0.7027
Tobacco Palǒmïnïa	0.0027	0.0087	0.0718	0.1341	0.3550	-0.0067	0.9851	1.0000	-0.2196	0.7323
Hypertension Ambernïa	0.0512	0.0045	0.5116	0.0314	-0.4945	-0.5165	-0.2945	-0.2196	1.0000	0.1039
Hypertension Palǒmïnïa	-0.0670	-0.0941	-0.1408	-0.0075	0.3882	0.0606	0.7027	0.7323	0.1039	1.0000

*Figure 10: Correlation Heat map between parameters (Source: Sheet: **Correlation Parameter, Excel file attached**)*

Based on heat index above, obesity shows a low correlation with other parameter products, which reduces the risk since our forecast analyzed that obesity products will have the largest demand. Moreover, Tobacco-Hypertension in Palǒmïnïa and Tobacco-Alcohol in Ambernïa are the pairs having noticeable high correlation. Comparing between these two countries, Obesity, Alcohol and Tobacco have the same trend, which may increase the risk to the project. Therefore, with a pair of products having high correlation, we suggest that their total number should not be more than 60% of the total contracts in 5 years ahead. Meanwhile, low correlation products may be granted with discount when purchased together.

SENSITIVITY ANALYSIS

NEW WORLD'S target is to be a player in the market as promptly as possible to get the first-mover advantage. To achieve that, the essential objective is taking out the market share, which includes the total number of companies that use the parametric products, the percentage of companies willing to pay for these products and the growth rate each year.

We estimated that with strong approach and position as a first rank insurance company in the market, the percentage of money for parametric insurance that a customer willing to pay in total expense to NEW WORLD will be equal to the average probability of all five years that the event will be triggered. However, with the involvement of other competitors and economic condition of Palòmïnïa and Ambernïa, another four scenarios have been built, which is 80%, 90%, 110% and 120% of original estimation, respectively. Further detail can be found in Figure 11 and Figure 12.

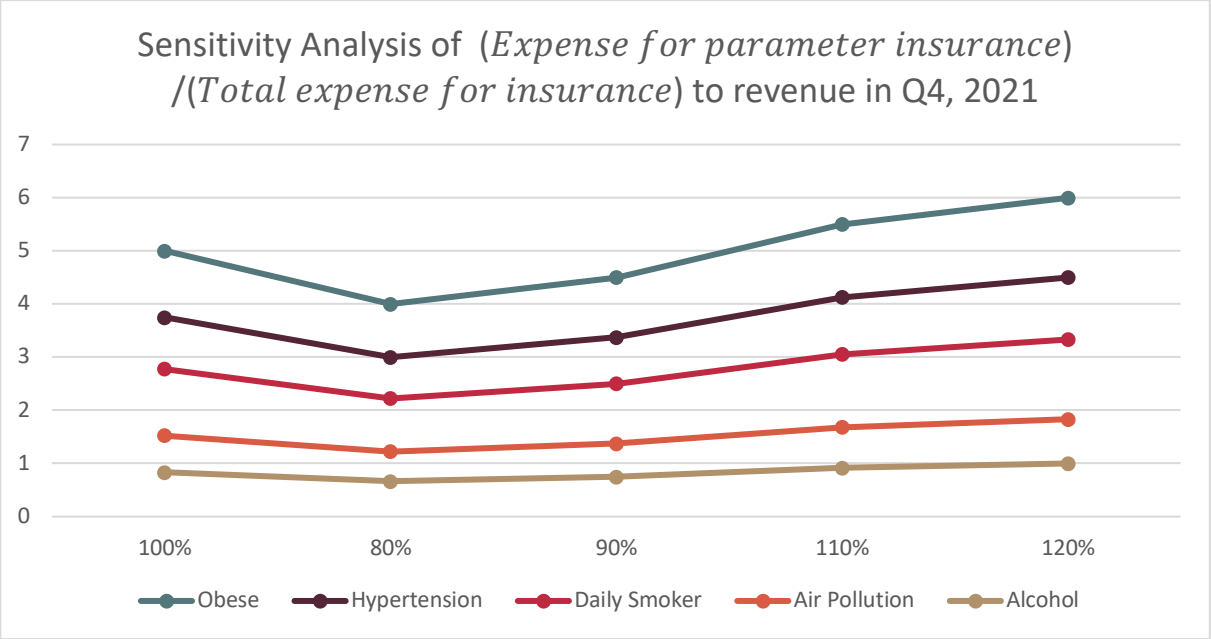

Figure 11: Sensitivity Analysis of (*Expense for parametric insurance*)/(*Total expense for insurance*) to revenue in Q4, 2021 (Source: **Appendix D3**)

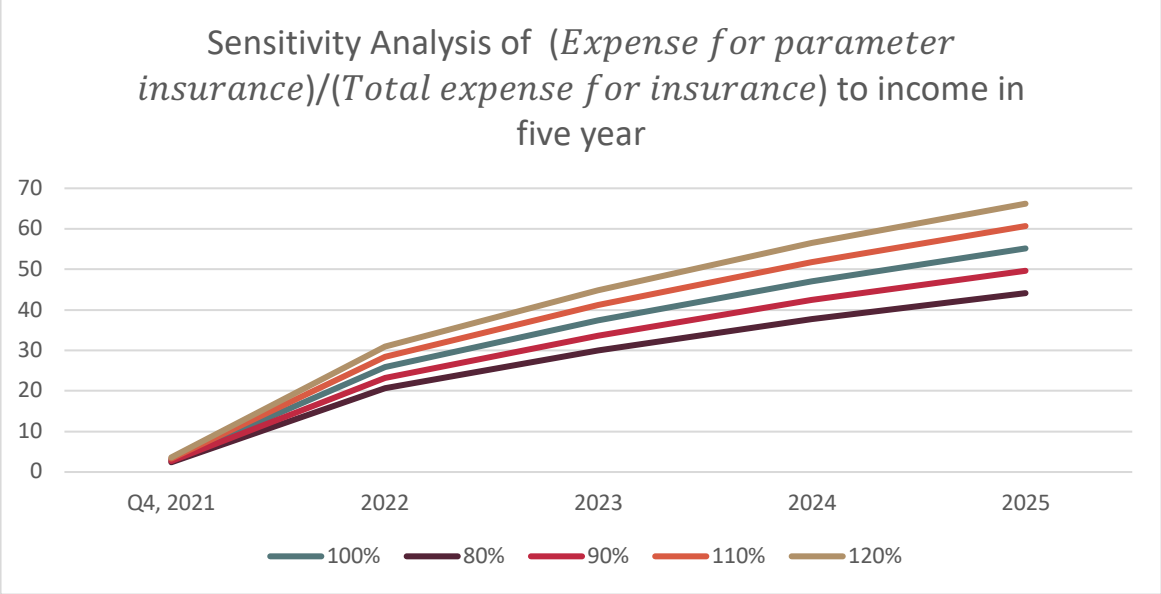

Figure 12: Sensitivity Analysis of (*Expense for parameter insurance*)/(*Total expense for insurance*) to income in five year (Source: **Appendix D3**)

In terms of market share, we suggest that NEW WORLD should focus on medium and low companies, especially the bottom 30 % of the market, which leads to expected value of take-up rates in Table 11 on Assumption and Data Limitation task. To analyze the sensitive of market share and take up rate, nine scenarios have been built in Table 14.

Market Share of target customer	30%	30%	30%	20%	20%	20%	40%	40%	40%
Take up rate among target customer	4.60%	3%	6%	4.60%	3%	6%	4.60%	3%	6%
Total revenue in Q4 2021 (Million, Ψ)	13.8837	9.0546	18.1092	9.2558	6.0364	12.0728	18.5116	12.0728	24.1456
Total expense in Q4 2021 (Million, Ψ)	11.065	7.2163	14.4327	7.3767	4.8109	9.6218	14.7534	9.6218	19.2436
Total income in Q4 2021 (Million, Ψ)	3.0988	2.021	4.042	2.0659	1.3473	2.6946	4.1318	2.6946	5.3893

*Table 14: Sensitivity Analysis of Market Share and Take up rate in Q4, 2021 (Source: **Appendix D3**)*

It is clear that to achieve the higher income in Q4 2021 and in the long term, NEW WORLD needs to increase their market share, their take up rate among the target customer, or convince customers to pay more money for each product. Since NEW WORLD will have first-mover advantage in parametric insurance, we suggest that they should focus on market share, which leads to higher income in the long term. We recommend that NEW WORLD should expand market strongly, with the goal is 6% of target customer, who is top 30% lower and medium companies. If achieved that, the income expected will increase 23.36%, to Ψ4.042 millions.

In addition, we also developed other recommendation for NEW WORLD in Table 15, which could be useful in some particular cases.

Recommendation	Positive	Negative
Increase Market Share of target customer by target larger insurance companies	- Increase revenue of every product - Greater chance to have more valuable contracts	Difficult to convince customers, since most large insurance companies have low risk level
Focus on higher rate of return products: Hypertension and Obese	For each 1% increase of number of Hypertension and Obese product, total revenue increase by 0.2 - 0.4%	Increase risk of total project and reduce diversification between other products
Increase the rate of expense for parameter insurance for each customer	For each 1% increase of expense, total income increase by 1%	Difficult to convince customers to invest high percentage rate of insurance in the first year

Table 15: Recommendation from Sensitivity Analysis

CONCLUSION

After five years of the outlined program, we would expect the total revenue for NEW WORLD from this project to increase sharply by Ψ786.385 millions between 2021 and 2025, which is equals to 5.4% of total revenue in 2020. Furthermore, the expected income from this project is valued to be Ψ168.3977 millions in the same period, which is equal to 4.4% of total income in 2020.

We would also recommend for NEW WORLD to implement this Parametric Insurance project in Q4 of 2021 with a strong approach in order to become the first-mover that innovate with this product, with the main goal achieved of 6% market share for low and medium insurance companies segment in the first year and increase by 3 percentage points for each following year. After acquiring market share, NEW WORLD will have the superiority as the first-mover that other competitors will need a long time to be able to compete.

APPENDIX

Appendix A: Program Design

Section A1: Parameter Estimation in 2021 R Code

'R Studio' was used to estimate the mean and standard deviation of chosen parameters in the next 5 years. Air Pollution and Hypertension were processed by ARIMA, while others using growth rate estimated from neighbor countries. In this report, we provide source codes of Air Pollution and Alcohol in Palὸmïnïa while the remaining parameters run the same approaches.

```
#Air Pollution
#Loading Packages and Parameter Data
library(readxl)
library(forecast)
library(ggplot2)
library(dplyr)
path = "2021-student-case-study2.xlsx"
Healthcare_Spending_per_Person <- read_excel(path, sheet = 'Economic and Population Data', range = "A41:C51")
Air_Pollution <- read_excel(path, sheet = 'Triggers', range = "A123:C133")

#Rename columns
names(Air_Pollution)[1] <- "Year"
names(Air_Pollution)[3] <- "TwoF"
names(Air_Pollution)[4] <- "Ten"

# Convert to datatype timeseries
df = data.frame(Air_Pollution) %>% select(Year, TwoF ,Ten)
df = data.frame(lapply(df, as.numeric))
df1 = as.ts(df)

#Estimate acf and pacf
data = df1[,2]
acf(data)
pacf(data)
```

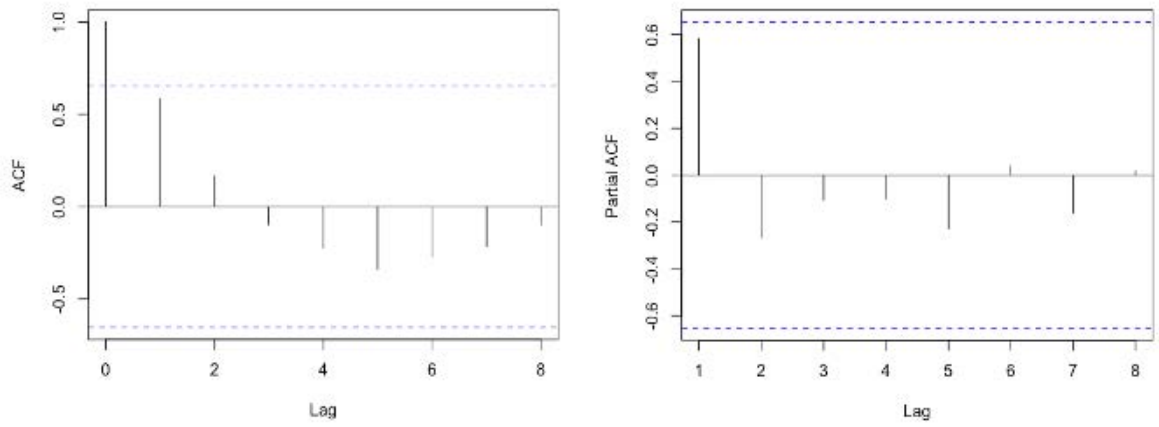

Figure A-1: acf and pacf of Air Quality Parameter

```
#Fit model and Forecast
arima_fit <- arima(data, order = c(0,1,1))
Est_TwoF = predict(arima_fit, n.ahead = 5, se.fit = TRUE)

#$pred
#Time Series:
#Start = 12
#End = 16
#Frequency = 1
#[1] -0.0008041549 -0.0071354072 -0.0079022499 -0.0079951301 -0.0080063798

#$se
#Time Series:
#Start = 12
#End = 16
#Frequency = 1
#[1] 0.006829493 0.008529493 0.013671477 0.017774948 0.021138892



#Alcohol
#Loading Packages and Parameter Data
library(readxl)
library(forecast)
library(ggplot2)
library(dplyr)
path = "2021-student-case-study2.xlsx"
Alcohol <- read_excel(path, sheet = 'Triggers', range = "A28:Q36")

#Rename columns
names( Alcohol)[1] <- "Year"
names(Alcohol)[3] <- "Day"
```

```
names(Alcohol)[4] <- "Week"

#Estimate growth rate from neighbor countries. This value were calculated from neighbor countries in Appendix B3 and B4
Mean_Delta = 0.043079799

#Percentage obtained from percentage of Population, will be shown in Appendix A3
rate <- c(0.0792, 0.0880, 0.1906, 0.1938, 0.1647, 0.1349, 0.0925, 0.0564)

#Build parameter = 0.75 of Daily Alcohol Assumption + 0.25 of Weekly Alcohol Assumption
Alcohol <- cbind(Alcohol,rate)
df = data.frame(Alcohol) %>% select(Day, Week, rate)
df["Alcohol_Frequently"] = df["Day"] * 0.75 + df["Week"] * 0.25

#Build mean and standard deviation
mean_AF = sum(df["Alcohol_Frequently"] * df["rate"])
std_AF = sqrt(sum(((df$Alcohol_Frequently - mean_AF)^2)*df$rate))
mean_AF
std_AF
#[1] 0.0610199
#[1] 0.02067107

#Build mean and standard deviation for the next 2 years
mean_AF_2 = mean_AF*(1+Mean_Delta)
std_AF_2 = std_AF*(1+Mean_Delta)
mean_AF_2
std_AF_2
#[1] 0.06364863
#[1] 0.02156158


#Build mean and standard deviation for the next 3 years
mean_AF_3 = mean_AF_2*(1+Mean_Delta)
std_AF_3 = std_AF_2*(1+Mean_Delta)
mean_AF_3
std_AF_3
#[1] 0.0663906
#[1] 0.02249045
```

The table below summarizes the mean and standard deviation outputs for each parameter. From these estimations, thresholds were chosen, which can be found in Appendix C.

Parameter	Countries		2021	2022	2023	2024	2025
Air Pollution	**Palòmïnïa**	Mean	*21.6025*	*21.6025*	*21.6025*	*21.6025*	*21.6025*
		Standard Deviation	*2.3155*	*3.0637*	*3.6622*	*4.1758*	*4.6327*
	Ambernïa	Mean	*8.6600*	*8.6600*	*8.6600*	*8.6600*	*8.6600*
		Standard Deviation	*0.7631*	*1.0792*	*1.3218*	*1.5263*	*1.7064*
Alcohol	**Palòmïnïa**	Mean	*0.0636*	*0.0664*	*0.0693*	*0.0722*	*0.0753*
		Standard Deviation	*0.0216*	*0.0225*	*0.0235*	*0.0245*	*0.0255*
	Ambernïa	Mean	*0.1192*	*0.1185*	*0.1177*	*0.1170*	*0.1163*
		Standard Deviation	*0.0399*	*0.0397*	*0.0394*	*0.0392*	*0.0389*
Obesity	**Palòmïnïa**	Mean	*0.1505*	*0.1563*	*0.1622*	*0.1684*	*0.1748*
		Standard Deviation	*0.0798*	*0.0828*	*0.0860*	*0.0893*	*0.0927*
	Ambernïa	Mean	*0.1576*	*0.1614*	*0.1652*	*0.1692*	*0.1733*
		Standard Deviation	*0.0447*	*0.0458*	*0.0469*	*0.0480*	*0.0491*
Tobacco	**Palòmïnïa**	Mean	*0.1510*	*0.1560*	*0.1620*	*0.1680*	*0.1750*
		Standard Deviation	*0.0800*	*0.0830*	*0.0860*	*0.0890*	*0.0930*
	Ambernïa	Mean	*0.1580*	*0.1610*	*0.1650*	*0.1690*	*0.1730*
		Standard Deviation	*0.0450*	*0.0460*	*0.0470*	*0.0480*	*0.0490*
Hypertension	**Palòmïnïa**	Mean	*128.6991*	*128.6991*	*128.6991*	*128.6991*	*128.6991*
		Standard Deviation	*0.1046*	*0.2071*	*0.2734*	*0.3265*	*0.3721*
	Ambernïa	Mean	*122.8350*	*122.8350*	*122.8350*	*122.8350*	*122.8350*
		Standard Deviation	*0.1783*	*0.3840*	*0.5129*	*0.6154*	*0.7031*

Table A-1: Mean and Standard Deviation Estimate of Parameters

Section A2: Health care expense in 2021 R Code

'R Studio' was used to estimate the mean and standard deviation of Health Care Expense for the next 5 years. The code provided below was used for Palòmïnïa's data and similar code was applied for Ambernïa. From these computations, health care expenses were acquired to process data on Implementation Plan.

```
#Loading Packages and Parameter Data
library(readxl)
library(forecast)
library(ggplot2)
library(dplyr)
path = "2021-student-case-study2.xlsx"
Population <- read_excel(path, sheet = 'Economic and Population Data', range = "A27:C37")
Healthcare_Spending_per_Person <- read_excel(path, sheet = 'Economic and Population Data', range = "A41:C51")

#Rename columns
names(Healthcare_Spending_per_Person)[1] <- "Year"
names(Population)[1] <- "Year"

#Health Care data process
df = data.frame(Healthcare_Spending_per_Person) %>% select(Year, Palòmïnïa ,Ambernïa )
df = df %>% slice(2:10)
Healthcare_Spending_per_Person = data.frame(lapply(df, as.numeric))
Data <- Healthcare_Spending_per_Person
names(Data) <- c("Year", "Pal_Healthcare_Spending", "Amb_Healthcare_Spending")

#Population data process
df = data.frame(Population) %>% select(Year, Palòmïnïa ,Ambernïa )
df = df %>% slice(2:10)
Population = data.frame(lapply(df, as.numeric))
Data["Pal_pop"] <- Population$Palòmïnïa
Data["Amb_pop"] <- Population$Ambernïa

#Combine with Health Expense
Data["Pal_Health_Expense"] = Data$Pal_Healthcare_Spending*Data$Pal_pop/10^6
Data["Amb_Health_Expense"] = Data$Amb_Healthcare_Spending*Data$Amb_pop/10^6

#Estimate acf and pacf
acf(Data$Pal_Health_Expense)
pacf(Data$Pal_Health_Expense)
```

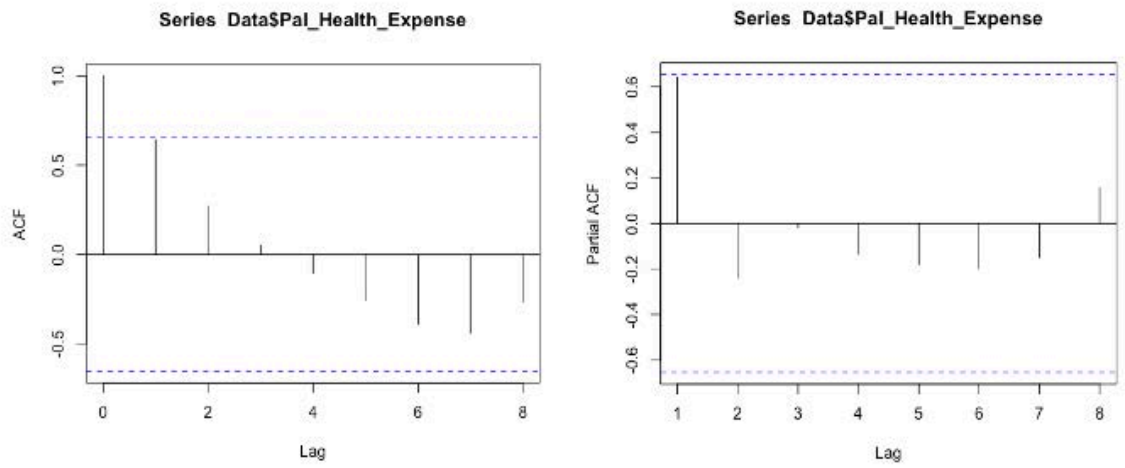

Figure A-2 acf and pacf of Health Expense ARIMA model

```
#q = 1; p = 1, d = 1
arima_fit <- arima(Data$Pal_Health_Expense, order = c(1,2,1))
out = predict(arima_fit, n.ahead = 5, se.fit = TRUE)
out

#$pred
#Time Series:
#Start = 10
#End = 14
#Frequency = 1
#[1] 16996.89 18044.23 19100.74 20154.27 21208.77

#$se
#Time Series:
#Start = 10
#End = 14
#Frequency = 1
#[1]  621.6936  790.3104  989.5703 1166.9022 1343.2663
```

Section A3: Age band transformation

Transformation has been made to calculate the percentage of population for each age band for Alcohol, Daily Smoker and Obesity parameter as in Appendix A1. Overall, the formula is:

$$P(\overline{a5} < x < \overline{(a+1)4}) = \frac{P(\overline{a0} < x < \overline{(a+1)0}) + P(\overline{(a+1)0} < x < \overline{(a+2)0})}{2}$$

Based on population and Age Band data, the following result had been achieved.

Age Band	% of Total Population in Palòmïnïa	% of Total Population Ambernïa
15–19	6.25%	5.75%
20–24	6.95%	6.50%
25–34	15.05%	12.90%
35–44	15.30%	12.80%
45–54	13.00%	12.95%
55–64	10.65%	12.25%
65–74	7.30%	10.30%
75+	4.65%	9.50%

Table A-2: Age band transformation

Section A4: Interest Rate Estimation

ARIMA was used to estimate the interest rate used to calculate present value of expense. Table below shows the output of the model:

Date	**Palòmïnïa**	**Ambernïa**
1/1/21	0.61%	(0.08%)
1/1/22	0.87%	(0.71%)
1/1/23	1.39%	(0.79%)
1/1/24	1.76%	(0.80%)
1/1/25	2.06%	(0.80%)

Table A-3: Long Term Interest Rates on January 1

Section A5: Revenue Simulation R code

```
#Import library
library(readxl)
library(forecast)
library(ggplot2)
library(dplyr)

#Build simulate vector, follow take-up rate
TUR <- c(rep(0.02,300),rep(0.05,600),rep(0.08,50),rep(0.1,50))
Exp_low_A = 7621.69
Exp_low_P = 2838.65

###Revenue Simulation
x= list()
i = 0
while (i < 500) {
  Exp_Tar_Cus_P = sample(TUR,1) * Exp_low_P
  Exp_Tar_Cus_A = sample(TUR,1) * Exp_low_A
  Revenue_P = Exp_Tar_Cus_P*0.36*rnorm(1,mean = 0.1174,sd = 0.05) +   Exp_Tar_Cus_P*0.27*rnorm(1,mean =
            0.1139,sd = 0.05) +     Exp_Tar_Cus_P*0.2*rnorm(1,mean = 0.1174,sd = 0.05) +
            Exp_Tar_Cus_P*0.11*rnorm(1,mean = 0.1094,sd = 0.05) + Exp_Tar_Cus_P*0.06*rnorm(1,mean = 0.1444,sd
            = 0.05)

  Revenue_A = Exp_Tar_Cus_A*0.36*rnorm(1,mean = 0.1157,sd = 0.05) +    Exp_Tar_Cus_A*0.27*rnorm(1,mean =
            0.1315,sd = 0.05) + Exp_Tar_Cus_A*0.2*rnorm(1,mean = 0.1157,sd = 0.05) +
            Exp_Tar_Cus_A*0.11*rnorm(1,mean = 0.1268,sd = 0.05) + Exp_Tar_Cus_A*0.06*rnorm(1,mean = 0.0676,sd
            = 0.05)
  x <- c(x,Revenue_A + Revenue_P)
  i = i + 1}
```

```
#Build histogram
unlist(x)
Revenue <- as.numeric(x)
hist(Revenue, freq = FALSE)


#Build cost simulation, following cost distribution, can be found in Excel file
AP <- c(rep(600000,1),rep(480000,4), rep(360000, 88), rep(240000, 1314), rep(120000, 3036), rep(0, 5558))
AA <- c(rep(600000,1),rep(480000,8), rep(360000, 132), rep(240000, 1644), rep(120000, 3200), rep(0, 5016))

AlP <- c(rep(600000,1),rep(480000,15), rep(360000, 193), rep(240000, 2043), rep(120000, 3208), rep(0, 4541))
AlA <- c(rep(600000,1),rep(480000,1), rep(360000, 24), rep(240000, 773), rep(120000, 2154), rep(0, 7048))

OP <- c(rep(600000,1),rep(480000,8), rep(360000, 112), rep(240000, 1591), rep(120000, 2951), rep(0, 5338))
OA <- c(rep(600000,1),rep(480000,7), rep(360000, 108), rep(240000, 1561), rep(120000, 2933), rep(0, 5391))

TP <- c(rep(600000,1),rep(480000,1), rep(360000, 42), rep(240000, 2028), rep(120000, 2169), rep(0, 5760))
TA <- c(rep(600000,1),rep(480000,2), rep(360000, 64), rep(240000, 2266), rep(120000, 2217), rep(0, 5451))

HP <- c(rep(600000,1),rep(480000,3), rep(360000, 88), rep(240000, 1298), rep(120000, 3235), rep(0, 5375))
HA <- c(rep(600000,1),rep(480000,6), rep(360000, 136), rep(240000, 1647), rep(120000, 3372), rep(0, 4839))

#Income Simulation
x= list()
i = 0
while (i < 500) {
  Exp_Tar_Cus_P = sample(TUR,1) * Exp_low_P
  Exp_Tar_Cus_A = sample(TUR,1) * Exp_low_A

  Income_P = Exp_Tar_Cus_P*0.36*rnorm(1,mean = 0.1174,sd = 0.05)*10*(100000-sample(OP,1))+
             Exp_Tar_Cus_P*0.27*rnorm(1,mean = 0.1139,sd = 0.05)*10*(100000-sample(HP,1)) +
             Exp_Tar_Cus_P*0.2*rnorm(1,mean = 0.1174,sd = 0.05)*10*(100000-sample(TP,1)) +
             Exp_Tar_Cus_P*0.11*rnorm(1,mean = 0.1094,sd = 0.05)*10*(100000-sample(AP,1))  +
             Exp_Tar_Cus_P*0.06*rnorm(1,mean = 0.1444,sd = 0.05)*10*(100000-sample(AlP,1))

  Income_A = Exp_Tar_Cus_A*0.36*rnorm(1,mean = 0.1174,sd = 0.05)*10*(100000-sample(OA,1))  +
             Exp_Tar_Cus_P*0.27*rnorm(1,mean = 0.1139,sd = 0.05)*10*(100000-sample(HA,1)) +
             Exp_Tar_Cus_P*0.2*rnorm(1,mean = 0.1174,sd = 0.05)*10*(100000-sample(TA,1)) +
             Exp_Tar_Cus_P*0.11*rnorm(1,mean = 0.1094,sd = 0.05)*10*(100000-sample(AA,1))  +
             Exp_Tar_Cus_P*0.06*rnorm(1,mean = 0.1444,sd = 0.05)*10*(100000-sample(AlA,1))

  x <- c(x,(Income_P + Income_A)/1000000)
  i = i + 1
}

#Build histogram of Income
unlist(x)
Income <- as.numeric(x)
hist(Income, freq = FALSE)
```

Appendix B - Assumption Detail

To estimate the growth of Obesity, Alcoholic consumption and Tobacco consumption, we collected data of similar countries. Table B-1 and B-2 show detail information about Obesity percentage among people, Table B-3 and B-4 show values for Alcoholic Beverages, and Table B-5 and B-6 illustrate figure for Daily Smoker. (Source: ourworldindata.org)

Year	Australia	Germany	Norway	Portugal	United States	Average
2002	0.0290	0.0241	0.0244	0.0355	0.0267	0.0279
2003	0.0235	0.0176	0.0298	0.0274	0.0260	0.0249
2004	0.0275	0.0231	0.0231	0.0267	0.0254	0.0252
2005	0.0223	0.0169	0.0282	0.0325	0.0247	0.0249
2006	0.0262	0.0222	0.0220	0.0252	0.0241	0.0239
2007	0.0213	0.0217	0.0215	0.0307	0.0202	0.0231
2008	0.0250	0.0213	0.0263	0.0238	0.0231	0.0239
2009	0.0203	0.0156	0.0205	0.0291	0.0226	0.0216
2010	0.0199	0.0205	0.0251	0.0226	0.0189	0.0214
2011	0.0234	0.0201	0.0196	0.0276	0.0217	0.0225
2012	0.0191	0.0197	0.0240	0.0215	0.0182	0.0205
2013	0.0225	0.0193	0.0188	0.0263	0.0208	0.0215
2014	0.0220	0.0190	0.0230	0.0205	0.0175	0.0204
2015	0.0179	0.0186	0.0180	0.0251	0.0201	0.0199
2016	0.0211	0.0183	0.0221	0.0196	0.0169	0.0196

Table B-1: Growth of Prevalence of Obesity on Some Advanced Economies

Year	Brazil	China	India	Mexico	Pakistan	Average
2002	0.0333	0.0800	0.0588	0.0235	0.0488	0.0489
2003	0.0258	0.0370	0.0556	0.0229	0.0698	0.0422
2004	0.0314	0.0714	0.0526	0.0224	0.0435	0.0443
2005	0.0244	0.0667	0.0500	0.0219	0.0625	0.0451
2006	0.0298	0.0625	0.0952	0.0215	0.0392	0.0496
2007	0.0289	0.0882	0.0435	0.0210	0.0566	0.0476
2008	0.0225	0.0541	0.0417	0.0206	0.0536	0.0385
2009	0.0275	0.0513	0.0800	0.0202	0.0508	0.0460
2010	0.0267	0.0732	0.0370	0.0198	0.0484	0.0410
2011	0.0208	0.0682	0.0714	0.0194	0.0462	0.0452
2012	0.0255	0.0638	0.0333	0.0190	0.0441	0.0372
2013	0.0249	0.0400	0.0645	0.0187	0.0563	0.0409
2014	0.0243	0.0577	0.0606	0.0183	0.0400	0.0402
2015	0.0237	0.0727	0.0571	0.0180	0.0513	0.0446
2016	0.0231	0.0508	0.0541	0.0212	0.0488	0.0396

Table B-2: Growth of Prevalence of Obesity on Some Emerging Market Economies

Year	Australia	Germany	Norway	Portugal	United States	Average
2002	0.0037	0.0159	0.0153	-0.0111	-0.0006	0.0046
2003	-0.0004	-0.0149	0.0082	-0.0350	0.0069	-0.0070
2004	0.0084	-0.0143	0.0244	-0.0555	-0.0010	-0.0076
2005	-0.0324	-0.0252	0.0277	0.0788	0.0190	0.0136
2006	-0.0015	-0.0589	0.0045	-0.0021	-0.0220	-0.0160
2007	0.0089	0.0009	0.0763	0.0166	0.0027	0.0211
2008	0.0185	-0.0178	-0.0195	-0.0152	0.0018	-0.0064
2009	-0.0227	0.0572	0.0172	-0.0040	-0.0012	0.0093
2010	-0.0096	-0.0130	0.0085	-0.0737	-0.0069	-0.0190
2011	-0.0463	-0.0336	0.0080	-0.0391	-0.0166	-0.0255
2012	0.0556	-0.0107	-0.0239	-0.0253	-0.0212	-0.0051
2013	-0.0654	-0.0505	-0.0210	0.0711	-0.0048	-0.0141
2014	0.0361	0.0359	-0.0292	-0.0648	-0.0228	-0.0090
2015	0.0159	-0.0062	-0.0269	-0.0222	0.0179	-0.0043

Table B-3: Growth of Alcoholic Beverages on Some Advanced Economies

Year	Brazil	China	India	Mexico	Pakistan	Average
2002	-0.0585	0.0136	0.1500	0.0377	-0.2500	-0.0214
2003	0.3265	0.0347	0.0062	-0.0125	0.1111	0.0932
2004	0.0224	0.0759	-0.0556	-0.0119	-0.2500	-0.0438
2005	-0.1235	0.0355	-0.0196	0.0188	-0.2000	-0.0578
2006	-0.0507	0.0045	0.1000	0.0252	-0.0833	-0.0009
2007	0.1146	0.1285	-0.1697	0.0042	0.0000	0.0155
2008	0.0125	0.0445	-0.1898	0.0391	-0.3636	-0.0915
2009	0.0184	0.0985	0.3694	0.0291	0.0000	0.1031
2010	0.0263	0.1001	0.4276	0.0378	-0.1429	0.0898
2011	0.0875	0.0345	-0.0691	-0.0098	-0.1667	-0.0247
2012	-0.0131	0.0031	-0.3317	0.0480	0.0000	-0.0588
2013	0.1784	0.0459	0.1407	-0.0615	0.2000	0.1007
2014	0.0300	0.0555	0.3117	0.0079	0.3333	0.1477
2015	-0.0141	-0.0124	0.0149	-0.0234	-0.3750	-0.0820
2016	0.0053	0.0412	-0.0146	-0.0247	0.0000	0.0014

Table B-4: Growth of Alcoholic Beverages on Some Emerging Market Economies

Year	Australia	Germany	Norway	Portugal	United States	Average
2002	-0.0239	-0.0280	-0.0412	0.0183	-0.0260	-0.0202
2003	-0.0245	-0.0247	-0.0430	0.0000	-0.0160	-0.0216
2004	-0.0251	-0.0042	-0.0490	-0.0045	-0.0163	-0.0198
2005	-0.0258	0.0000	-0.0472	-0.0090	-0.0166	-0.0197
2006	-0.0317	-0.0042	-0.0541	-0.0046	-0.0169	-0.0223
2007	-0.0328	-0.0085	-0.0524	0.0000	-0.0229	-0.0233
2008	-0.0282	-0.0086	-0.0503	0.0000	-0.0234	-0.0221
2009	-0.0233	-0.0087	-0.0370	0.0046	-0.0180	-0.0165
2010	-0.0238	-0.0087	-0.0385	-0.0046	-0.0305	-0.0212
2011	-0.0061	-0.0088	-0.0229	-0.0046	-0.0189	-0.0122
2012	0.0000	-0.0089	-0.0117	-0.0046	-0.0192	-0.0089

Table B-5: Growth of Daily Smoker Prevalence on Some Advanced Economies

Year	Brazil	China	India	Mexico	Pakistan	Average
2002	-0.0121	-0.0303	-0.0063	-0.0111	-0.0134	-0.0732
2003	-0.0061	-0.0234	-0.0127	-0.0112	-0.0068	-0.0602
2004	-0.0185	-0.0160	-0.0128	-0.0114	0.0068	-0.0519
2005	-0.0189	-0.0122	-0.0260	-0.0172	0.0102	-0.0641
2006	-0.0192	-0.0123	-0.0267	-0.0234	0.0101	-0.0716
2007	-0.0261	-0.0083	-0.0479	-0.0180	0.0133	-0.0871
2008	-0.0201	0.0000	-0.0432	-0.0122	0.0164	-0.0591
2009	-0.0137	0.0042	-0.0376	-0.0185	0.0129	-0.0527
2010	-0.0139	0.0126	-0.0156	-0.0126	0.0032	-0.0264
2011	-0.0141	0.0124	0.0000	-0.0127	0.0063	-0.0081
2012	-0.0143	0.0163	0.0000	-0.0065	0.0063	0.0019

Table B-6: Growth of Daily Smoker Prevalence on Some Emerging Market Economies

To estimate insurance health expenditure of Ambernïa and Palòmïnïa, we compare them with similar countries. Table B7 and B8 show the insurance health expenditure from 10 economies from advanced and emerging market economies. Averages were calculated from them to assume values for Ambernïa (80.7%) and Palòmïnïa (55.67%). (Source: ourworldindata.org)

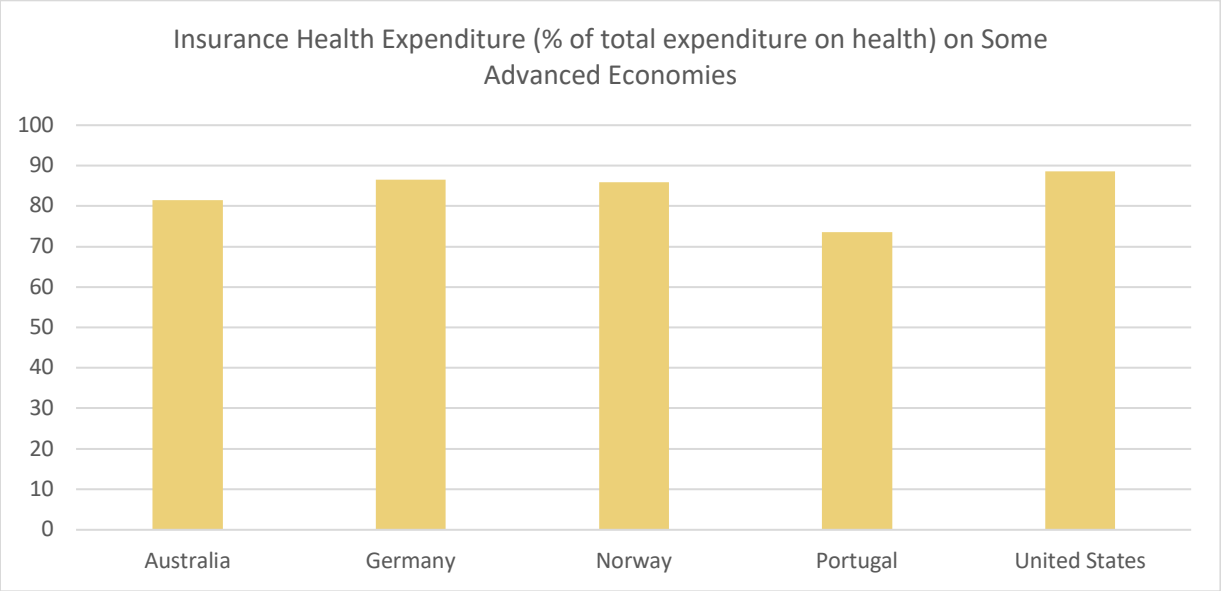

Table B-7: Insurance health expenditure (% of total expenditure on health) on some advanced economies

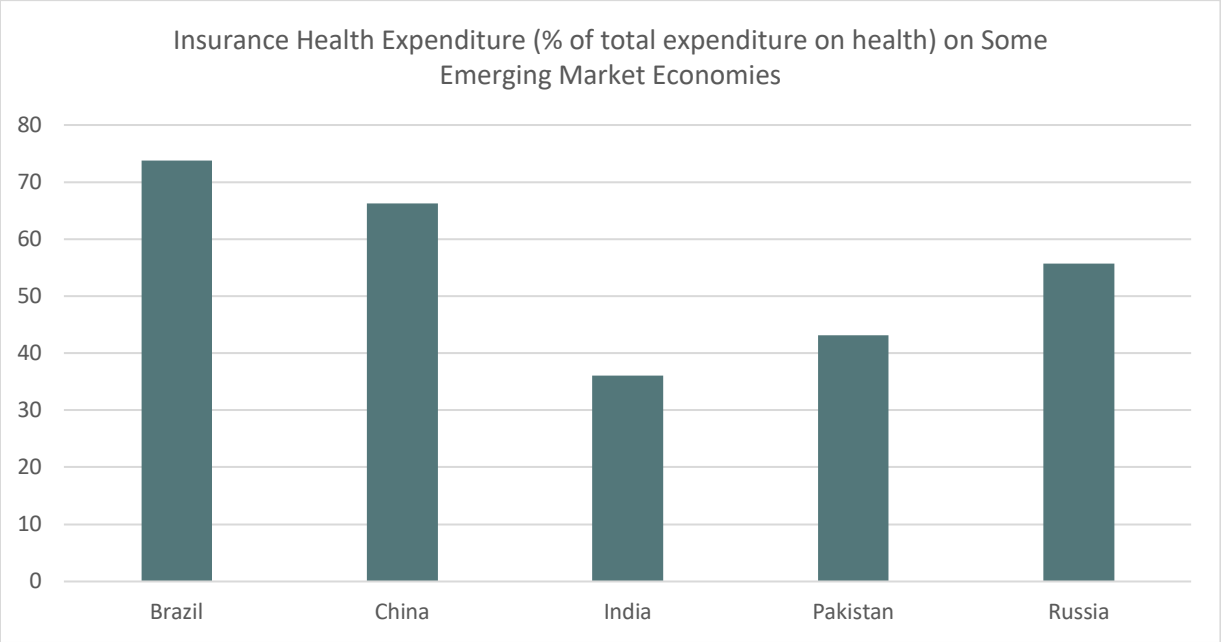

Table B-8: Insurance health expenditure (% of total expenditure on health) on some emerging market economies

Appendix C - Parameter Analyst Detail

Section C1: Parameter Selection

Table C-1 shows parameters of each contribution that may lead to the loss of economy.

Parameter	**Contribution to the loss of economy**
Air Pollution	Air Pollution is highly correlated to Gross Domestic Products (GDP) of a country. An insurance company may purchase a parametric insurance policy if the Air Pollution rate falls above a pre-determined threshold. The air pollution is the triggering events that lead to progress of GDP. According to Organisation for Economic Co-operation and Development (OECD), it is projected to lead to global economic costs that gradually increase to 1% of global GDP by 2060 and there's no sign of reducing the impact of air pollution.
Alcohol	Excess consumption of alcohol may disrupt the economy of a country and community including increase in high health care spending of a country. Research by Institute of Alcohol Studies shows that the major cost by this trigger is it contributes to people being less productive at work (presenteeism), missing work (absenteeism), failing to find work, and in the most extreme cases, dying prematurely. Payment by insurance company will be given if the alcohol consumption rate falls above a pre-determined threshold.
Tobacco	Excess intake of tobacco may have the same correlation with air pollution but with different threshold. It is preventable causes of death and has killed over 7 million people every year as published by World Health Organization (WHO). A parametric insurance policy will pay if it exceed a pre-determined threshold and payout only occurs if the mean proportion in the year is above the threshold.
Hypertension	Hypertension may lead to other kind of diseases such as cardiovascular morbidity and mortality and related to greater cost to the health sector spending. A parametric insurance policy will pay if it exceed a pre-determined threshold and payout only occurs if the mean proportion in the year is above the threshold.
Obesity	Obesity exhibits a positive relationship with Gross National Income (GNI) and based on current trends, obesity prevalence will continue to rise. The rate of obesity is the triggering levels and payout is given if the value is above the threshold of a pre-determined levels of triggering events.

Table C-1 Contribution to the loss of the economy of each parameter

Section C2: Parameter Probability

Probability of events not being triggered for each parameter in each countries is obtained by using normal distribution method with forecasted mean and standard deviations and confidence level that is chosen based on how likely the proposed model can survive in the market. Detail of these calculation can be found on Sheet "Air Quality", "Obesity", "Hypertension", "Alcohol" and "Tobacco" in attached excel file.

Payout/ Ψ	Air Pollution Prob.	Alcohol Used Prob.	Tobacco Used Prob.	Hypertension Prob.	Obesity Prob.
600 000	0.00070%	0.00437%	0.00005%	0.00004%	0.00185%
480 000	0.04378%	0.15376%	0.00930%	0.03082%	0.07572%
360 000	0.87537%	1.92869%	0.41505%	0.88415%	1.12183%
240 000	13.13884%	20.43228%	20.28438%	12.97922%	15.91375%
120 000	30.35985%	32.07754%	21.68628%	32.35178%	29.50982%
0	55.58217%	45.40773%	57.60499%	53.75404%	53.37888%

Table C-2 Probabilities for each trigger in obtaining the payout amount in Palòmïnïa

Payout/ Ψ	Air Pollution Prob.	Alcohol Used Prob.	Tobacco Used Prob.	Hypertension Prob.	Obesity Prob.
600 000	0.00133%	0.00014%	0.00020%	0.00008%	0.00173%
480 000	0.07588%	0.00963%	0.02214%	0.05783%	0.07184%
360 000	1.32119%	0.23893%	0.64248%	1.35842%	1.07800%
240 000	16.44282%	7.73067%	22.65844%	16.47157%	15.61070%
120 000	32.00215%	21.53839%	22.16827%	33.71980%	29.32751%
0	50.15796%	70.48238%	54.50866%	48.39238%	53.91195%

Table C-3 Probabilities for each trigger in obtaining the payout amount in Ambernïa

Moreover, detail of each probability that parameter is higher than threshold in each year is as follows:

a. Air Pollution

The parameter use is PM 2.5 (micrograms per cubic meter). It will be determined once a year and calculated by average PM 2.5 of all days in a year.

Threshold **25.9574**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Palòmïnïa	0.9700	0.9224	0.8828	0.8515	0.8264

Table C-4: Threshold and forecasted values for Air Pollution in Palòmïnïa

Threshold **10.0953**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Ambernïa	0.9700	0.9082	0.8612	0.8265	0.7999

Table C-5: Threshold and forecasted values for Air Pollution in Ambernïa

b. Alcohol Used

Threshold **0.0950**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Palòmïnïa	0.9250	0.8958	0.8609	0.8206	0.7757

Table C-6: Threshold and forecasted values for Alcohol Used in Palòmïnïa

Threshold **0.1770**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in *Ambernïa*	*0.9250*	*0.9289*	*0.9326*	*0.9362*	*0.9396*

Table C-7: Threshold and forecasted values for Alcohol Used in Ambernïa

c. Tobacco Used

Threshold **0.2840**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Palòmïnïa	0.7500	0.8538	0.9298	0.9741	0.9932

Table C-8: Threshold and forecasted values for Tobacco Used in Palòmïnïa

Threshold **0.2880**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Ambernïa	0.7500	0.8415	0.9128	0.9601	0.9855

Table C-9: Threshold and forecasted values for Tobacco Used in Ambernïa

d. Hypertension

Threshold **129.0095**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Palòmïnïa	0.9985	0.9331	0.8720	0.8292	0.7980

Table C-10: Threshold and forecasted values for Hypertension in Palòmïnïa

Threshold **123.3642**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Ambernïa	0.9985	0.9159	0.8489	0.8051	0.7742

Table C-11: Threshold and forecasted values for Hypertension in Ambernïa

e. Obesity

Threshold **0.2650**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Palòmïnïa	0.9250	0.9061	0.8848	0.8613	0.8357

Table C-12: Threshold and forecasted values for Obesity in Palòmïnïa

Threshold **0.2220**

Year	2021	2022	2023	2024	2025
Prob that event is not triggered in Ambernïa	0.9250	0.9071	0.8867	0.8639	0.8388

Table C-13: Threshold and forecasted values for Obesity in Ambernïa

By considering the data given, there are two types of data; data based on year (e.g.: Blood Pressure) and data based on age band (e.g.: Alcohol Use). Therefore, different methods are used for each considering the behavior of data. In addition, the confidence interval computed for this model varies depending on triggers to ensure company will be in good term.

Triggers	Confidence Level (%)
Air Pollution	97.00
Alcohol Used	92.50
Tobacco Used	75.00
Hypertension	99.85
Obesity	92.50

Table C-14 First year interval confidence level

Firstly, for data based on age band, method used is multi-period average because data available is yearly and some data available for every five years (Tobacco Used). In this case, ratio of difference for each lag is obtained and then by descriptive analysis, mean for triggering event for year 2020 is tabulated with probability of different confidence level. Then, forecast values for 2021 – 2025 were obtained by accumulating the mean obtained to the time year ahead.

Secondly, for data based on year is simpler. Forecast value for 2021 was obtained by using the 10 years data given for each trigger and then ARIMA function in '*R Studio*' was used and assumed to be the same until next four years.

Since this model is provide for organizations, we do not have sufficient data point to consider it is individual metrics. The triggering event is measure based on a suite of metrics and correlation may or may not involve depending on the assumption to the model. In this case, many researchers have done their studies theoretically on these but quite hard to find the exact value of the correlation for every trigger but proved as in table value on the correlation when compared with 5% p-value. Therefore, assumption made is the triggers are independent of each other.

Trigger	p-value	Correlation Result
Tobacco – Air Pollution	0.195	Positive
Alcohol – Hypertension	0.805	Positive
Obese - Hypertension	0.915	Positive

Table C-15: Correlation Results using 'R Studio'

In our point of view, this design has sufficient requirement to insure in a country considering the data given. However, there may be some drawbacks in terms of its accuracy as we only assume six countries for each imaginary country. Higher number of countries assumed to be in the same group would likely lead to greater accuracy.

Appendix D - Revenue Analyst

Section D1: Revenue Components

To estimate the percentage of revenue from each product, we research the percentage of total health expense of people in US. The figure D-1 shows the total amount of money people in United States spend on health service in 2018. Then rate of each parameter in total revenue is calculated from this information given.

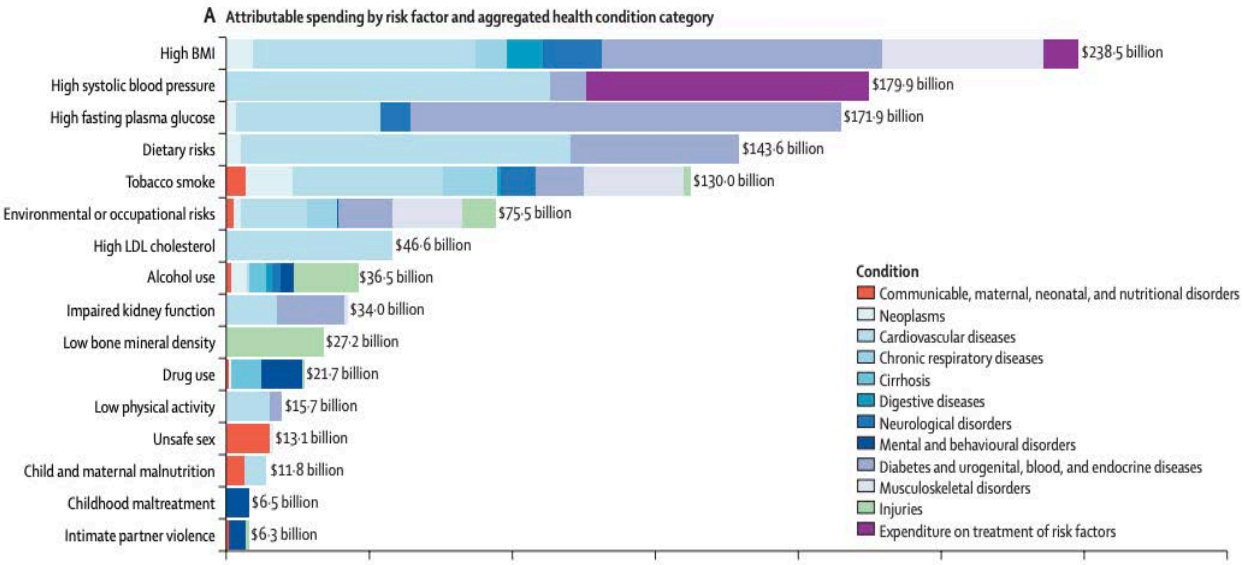

Figure D-1 Health Spending by risk factor (Source: www.thelancet.com)

From these information, we also calculated the percentage of each parameter components:

Parameter	Percentage
Obesity	36%
Hypertension	27%
Daily Smoker	20%
Air Pollution	11%
Alcohol	6%

Table D-1 Percentage of Parameter

Section D2: Revenue and Expense Calculation

- Information and Formula in Developing pure Premium Projects tables can be found in Excel File attached, in Sheet "Revenue Estimate", Cell A1:E42.
- Information and Formula in Expected value of expense for each product in Q4 2021 table can be found in Excel File attached, in Sheet "Revenue Estimate", Cell A45:E94.
- Information and Formula in Percentage of Trigger Events table can be found in Excel File attached, in Sheet "Revenue Estimate", Cell A154:F179.
- Present value of Expected Payout and worse scenarios in Q4, 2021 table can be found in Excel File attached, in Sheet "Revenue Estimate", Cell A96:D121.
- Revenue and Expense Projection in 5 years table can be found in Excel File attached, in Sheet "Revenue Estimate", Cell A124:E137.
- Revenue and Expense Projection in 10 years table can be found in Excel File attached, in Sheet "Revenue Estimate", Cell D140:J151 and D186:K196.

Section D3: Sensitive Analyst Calculation

- Information and Formula in Sensitivity Analysis of $(Expense\ for\ parameter\ insurance\ )/(Total\ expense\ for\ insurance)$ to revenue in Q4, 2021 can be found in Excel File attached, in Sheet "SA", Cell A1: L41.
- Information and Formula in Sensitivity Analysis of Sensitivity Analysis of $(Expense\ for\ parameter\ insurance\ )/(Total\ expense\ for\ insurance)$ to income in five year can be found in Excel File attached, in Sheet "SA", Cell A1: L41.
- Information and Formula in Sensitivity Analysis of Market Share and Take-Up rate in Q4, 2021 can be found in Excel File attached, in Sheer "SA", Cell A48:K69.

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