



MAKERERE

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COLLEGE OF BUSINESS AND MANAGEMENT SCIENCES (CoBAMS)

SCHOOL OF STATISTICS AND PLANNING

**A PRICING AND PROFIT TESTING MODEL FOR
A UNIT-LINKED MICRO INSURANCE PLAN FOR UGANDAN MIGRANT
WORKERS (DIASPORA)**

BY

JASPER OBETE

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**A MODEL SUBMITTED TO THE SCHOOL OF STATISTICS AND
PLANNING IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN ACTUARIAL
SCIENCE**

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DECLARATION

I, Jasper Obete hereby declare that the information contained in this dissertation report is my own authentic ideas and work, which has never been submitted to any college, University or institution for an academic award.

Signature:  Date: 18/09/2025

APPROVAL

This research project has been submitted for examination with my approval as the Student's University supervisor.

Signature: S. Memon..... Date: 24/01/2025.....

Ms. SHAHEEN MEMON

Lecturer,

Department of Statistics and Actuarial Sciences,

School of Statistics and Planning,

College of Business and Management Sciences (CoBAMS),

Makerere University.

DEDICATION

I dedicate this project to my beloved parents, Mr. John Bosco Ocwer and Mrs. Santa Rose Amolo for their immense sacrifice, prayers and material support that enabled me to complete this project successfully.

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LIST OF ACRONYMS

CPI-Consumer Price Index

EPRC-Economic Policy Research Centre

EPV-Expected Present Value

FDI-Foreign Direct Investment

GWP-Gross Written Premium

IFOA-Institute and Faculty of Actuaries (UK)

IOM-International Organization for Migration

IRA-Insurance Regulatory Authority (Uganda)

LMIC-Low- and Middle-Income Countries

NPHC-National Population and Housing Census

NPHS-National Population and Housing Survey

NPV-Net Present Value

ODA-Official Development Assistance

OECD-Organisation for Economic Co-operation and Development

UAE-United Arab Emirates

UBOS-Uganda Bureau of Statistics

UG.SHS / UGX-Ugandan Shillings (currency)

UK-United Kingdom

ULIP-Unit Linked Insurance Plan/Product

USA-United States of America

USD -United States Dollar

ABSTRACT

The main objective of this dissertation project was to design a unit-linked microinsurance product for Ugandan migrant workers, which provide financial protection in the event death of the policyholder, surrender, permanent disability or survival of the policyholder to the end of the policy term along with a structured investment element. The product seeks to create a secure, efficient, and transparent way to remit funds, along with a structured investment element and essential life insurance protection for policy holders and their families in Uganda. The pricing and profit testing techniques was adopted in the design of the models for the calculation of appropriate premiums that would be paid by each eligible individual based on certain factors. The factors considered for this model were age, sex and policy term. Other factors include the demographic profile of the migrant workers, income levels, and specific financial goals and aspiration of the intending policyholder.

The policy design considered majorly three decrements, that is, death, permanent disability and Surrender. Actuarial techniques were used and assumptions were taken for the interest rate of 17.41%, a risk discount rate of 18.41%, initial expense of 15% and renewal expense of 5% of premiums, initial commission of 25% and renewal commission of 3.5% of premium, a management charge of 2%, inflation rate of 3.3% and mortality and disability tables were the Kenyan tables deflated to 90%, Premiums were calculated based on the Actuarial principle of Equivalence, this was achieved by balancing equation of value to zero. This process helped to determine appropriate premium to be charged for a specific individual and profits testing involved determining Profits margins over various ages and policy terms which was done in Microsoft Excel for a 25-year-old both male and female. Generalization of the model was done in Python to be able to generate results for various ages across different policy terms. Sensitivity analysis was also done in Microsoft Excel to understand the relationship between premiums and profits margins across various ages and policy terms when each of the assumed variables change while holding others constant.

The output show that for a male policyholder between 25 years to 45 yours old, the annual premiums generally ranged between **UGX.1,317,042** and **UGX.4,944,196** while profits margins ranged from **3.56%** to **6.71%** for the policy term of 5-10 years. The results also indicate that premiums generally increase with the age of inception of the policy while profits margins decline with increase in age of policy inception across all the policy terms. Overall, the product was more profitable for a 31-year-old male across all terms compared to other ages.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This introductory chapter brings forward deep understanding the importance of the project to design a unit-linked insurance product for Ugandan Migrant workers. It starts by defining insurance and the product, it then proceeds by placing the product into a larger context of the global and national remittance flows, showcasing Uganda's growing dependence on support from its Diaspora population. The chapter further clearly outlines the specific problems and challenges related to the current use of these crucial funds (remittances), especially their potential mismanagement and investment in unproductive or low-quality ventures. This chapter also states the main objective as well as other objectives of the product and the wider effects this plan may have on Uganda's ongoing social and economic development.

1.2 Background

Insurance is an agreement/contract between the insurer (company) and the insured (individual/firm/institution), where the insurer promises to pay the insured a certain amount of money (Sum Assured) in return to premiums paid by the insured, in case of happening of an uncertain event stated in the contract.

A Unit-Linked Insurance Plan (ULIP) is a unique financial tool that combines the benefits of life insurance with investment options tied to the market. The policyholder's premium is divided: part goes towards life coverage, creating a vital safety net, while the rest is invested in different fund options, like equity, debt or hybrid funds, based on the policyholder's risk preference.

The "Diaspora Family Support ULIP" is an innovative Unit-Linked Insurance Plan/product (ULIP) designed for the Ugandan migrant workers (diaspora) who seek to secure their families in Uganda, get life cover and grow their capital through remittances. Its main objective is to create a secure, efficient, and transparent way to remit funds, along with a structured investment element and essential life insurance protection for policy holders and their families in Uganda.

The dual nature of this product shifts the use of remittances from a basic means of survival into a powerful tool for building wealth and resilience for Ugandan families thus ensuring greater peace of mind for the policy holders and their families

The Diaspora Family support ULIP was designed for Ugandan diaspora population who will pay premiums to the insurer (Insurance Company) and in case of death, permanent disability, surrender or survival to the end of the policy term, the insured receive benefits from the insurer.

The flow of remittances has become a significant force in the global financial system, greatly affecting the economies of low-and middle-income countries (LMIC). These private transfers from migrant workers have moved beyond being simple supplements to household income to primary source of external financing(AESC, 2024; Helen Murphy, 2024).

In 2023, global remittances were estimated to be USD 656 billion going specifically to LMICs. This amount is roughly four times the total Official Development Assistance (ODA) provided by OECD countries that same year. Remittances consistently exceed both Foreign Direct Investment (FDI) and ODA as sources of capital for developing economies(AESC, 2024). As such, a financial tool like Diaspora Family Support ULIP aimed at optimizing these flows have shifted from welfare programs to essential components of national economic strategy(Wampamba, 2025). Research show that the impact of remittances reaches about one (1) billion people worldwide, underscoring their widespread effect on livelihood and development.

Uganda in particular, has seen a steady and significant rise in remittance inflows over the past decade, reaching a record of USD 1.42 Billion in the years leading to January 2024, a 13.4% increase from the previous year's USD 1.25 Billion(Jude Sebuliba, 2025).

A 2023 world Bank Report highlights Uganda's diverse migration patterns. About 40% of remittances originate from United States (USA) and United Kingdom (UK), where Uganda's professionals have established themselves in healthcare, finance and education. The Middle East, particularly Saudi Arabia, the UAE and Qatar contribute about USD 500 million in remittance representing 35%, primarily from Ugandans engaged in domestic work, security and construction. Kenya accounts for USD 100 million representing 7%(Jude Sebuliba, 2025), highlighting the growing role of intra- regional migration. This difference suggests that a single financial product may not effectively serve this diverse market(Wampamba, 2025). Thus, the Diaspora Family Support ULIP was designed considering flexibility aspects such as tiered

premium options for smaller, more frequent contributions, a variety of investment fund options (like bonds, equity and other money market instruments) depending on the risk appetite of the policy holder. This approach could better address the diverse needs of these groups, improve market reach and user adoption.

The 2024 National Population and Housing Census (NPHS) reveals that 1.5% of Uganda's 10.6 million households received remittances in the past year (Source: UBOS 2024 NPHC Report). The 2024 NPHC also reveals that from the remittances received by households, about 25% goes towards food and daily necessities, 17% to education, and the remainder to healthcare, housing and small business investment. It is estimated that up to a quarter of total remittances are used for income generating activities and long-term goals, including housing, savings, and investments. This shows that remittances are not just for immediate use, they play active role in building human capital and productive assets(Jude Sebuliba, 2025). The Diaspora Family Support ULIP, by facilitating and structuring these long-term investments presents the transformative potential of remittances by utilizing them effectively, consequently contributing directly to achieving Sustainable Development Goals (SDGs) such as better education, healthcare and poverty eradication. Therefore, the Diaspora Family Support ULIP stands as a powerful development tool, moving beyond a simple financial product to a means of sustainable socio-economic improvement.

1.3 Problem Statement

Despite their importance, remittances coming into Uganda faces several problems that reduce their overall impact. A significant challenge this product design seek to solve is funds being mismanaged by intermediaries or invested in poor and unproductive ventures(Jude Sebuliba, 2025). This problem worsens with inadequate customer support, particularly for mobile money transfers. For example, when funds are sent to wrong number, they can usually be recovered if they haven't been withdrawn yet by unintended recipient. The irreversible nature of many digital transactions also creates anxiety for senders (Diaspora population) about whether their money is delivered correctly. This reflects a major breakdown of trust in the traditional remittance system. Research shows high transaction fees, reliance on informal channels, low financial literacy, and poor support for errors contribute to lack of trust in the traditional remittance systems. These factors make senders (Diaspora population) doubt whether their hard-earned money will truly help their families and support long-term goals. This lack of trust

and effective investment options means a large part of remittances, meant for family support and growth could be misused, spent incorrectly or return less than expected

Additionally, low financial literacy among recipients hinders the productive use of remittances, leading some to fall victim to exploitative middlemen who charge unnecessary fees. A 2023 study by the International Organization for Migration (IOM) found that nearly 30% of Ugandan remittance recipients did not know about investment opportunities (Jude Sebuliba, 2025). This seriously limits the long-term benefits of these funds. While some remittances serve long-term goals, the lack of suitable investment tools restrict the diaspora's ability to invest effectively in their home country. This presents a major untapped opportunity for national development. Both the capital and desire to invest are there, but accessible, reliable, and structured ways to guide this capital into productive projects are mostly missing.

1.4 Objectives of the Study.

Main Objective of this project

To design a unit-linked microinsurance product for Ugandan migrant workers, which provide financial protection in the event death of the policyholder, surrender, permanent disability or survival of the policyholder to the end of the policy term along with a structured investment element.

The Specific objectives

To design a low-premium unit-linked microinsurance product that is affordable and accessible to Ugandan migrant workers, considering their income patterns and working conditions.

To develop a sustainable and profitable microinsurance product that is attractive to insurers, encouraging them to extend coverage beyond the borders of Uganda.

To create a secure, efficient, and transparent way to remit funds, along with a structured investment element and essential life insurance protection for Ugandan Migrant workers and their families in Uganda through insurance plan.

To address the significant gaps in the current remittance practices, providing a complete solution for long-term family financial security and wealth creation ensuring peace of minds for Ugandan migrant workers and beneficiaries through insurance plan.

Other Objectives

To guide diaspora capital/remittance into productive sector in Uganda thereby fueling national Economic Growth.

To increase insurance uptake as well as contribute to Gross Written Premiums (GWP) which will fuel Economic Growth of Uganda.

To create an affordable insurance plan for the Ugandan migrant workers.

To increase the product range available to Ugandan migrant workers thereby increasing insurance uptake as well as reducing dependence on a single or very few products.

1.5 Demographic Scope

The key demographic factors considered for this model were age, sex and policy term. However, other factors like demographic profile of the migrant workers, income levels, and specific financial goals and aspiration of the intending policyholder will be considered while selling the product to the migrant workers.

Migrant workers between ages of 25-45 was considered due to several reasons like working age in the host countries, average age at which Ugandans join the workforce after completing studies and various articles that show that most Ugandans migrant workers fall between that threshold.

1.6 Significance of the study

The successful completion and deployment of this product will contribute to the efforts by insurers and Insurance Regulatory Authority (IRA) to create more products to increase the uptake of insurance policies which in turn increase insurance penetration in Uganda and world over. This research project will provide evidence that more profitable microinsurance products can be created, this will cause insurers to increase their product range available for Diaspora population. Additionally, once the ULIP has been launched to the market, the families of the policyholder will get financial cover when claims are made and approved.

CHAPTER TWO

MODEL ASSUMPTIONS

2.1 Introduction

This chapter covers the basis of the pricing and profits model. It covers the assumptions that were used to develop the pricing and profits testing models. The section further explains the sources of some of the assumptions as shown below;

Table 2. 1 Assumptions of the Model

Assumption	Value
Sum assured	UGX 33,300,000
Initial expenses	15% of premium
Renewal expenses	5% of premium
Initial commission	25% of premium
Renewal commission	3.5% of premium
Mortality	90% of Kenyan Mortality
Disability rates	90% Kenyan disability rates
Surrender rate	0% in the first and last year, 10% in 2 nd -6 th policy years, and 5% in 7 th -9 th policy years
Inflation rate	3.3%
Allocation in first year	60%

Allocation in other years	98%
Bid offer spread rate	5%
Unit fund interest rate	17.41%
Management charge	2%
Risk discount rate	18.41%
Non – unit fund interest rate	17.41%
Death benefit	Sum assured or unit fund value at end of year
Surrender benefit	65% of the premiums paid so far
Maturity benefit	100% of fund value at the end of final policy year
Disability benefit	110% of unit fund value at year end

2.2 Explanation and sources of Assumptions

Mortality and disability rates; These were extracted from Kenyan Mortality and Disability tables respectively. However, the rates were deflated by a factor (0.90) to cater for lower risks of death and disability due to the fact that Ugandans in diaspora live and work in developed or upper middle-income countries with better standards of living and have well-developed healthcare systems.

Surrender rates; these were extracted from the institute and faculty of actuaries (IFOA) past papers.

Interest rate; This was obtained from the bank of Uganda interest on a 10-year bond for May 2025.

Unit and non-unit fund interest rates; These were obtained from bank of Uganda interest rates on a 10-year bond issued as of May 2025.

Risk discount; This is based on the interest rate on issued bonds from which 1 is added to obtain the risk discount rate as advised by industry experts. It indicates the rate at which the insurer is willing to take on the risks associated with the policy.

Management charge; the management charge adopted is the rate charged by some of the Ugandan fund managers like UAP old mutual(*Umbrella Trust Fund March 2023,2023*)

Initial and renewal expenses and commission; the adopted rates for expense were based on the industry benchmarks for different insurers while the initial commission is based on IRA guideline(*Insurance-Minimum-and-Maximum-Amendment-Regulations-2023.Pdf, 2023*)

Inflation rate; this was obtained from bank of Uganda(CPI data) for May 2025(Bank of Uganda, 2025).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the several formulae and techniques used in the pricing and profit testing models and the software used.

3.2 Software

Microsoft Excel was initially used to develop a pricing and profit testing model for a single life, a 25-year-old male and female with a policy term of ten years under the various assumptions. The same procedure was then carried out in Python 3.13.3 thereby writing a program that automates the pricing and profit testing models that were built in Microsoft Excel given ages and policy terms, depending on the input by the user.

3.3 Formulae

The table below shows the formulae used in the model, defining all the terms and symbols mathematically.

Table 3. 1 Multiple decrement formulae

output	Formulae
$(aq)_{x^d}$	$q_{x^d} (1 - \frac{1}{2}(q_{x^w} + q_{x^b}) + \frac{1}{3} (q_{x^w} * q_{x^b}))$
$(aq)_{x^w}$	$q_{x^w} (1 - \frac{1}{2}(q_{x^d} + q_{x^b}) + \frac{1}{3} (q_{x^d} * q_{x^b}))$
$(aq)_{x^b}$	$q_{x^b} (1 - \frac{1}{2}(q_{x^d} + q_{x^w}) + \frac{1}{3} (q_{x^d} * q_{x^w}))$

$(ap)_x$	$1 - [(aq)_x^d + (aq)_x^w + (aq)_x^b]$
${}_{t-1}(ap)_x$	<i>1 in the first year</i> $(ap)_x * {}_{t-1}(ap)_x$

Table 3. 2 Pricing and profit testing formulae

Output	Formula
Discount factor	$(1 / (1 + \text{risk discount rate}))^{\text{year}}$
Death benefit	Sum Assured
EPV Death Benefit	Death Benefit * $(aq)_x^d$ * Discount factor
Survival Benefit	Fund value in final policy year
EPV Survival	Survival Benefit * ${}_{t-1}(ap)_x$ * Discount Factor

Disability Benefit	Sum assured
EPV Disability Benefit	Disability Benefit * $(aq)x^b$ * Discount Factor
Surrender Benefit	65% * premiums paid so far.
EPV of Surrender Benefit	Surrender Benefit * $(aq)x^w$ * Discount Factor
Expenses	Initial Expenses; 15% * Premium Renewal Expenses; 5% * Premium * $((1 + \text{inflation rate})^{(\text{year} - 1)})$
EPV of expenses	Initial Expense * $t-1(ap)x$ * Discount Factor Renewal Expense * $t-1(ap)x$ * Discount Factor
Commission	Initial; 25% * Premium Renewal; 3.5%*Premium
EPV of commission	Commission * $t-1(ap)x$ * Discount Factor
Premium	Assumed Premium (Before Goal Seek)
EPV Premium	Premium * $t-1(ap)x$ * Discount factor
Equation of Value	Income (EPV Premium) – Outgo (EPV of death, survival, surrender and disability benefits + EPV of expenses +EPV of commission)

Premium Allocated	60% * Premium in the first year for the first-year allocation 98% * subsequent premiums in other years
Bid/Offer spread	5% * Allocated Premium
Cost of Allocation	Premium Allocated – Bid/Offer spread
Fund after allocation	Fund at the end of year for previous year + Cost of allocation
Fund before management charge	Fund after allocation * (1+ Unit Fund interest rate)
Management Charge	2% * Fund before management charge
Bid value of units	Fund before management charge – Management charge
Premium less Cost of Allocation	Unallocated premium (Premium received – Premium Allocated) + Bid/Offer spread
Initial Expenses	15% * Premium
Renewal Expenses	5% * Premium * ((1+ inflation rate) ^ (year-1))
Initial Commission	25% * Premium
Renewal Commission	3.5% * Premium

Interest gained in Non – unit Fund	Non-unit interest rate * (Premium less Cost of Allocation– Expenses – Commission)
Extra Death Cost	$\max [(aq)x^d * (\text{Sum Assured} - \text{Fund at year end}), 0]$
Extra Disability Cost	$\max [(aq)x^{di} * (\text{Disability Benefit} - \text{Fund at year end}), 0]$
Expected Surrender Penalty	$35\% * \text{Unit fund value at year end} * (aq)x^w$
Profit Vector	(Unallocated premium + Bid offer spread + Interest + Management charge + Expected surrender Penalty) - (Expenses + Commission + Extra Death Cost + Extra Disability Cost)
Discount Factor (profits)	$(1 / (1 + \text{risk discount rate}))^{\text{year}}$
Discount Factor (premiums)	$(1 / (1 + \text{risk discount rate}))^{(\text{year}-1)}$
Discounted Profits	Profit Signature * Discount Factor (profits)
Discounted Premiums	$\text{Premiums} * t-1(ap)x * \text{Discount Factor (premiums)}$
NPV of profits	Sum of discounted profits
NPV of premiums	Sum of discounted premiums
Profit Margin	NPV of profits /NPV of premiums

3.4 Description of symbols

q_x^d : independent probability of death

q_x^b : independent probability of disability

q_x^w : independent probability of withdrawal/surrender

$(aq)x^d$: dependent probability of death

$(aq)x^b$: dependent probability of disability

$(aq)x^w$: dependent probability of withdrawal/surrender

$(ap)x$: dependent probability of survival

${}_{t-1}(ap)x$: cumulative probability of a policy being in-force at the start of each year

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the results for both pricing and profits testing models. Sensitivity analysis is also included to show how the profit margin and the premium can be affected by changes in some key assumptions used in building these models, for instance, interest rates, inflation and the policy term among other assumptions.

4.2 Results from the model

The results presented herein are based on a healthy 25-year-old male or female, who purchases a 10-year term policy with sum assured of UGX. 33,300,000.

4.2.1 Multiple decrements

In this section, the multiple decrement tables for both males and females are presented. For each of these tables, the dependent and independent probability rates are captured.

Table 4. 1 Multiple decrements for male life

Age	qxd	qxb	qxw	(aq)xd	(aq)xb	(aq)xw	(ap)x	t-1(ap)x
25	0.001767	0.000531	0.0000	0.001766	0.000531	0.000000	0.9977032	1.0000000
26	0.001795	0.000531	0.1000	0.001704	0.000504	0.099884	0.8979078	0.9977032
27	0.001795	0.000531	0.1000	0.001704	0.000504	0.099884	0.8979078	0.8958455
28	0.001774	0.000531	0.1000	0.001685	0.000504	0.099885	0.8979264	0.8043867
29	0.001739	0.00054	0.1000	0.001651	0.000513	0.099886	0.8979499	0.7222800
30	0.001697	0.000549	0.1000	0.001612	0.000521	0.099888	0.8979791	0.6485713
31	0.001656	0.000567	0.0500	0.001614	0.000552	0.049944	0.9478890	0.5824034
32	0.001623	0.000585	0.0500	0.001582	0.000570	0.049945	0.9479036	0.5520538
33	0.001604	0.000621	0.0500	0.001563	0.000605	0.049944	0.9478874	0.5232938
34	0.001608	0.000657	0.0000	0.001608	0.000656	0.000000	0.9977358	0.4960236

Table 4. 2 Multiple decrement table for a female life

Age	qxd	qxb	qxw	(aq)xd	(aq)xb	(aq)xw	(ap)x	t-1(ap)x
25	0.001621	0.000414	0.0000	0.0016206	0.0004137	0.000000	0.9979658	1
26	0.001607	0.000405	0.1000	0.0015259	0.0004353	0.099899	0.8981394	0.997966
27	0.00157	0.000405	0.1000	0.0014908	0.0004341	0.099901	0.8981737	0.896312
28	0.001516	0.000414	0.1000	0.0014395	0.0004410	0.099904	0.8982159	0.805044
29	0.001451	0.000414	0.1000	0.0013780	0.0004389	0.099907	0.8982763	0.723104
30	0.001381	0.000423	0.1000	0.0013113	0.0004453	0.099910	0.8983336	0.649547
31	0.00131	0.000432	0.0500	0.0012774	0.0004422	0.049956	0.9483240	0.58351
32	0.001247	0.00045	0.0500	0.0012159	0.0004587	0.049958	0.9483677	0.553356
33	0.001197	0.000477	0.0500	0.0011668	0.0004842	0.049958	0.9483908	0.524785
34	0.001165	0.000504	0.0500	0.0011352	0.0005100	0.049958	0.9483965	0.497701
35	0.001155	0.000531	0.0000	0.0011544	0.0005307	0.000000	0.9983149	0.472018

4.2.2 Pricing model

Pricing was based on the basic Actuarial Principle of Equivalence, that is, EPV income = EPV outgo. Outgo includes the expenses, commissions and the claims paid by the insurer inform of death, survival, disability and surrender benefits while income is the premium paid by the policyholder.

The pricing results presented here are for the 25-year-old male policyholder.

Table 4. 3 Expected Present Value of Premiums

TIME	PREM	t-1(apx)*	Discount	EPV
0	1,317,217	1.0000000	1.000000	1,317,217.070679
1	1,317,217	0.9977032	0.851716	1,119,318.402654
2	1,317,217	0.8958455	0.725420	856,012.877233
3	1,317,217	0.8043867	0.617852	654,646.653045
4	1,317,217	0.7222800	0.526235	500,659.673530
5	1,317,217	0.6485713	0.448203	382,903.760584
6	1,317,217	0.5824034	0.381742	292,853.724372
7	1,317,217	0.5520538	0.325135	236,430.315036
8	1,317,217	0.5232938	0.276923	190,880.794576
9	1,317,217	0.4960236	0.235860	154,103.990388
T.EPV INCOME				5,705,027

Table 4. 4 Expected Present Value of Death & Survival

TIME	SUM ASSURED	DISCOUNT	(aqx)d*	EPV
1	33,300,000	0.851716208	0.0017662	50,094
2	33,300,000	0.725420499	0.0017044	41,173
3	33,300,000	0.617852397	0.0017044	35,068
4	33,300,000	0.526234901	0.0016848	29,523
5	33,300,000	0.448202794	0.0016514	24,648
6	33,300,000	0.381741584	0.0016121	20,493
7	33,300,000	0.325135495	0.0016141	17,476
8	33,300,000	0.276923171	0.0015817	14,585
9	33,300,000	0.235859953	0.0015632	12,278
10	33,300,000	0.200885745	0.0016078	10,755
10	33,300,000	0.200885745	0.496023585	3,318,147
T. DEATH&SURVIVAL				3,574,241

Table 4. 5 Expected Present Value of Commission

TIME	COMMISION	t-1(apx)*	DISCOUNT	EPV
0	329,304	1	1	329,304
1	46,103	0.99770324	0.851716208	39,176
2	46,103	0.89584551	0.725420499	29,960
3	46,103	0.80438667	0.617852397	22,913
4	46,103	0.72228004	0.526234901	17,523
5	46,103	0.64857129	0.448202794	13,402
6	46,103	0.58240344	0.381741584	10,250
7	46,103	0.55205383	0.325135495	8,275
8	46,103	0.5232938	0.276923171	6,681
9	46,103	0.49602358	0.235859953	5,394
			T. COMMISION	482,878

Table 4. 6 Expected Present Value of Expenses

TIME	EXPENSES	t-1(apx)	DISCOUNT	EPV
0	197,583	1	1	197,583
1	65,861	0.997703238	0.851716	55,966
2	67,837	0.895845515	0.72542	44,085
3	69,872	0.804386671	0.617852	34,726
4	71,968	0.72228004	0.526235	27,354
5	74,127	0.648571292	0.448203	21,548
6	76,351	0.582403437	0.381742	16,975
7	78,641	0.55205383	0.325135	14,116
8	81,001	0.523293799	0.276923	11,738
9	83,431	0.496023585	0.23586	9,761
			T. EXPENSES	433,850

Table 4. 7 Expected Present Value of Disability Cost

TIME	SUM ASSURED	DISCOUNT	(aqX)b	EPV OF DIABILITY
1	33,300,000	0.851716	0.000531	15,047.001522
2	33,300,000	0.725420	0.000504	12,175.545091
3	33,300,000	0.617852	0.000504	10,370.109097
4	33,300,000	0.526235	0.000504	8,832.475369
5	33,300,000	0.448203	0.000513	7,650.392287
6	33,300,000	0.381742	0.000521	6,624.690575
7	33,300,000	0.325135	0.000552	5,980.653493
8	33,300,000	0.276923	0.000570	5,255.612740
9	33,300,000	0.235860	0.000605	4,751.798083
10	33,300,000	0.200886	0.000656	4,391.465336
			T. DISABILITY COST	81,079.743594

Table 4. 8 Accumulated Premium

TIME	PREMIUM
0	1,317,217
1	2,634,434
2	3,951,651
3	5,268,868
4	6,586,085
5	7,903,302
6	9,220,519
7	10,537,737
8	11,854,954
9	13,172,171

Table 4. 9 Expected Present Value of Surrender Cost

TIME	SURRENDER COST	DISCOUNT	(aq)w*	EPV
1	856,191	0.851716	0	0
2	1,712,382	0.72542	0.099883752	124,075
3	2,568,573	0.617852	0.099883752	158,515
4	3,424,764	0.526235	0.099884786	180,015
5	4,280,955	0.448203	0.099886091	191,655
6	5,137,147	0.381742	0.099887711	195,886
7	5,993,338	0.325135	0.049944441	97,324
8	6,849,529	0.276923	0.049944823	94,735
9	7,705,720	0.23586	0.049944397	90,772
10	8,561,911	0.200886	0	0
T. SURRENDER				1,132,979

Table 4. 10 Output of the Pricing Model After Goal Seek

TOTAL INCOME	5,705,027
TOTAL OUTGO	5,705,027
EQUATION OF VALUE	0
EXPECTED PREMIUM	1,317,217

4.2.2 Explanation of the pricing model

The above output show that Equation of value does balance, the Expected Present Value (EPV) of Income and Outgo are **UGX, 5,705,027** respectively. After what-if analysis with Goal seek, the accurate Premium that should be charged to a 25-year-old client who buys a 10-year policy is **UGX. 1,317,217** annually.

However, before this accurate value of premium is obtained using Goal Seek function, an assumed premium was used and all calculations were based on that assumed premium. The Goal seek analysis (in MS Excel) performs iteration in all cells to obtain the accurate premium and consequently all the values in the model are adjusted to the accurate premium after goal seek.

4.2.3 Profits Testing model

To determine whether the product designed will be profitable to the insurance companies/brokers or not, the profits testing model was developed. This model consists of a unit-fund and non-unit fund discounted cashflows.

When premium is paid by the insured/policyholder, a portion of premium is allocated to the unit-fund and the remainder to the non-unit fund. The portion of premiums in the unit-fund is invested in a relatively safe assets like bonds and equity to generate returns. The remaining portion (non-unit fund) goes to insurance cover and represents the profits to be earned by the insurer (insurance company) for the sale of policy. This is achieved by taking into account all the expenses (outgoes) and incomes (inflows) associated with each policy year.

The Net Present Value (NPV) of profits and NPV of Premiums are then obtained from the non-unit fund and unit funds respectively. The profits Margin was obtained by expressing NPV of Profits as a percentage of NPV of Premiums. For this particular model, the profits margin is 6.5% as shown in the tables below;

Table 4. 11 Unit-Fund Value

UNIT FUND VALE(MALE)									
TIME	AGE	PREMIUM	ALLOC PREM	B/O SPREAD	COST ALLOC	FUND AFTER ALLOC	FUND B4 MGT CG	MGT CG	BID VALUE OF UNITS
1	25	1,317,217	790,330	39,517	750,814	750,814	881,530	17,631	863,900
2	26	1,317,217	1,290,873	64,544	1,226,329	2,090,229	2,454,138	49,083	2,405,055
3	27	1,317,217	1,290,873	64,544	1,226,329	3,631,384	4,263,608	85,272	4,178,336
4	28	1,317,217	1,290,873	64,544	1,226,329	5,404,665	6,345,617	126,912	6,218,705
5	29	1,317,217	1,290,873	64,544	1,226,329	7,445,034	8,741,214	174,824	8,566,390
6	30	1,317,217	1,290,873	64,544	1,226,329	9,792,719	11,497,631	229,953	11,267,679
7	31	1,317,217	1,290,873	64,544	1,226,329	12,494,008	14,669,215	293,384	14,375,830
8	32	1,317,217	1,290,873	64,544	1,226,329	15,602,160	18,318,496	366,370	17,952,126
9	33	1,317,217	1,290,873	64,544	1,226,329	19,178,455	22,517,424	450,348	22,067,075
10	34	1,317,217	1,290,873	64,544	1,226,329	23,293,404	27,348,786	546,976	26,801,810

Table 4. 12 Non-Unit Fund Value

NON-UNIT FUND VALUE-MALE

TIM E	AG E	PREMIU M	(PREM- COST OF ALLOCATI ON)	EXPENS ES	COMMISSI ON	INTERE ST	EXTRA DISABILI TY COST	EXTR A DEAT H COST	EXTRA SURREND ER COST	MGT CHG	PROFI T VECT OR
1	25	1,317,217	566,403	197,583	329,304	6,880	46	57,290	0	17,631	6,691
2	26	1,317,217	90,888	65,861	46,103	-3,669	121	52,658	46,049	49,083	17,608
3	27	1,317,217	90,888	67,837	46,103	-4,013	211	49,636	46,049	85,272	54,410
4	28	1,317,217	90,888	69,872	46,103	-4,368	313	45,626	46,049	126,912	97,569
5	29	1,317,217	90,888	71,968	46,103	-4,732	439	40,846	46,050	174,824	147,675
6	30	1,317,217	90,888	74,127	46,103	-5,108	587	35,518	46,051	229,953	205,448
7	31	1,317,217	90,888	76,351	46,103	-5,496	794	30,546	23,026	293,384	248,009
8	32	1,317,217	90,888	78,641	46,103	-5,894	1,023	24,275	23,026	366,370	324,347
9	33	1,317,217	90,888	81,001	46,103	-6,305	1,335	17,560	23,026	450,348	411,959
10	34	1,317,217	90,888	83,431	46,103	-6,728	1,759	10,448	0	546,976	489,395

Table 4. 13 NPV of Profits Vector

NPV PROFITS				
YEAR	PROFIT VECTOR	Discount	t-1(apx)	NPV PROFITS
1	6,691	0.844523267	1	5,651
2	17,608	0.713219548	0.997703238	12,529
3	54,410	0.602330502	0.895845515	29,360
4	97,569	0.508682123	0.804386671	39,923
5	147,675	0.429593889	0.72228004	45,822
6	205,448	0.362802034	0.648571292	48,343
7	248,009	0.306394759	0.582403437	44,256
8	324,347	0.258757503	0.55205383	46,332
9	411,959	0.218526731	0.523293799	47,109
10	489,395	0.184550909	0.496023585	44,800
T.NPV PROFIT				364,124

Table 4. 14 NPV of Premiums

NPV PREMIUMS				
YEAR	PREMIUM	Discount	t-1(apx)	NPV PREMIUM
0	1,317,217	1	1	1,317,217
1	1,317,217	0.84452327	0.99770324	1,109,865
2	1,317,217	0.71321955	0.89584551	841,615
3	1,317,217	0.6023305	0.80438667	638,200
4	1,317,217	0.50868212	0.72228004	483,960
5	1,317,217	0.42959389	0.64857129	367,006
6	1,317,217	0.36280203	0.58240344	278,324
7	1,317,217	0.30639476	0.55205383	222,803
8	1,317,217	0.2587575	0.5232938	178,359
9	1,317,217	0.21852673	0.49602358	142,779
T.NPV PREMIUM				5,580,129

Table 4. 15 Profits Margin

PROFIT MARGIN	0.065
	6.50%

4.2.4 Analysis of Results

In this section, premiums and profits margin across ages and policy terms are analyzed to get insights on how the two variables affect returns from the sale of this product. This will help support decision making by the insurers (Underwriters) to ascertain which ages or policy terms are most or least profitable to the insurance company when sold.

4.2.4.1 Profits Margin

The analysis shows that for this product design, profits margin range between 3.56% to 6.71% across all ages and policy terms as shown in the table below;

Table 4. 16 Profits margins across ages and policy terms

AGE	TERM		
	5 yr s	7yrs	10yrs
25	3.89	5.08	6.53
26	3.89	5.09	6.53
27	3.90	5.10	6.57
28	3.91	5.12	6.61
29	3.92	5.14	6.65
30	3.93	5.16	6.69
31	3.94	5.17	6.71
32	3.94	5.17	6.70
33	3.94	5.16	6.67
34	3.93	5.13	6.60
35	3.91	5.09	6.50
36	3.89	5.04	6.37
37	3.85	4.97	6.23
38	3.82	4.91	6.08
39	3.78	4.83	5.92
40	3.74	4.76	5.77
41	3.70	4.69	5.62
42	3.66	4.62	5.48
43	3.63	4.55	5.35
44	3.59	4.49	5.24
45	3.56	4.44	5.14

Profits margin generally increases with increase in policy term and decreases with increase in the policyholder's age as shown in Figure 4.1 below

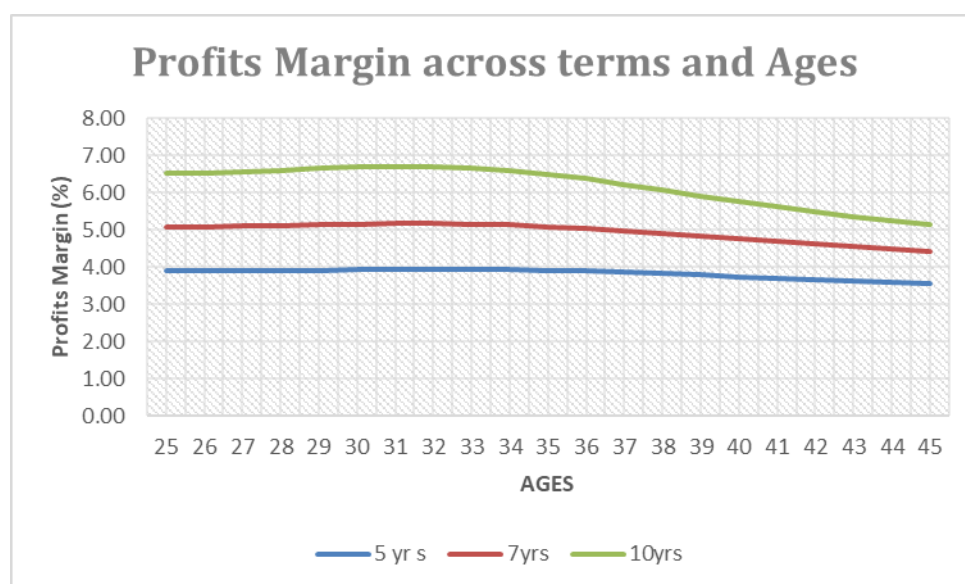


Figure 4. 1 A Line Graph Showing across Ages and Policy Terms

In figure 4.1 above, a 10-year term policy exhibits the highest profits margin across all ages compared to a 5-year term and 7-year policy term respectively. This therefore, show that, generally, the longer the policy term the higher the profits margin and the shorter the policy term, the lower the profits margin. It is also observed that much as profits margin tend to increase with increase in the policy term across all ages, profits margins also tend to decrease as the age of the policyholder increase.

4.2.4.2 Premium

It is observed that expected premiums for this product will range from UGX.1,317,042 to UGX.4,944,196 annually, which is approximately between UGX.109,754 and UGX. 412,016 Monthly for the basic sum assured of UGX. 33,300,000. However, premiums can be calculated based on the policyholder's desired sum assured.

Table 4. 17 Premiums across Ages and policy terms

AGE	TERM		
	5YR	7YR	10YR
25	4,893,975.93	2,876,404.16	1,317,216.34
26	4,893,935.85	2,876,333.10	1,317,253.87
27	4,893,558.23	2,876,029.08	1,317,086.87
28	4,893,008.63	2,875,654.93	1,317,042.03
29	4,892,579.95	2,875,437.90	1,317,457.21
30	4,892,345.44	2,875,484.56	1,318,493.25
31	4,892,555.13	2,875,966.17	1,320,424.88
32	4,893,284.76	2,876,996.80	1,323,367.45
33	4,894,685.97	2,878,657.61	1,327,496.93
34	4,896,732.69	2,880,923.36	1,332,679.18
35	4,899,359.62	2,883,787.42	1,338,900.88
36	4,902,500.17	2,887,147.76	1,345,953.73
37	4,906,068.98	2,890,904.50	1,353,714.19
38	4,910,039.74	2,895,031.98	1,362,099.65
39	4,914,242.51	2,899,400.09	1,370,914.00
40	4,918,782.91	2,904,067.66	1,380,206.08
41	4,923,573.14	2,908,989.82	1,389,877.42
42	4,928,588.93	2,914,100.03	1,399,847.94
43	4,933,731.89	2,919,307.26	1,409,959.56
44	4,938,960.20	2,924,597.55	1,420,254.97
45	4,944,195.82	2,929,898.30	1,430,637.86

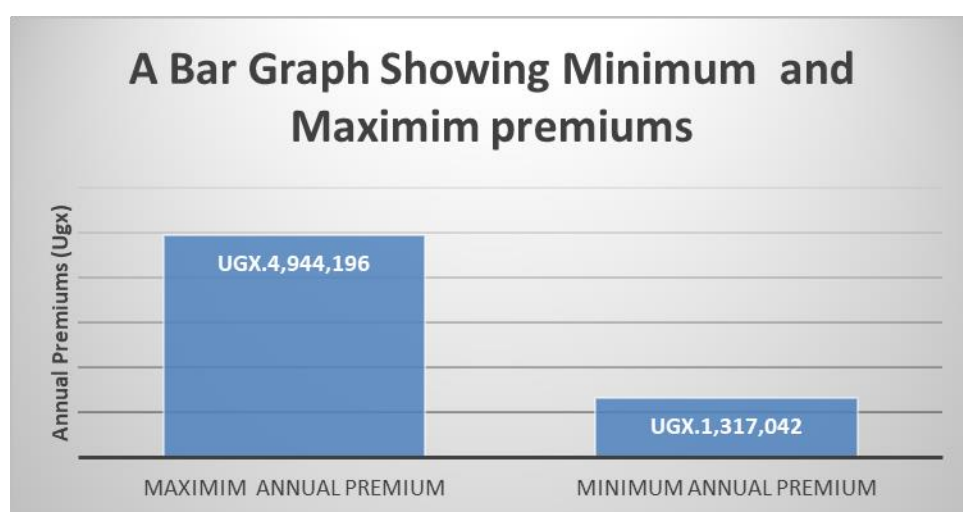


Figure 4. 2 Maximum and minimum premium

The result show that premiums generally decrease with increase in the policy term. This implies that the longer the policy term, the lower the premiums and the lower the policy term, the higher the premiums as shown in Figure 4.2 below;

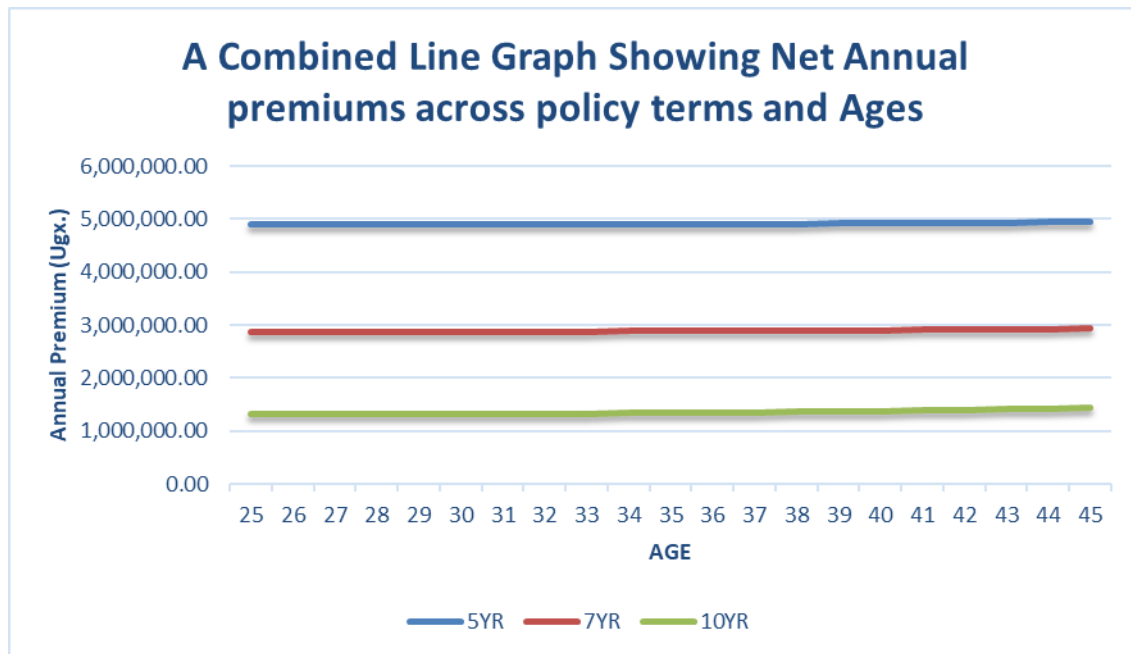


Figure 4. 3 A Combined Line Graph Showing Premiums across Ages and Policy terms

From figure 4.3 above, a 5-year term policy generally has a higher premium compared to a 7-year and a 10-year term respectively. It is also observed that generally, premiums tend to increase with age of the policyholder regardless of the policy term.

4.3 Sensitivity Analysis

This was done to test responsiveness of the model output to changes in some assumptions used to build these models. It is very important to asses these changes due to the fact that certain assumptions considered in building this model like interest rate, inflation rates and others are prone to frequent changes due to the changing market condition and other regulations in local and global financial and asset market. These changes may cause a significant effect on the profits margin of the product. Prior knowledge of these changes will increase the accuracy in premiums determination during policy inception and thus minimizes losses to insurance companies and brokers.

Sensitivity analysis shown in Table 4.18 is based on a healthy 25-year-old male client who purchases a 10-year term policy, with an initial profits margin of 6.5%. the result is achieved by making a 10% increase or decrease in a particular variable while holding other variables/assumptions constant.

Table 4. 18 Sensitivity Analysis.

ASSUPTION	CHANGE	PREMIUM	PROFITS MARGIN	COMMENT
Initial Expense	+ 10%	1,324,376	6.2%	A 10% increase in initial expense causes a 0.3% decline in profits margin
	0	1,317,217	6.5%	While
	-10%	1,310,135	6.9%	A 10% decrease in initial expenses causes a 0.4% increase in profits margin.
Renewal Expense	+10%	1,325,787	6.1%	A 10% increase in renewal expenses causes a 0.4% decline in profits margin
	0	1,317,217	6.5%	While
	-10%	1,308,758	6.9%	A 10% decrease in renewal expense causes a 0.4% increase in profits margin.

Initial Commission	+10%	1,329,192	6.6%	A 10% increase in initial commission has No effect on the profit margin, similarly, a 10% decrease in initial commission has no effect on the profits margin
	0	1,317,217	6.5%	
	-10%	1,305,456	6.5%	
Renewal Commission	+10%	1,322,775	6.5%	A 10% increase in renewal commission has No effect on the profits margin, similarly, a 10% decrease in renewal commission leaves the profits margin constant.
	0	1,317,217	6.5%	
	-10	1,311,706	6.5%	
Inflation	+10%	1,317,863	6.5%	A 10% increase in inflation rate has no effect on the profits margin (constant) While A 10% decrease in inflation rate causes a 0.1% increase in profits margin.
	0	1,317,217	6.5%	
	-10	1,316,579	6.6%	
	+10%	1,317,217	6.1%	
	0	1,317,217	6.5%	

Risk Discount Rate	-10%	1,317,217	6.9%	A 10% increase in risk discount rate leads to a 0.4% decline in profits margin While A 10% decrease in risk discount rate leads to a 0.4% increase in profits margin
Management Charge	+10%	1,317,217	7.3%	A 10% increase in management charge causes a 0.8% increase in profits margin While A 10% decrease in management charge causes a 0.8% decrease in profits margin.
	0	1,317,217	6.5%	
	-10%	1,317,217	5.7%	
Interest Rate	+10%	1,182,610	6.10%	A 10% increase in interest rate causes a 0.4% decline in Profits margin While
	0	1,317,217	6.5%	
	-10%	1,469,201	6.90%	

				A 10% decrease in interest rate causes a 0.4% increase in profits margin
Mortality	+10%	1,328,013	6.3%	10% increase in mortality causes a slight increase in premium and a 0.2% decline in profits margin while A 10% decrease in mortality causes a significant decline in premiums and a 0.3% increase in profits margin.
	0	1,317,217	6.5%	
	-10%	1,306,442	6.8%	

Table 4.18 show results of sensitivity analysis. It is observed that changes in expenses, inflation, interest rate, risk discount rate and mortality rates have inverse relationship with the profits margin. this implies that whenever one of these variable/assumption rates increases holding other variable constant, profits margin declines and a decrease in the rates of these variables holding other variables constant causes increase in the profits margin across ages and policy terms.

On the other hand, management charge has a direct relationship with the profits margin, that is, an increase in management charge holding other variables constant causes an increase in profits margin and vice versa.

It is also observed that changes in commission rates have no effect on the profits margin. conclusively, it is observed that management charge has the highest effect on profits margin, while initial commission, renewal commission and inflation have minimal effects on profits margin.

CHAPTER FIVE

SUMMARY OF RESULTS, CONCLUSIONS AND RECOMMENDATION

5.1 Introduction

This chapter presents final remarks about this project in line with the stated objectives, summary of results, conclusion and recommendations. These will be based on the results from the analysis of the models built to aid the development of Diaspora Family Support Unit-Linked Insurance Plan.

5.2 Summary of Results

The main objective of this project was to design a unit-linked insurance product tailored to the unique need of the Ugandan Migrant workers who seek to remit funds to support their families back in Uganda and also invest in productive ventures to get returns from their investment at home. The product thus provides a formal, open and safe way for Ugandan Migrant workers to remit funds. In addition, the dual nature of this product shifts the use of remittances from a basic means of survival into a powerful tool for building wealth and resilience for Ugandan families thus ensuring greater peace of mind for the policy holders and their families.

The analysis shows that for a male policyholder aged between 25 years and 45 years, who chooses the policy terms of 5 years to 10 years, premiums range between **UGX.1,317,042** and **UGX.4,944,196** annually which translates to between UGX.109,754 and UGX. 412,016 Monthly for the basic sum assured of UGX. 33,300,000. The profits margin of this product lies between **3.56%** to **6.71%**.

The result also indicates that the longer the policy term, the higher the profits margin from the sale of this product. Furthermore, the product is more profitable for younger migrant workers across all policy terms compared to the older counterpart. Policy terms less than six (6) are less profitable to the insurer while terms between seven (7) and ten (10) are more profitable to insurer. Policy terms above ten (10) may be profitable but not ideal for the target population, the insurer may sell the policy with terms above ten (10) at the request of the policyholder.

The results further show that, younger migrant workers who buys this product will pay slightly lower premiums compared to their older counterpart across all the policy terms. Migrant

workers who will choose shorter policy terms will pay slightly higher premiums compared to those who will choose longer policy terms across all ages.

5.3 Conclusion

The successful completion of this project will demonstrate that the unit linked micro insurance plan tailored for Ugandan migrant workers (Diaspora) can be priced based on the general actuarial pricing principles, yielding a relatively low premiums and a reasonable profits margin.

Furthermore, the successful completion of this project will make available affordable and unique insurance plan for the Ugandan diaspora population thereby reducing reliance on a few products and as a result increasing insurance uptake in Uganda.

Lastly, the dual nature of this product shifts the use of remittances from a basic means of survival into a powerful tool for building wealth and resilience for Ugandan families thus ensuring greater peace of mind for the policy holders and their families

5.4 Recommendations

Despite achieving the objectives of this project, the primary challenge remains in delivering the product to the target users, the Ugandan diaspora population given their diverse work destination and complexities in cross-border/international transactions. The challenge results from the fact that the target population live and work in diverse foreign countries with different Insurance regulatory authorities and insurance laws which both insurers and insured must comply with for transactions to be prompted between the clients and their insurers back in Uganda.

Secondly, the other challenge comes from the fact that payment of premiums will involve multiple currencies, this will likely attract higher transaction costs in terms of exchange rates and other taxes involving cross-border transactions.

Lastly, more challenges arise from existence of a few formal organizations and companies engaged in remittance of funds from migrant workers alongside very many informal organizations and companies that has led to loss of trust in sending remittances by diaspora population due to the fear of loss of their hard-earned cash. Therefore, for prompt premium collection and claims payment, the following measures are suggested to mitigate the above highlighted challenges;

The insurers could partner with mobile money service providers of Uganda like Airtel and MTN with Airtel Money and MTN MoMo respectively. The mobile money is more convenient to most Ugandans; the partnership will ensure direct transaction to the insurer's accounts thereby mitigating potential financial losses from intermediaries or relatives. Mobile Money services like Airtel Uganda through their Airtel App has a future that enable a client in diaspora to convert their moneys from their respective destination country's currency into Ugandan shillings (UG.SHS.) before sending, this can help reduce costs in exchange rates conversion costs associated with traditional remittance service providers like international financial banks.

Furthermore, insurers could partner with well-established local commercial banks which provide remittance services like Stanbic bank Uganda, Standard chartered bank Uganda, DFCU bank Uganda and Centenary Bank Uganda among other banks. Most migrant workers bank with these local commercial banks, this mean that they could arrange for automatic deduction of funds from their personal accounts to pay for premiums directly to theirs preferred insurer, this would reduce the costs of cross-border transactions but also ensure safe and secure means of paying premiums by the Ugandan diaspora population.

Insurance companies could design a computerized online system accessible through the website. This could be used to increase awareness about this unique product to the diverse Ugandan diaspora population. The computerized system could be integrated to allow purchase of insurance policy online, and the policyholder is able to pay for premiums, receive acknowledgement of payments; download receipts, certificate of insurance, insurance policy; submit claims and send relevant evidences seamlessly through the website or dedicated computer application. This will increase awareness among the diverse diaspora population but also makes it possible for them to buy this product at the client's convenience anywhere in the world in real time and process claims.

Insurers could partner with traditional remittance service providers like Western Union, MoneyGram and WorldRemit as well reputable labor export companies in Uganda to increase awareness about this unique insurance product which is designed with the focus to mitigate the challenges related to remitting funds; providing a life insurance cover alongside providing a suitable investment vehicle that will shift the use of remittance from a mere means of survival into a powerful tool for building wealth and resilience for Ugandan families thus ensuring greater peace of mind for the policy holders and their families but also contributing to economic development of Ugandan economy as a whole.

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APPENDICES

Appendix A: Maximum and Minimum Premium

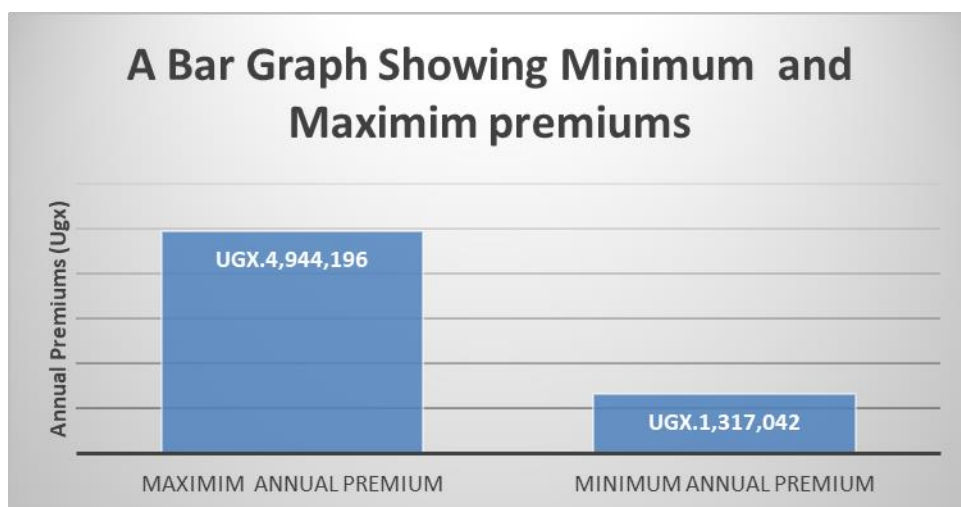


Figure A. 1 Maximum and minimum premiums across all ages and policy terms

Appendix B: Variation of Annual premiums for selected policy term.

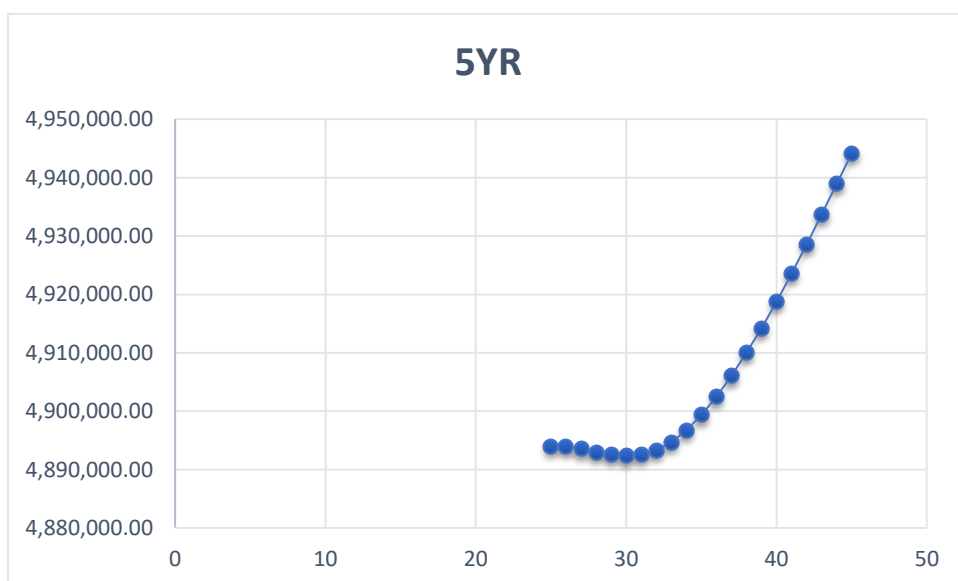


Figure B. 1 Annual premiums for a 5-year policy term

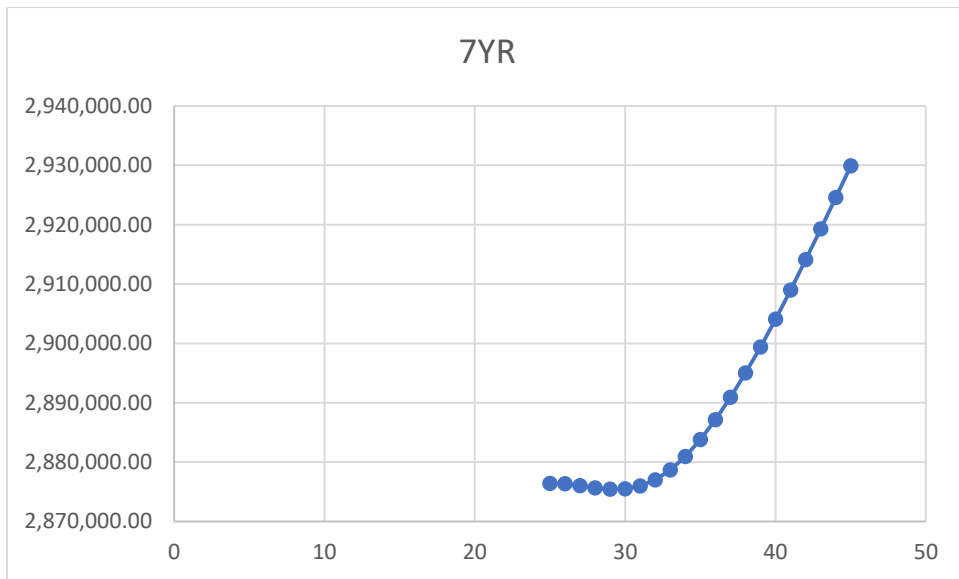


Figure B. 2 Annual premiums for a 7-year policy term

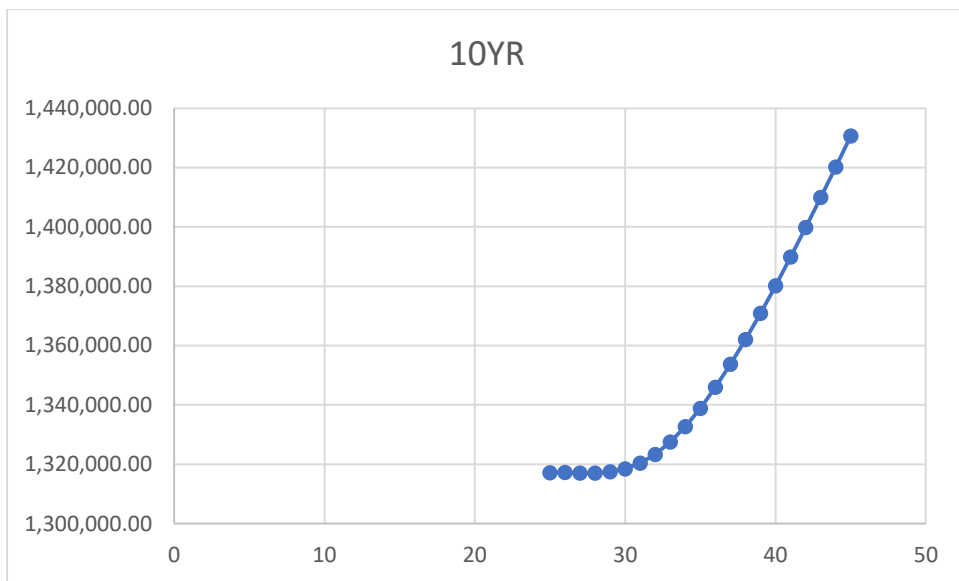


Figure B. 3 Annual Premium for a 10-year policy term.

Appendix C: Maximum and Minimum Profits margin

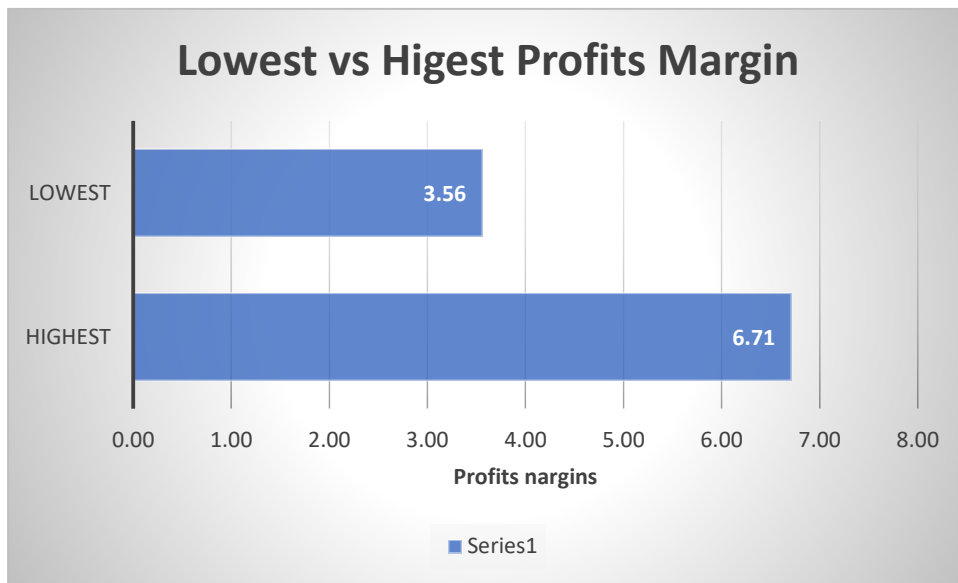


Figure C. 1 Maximum and Minimum Profits margin (%) across all ages and policy terms.

Appendix D: Variation in Profits Margins for selected policy terms.

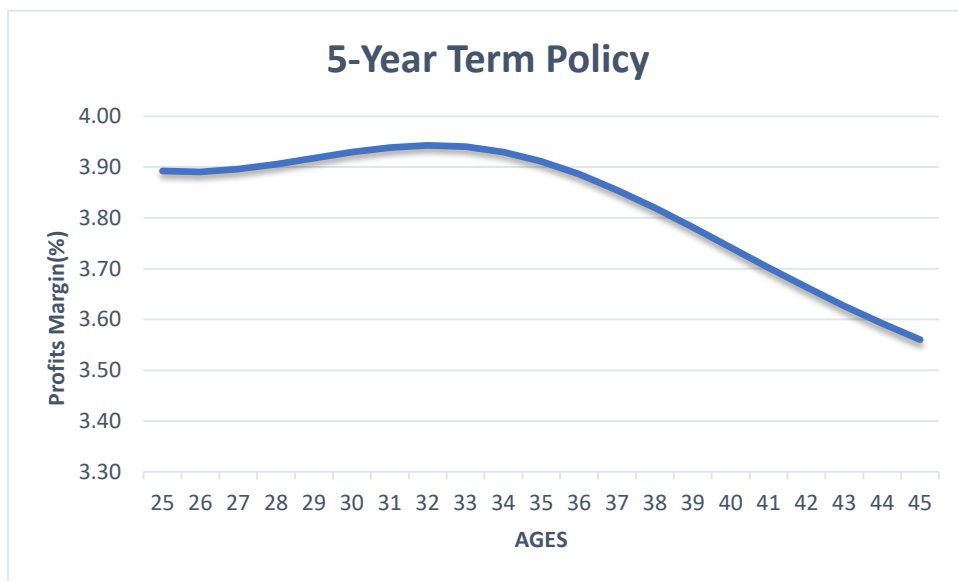


Figure D. 1 Profits Margin for a 5- year policy term

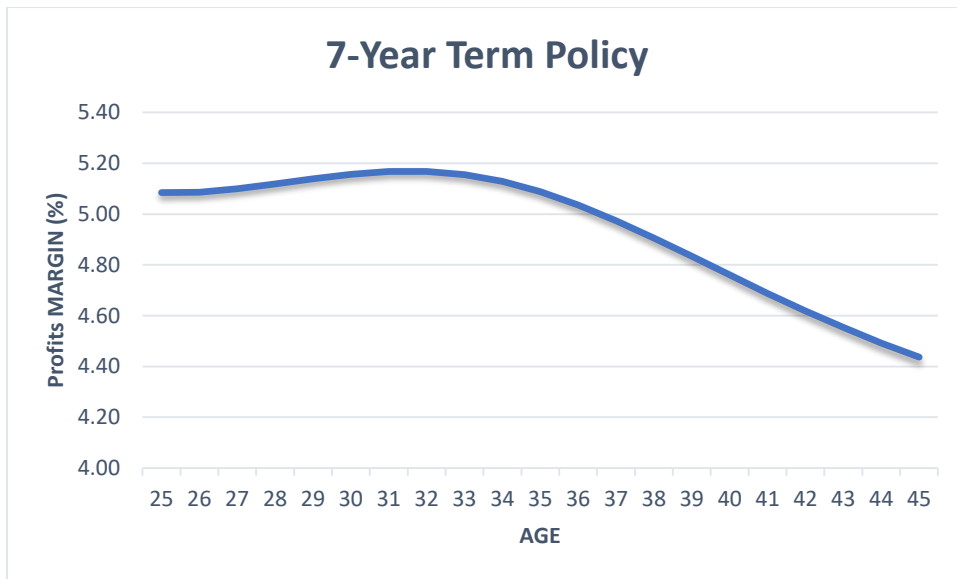


Figure D. 2 Profits Margin for a 7-year policy term.

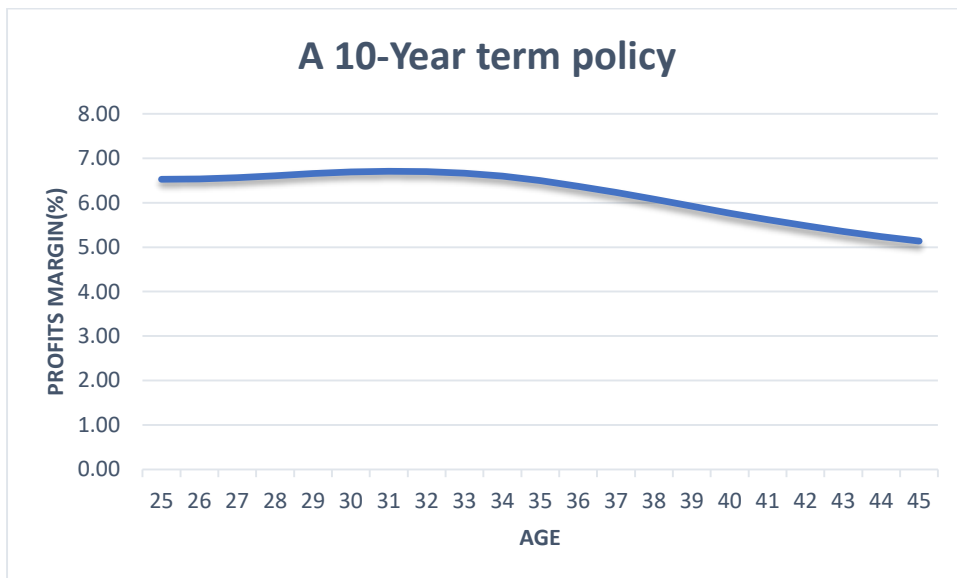


Figure D. 3 Profits Margin for a 10-year policy term.

Appendix E: Python output

```

Python 3.12.4 (tags/v3.12.4:8e8a4ba, Jun 6 2024, 19:30:16) [MSC v.1940 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Users\JUSPER THE GREAT\Desktop\CODES\jasper3.py
Looking for Excel file at: C:\Users\JUSPER THE GREAT\Desktop\CODES\mortality and disability tables.xlsx

=====
POLICY PARAMETER SETUP RATE
=====
Enter policyholder age (25-45): 25
Enter policy term in years (5-10): 10
Enter gender (male/female): male

Policy parameters set:
Age: 25
Term: 10 years
Gender: male
=====

Premium Model - Age: 25, Term: 10, Gender: male
=====

1. Decrement Table
2. Premium Calculations
3. Unit and Non-Unit Fund Calculations
4. Profit Testing and Margin
5. Modify Assumptions
6. Restart Program

Enter your choice:

```

Figure E. 1 Python output, first interface

First interface, allow user to enter key details of the intended policyholder, that is Age, Policy term and Gender; it also displays the menu that guides the user.

```

=====
Premium Model - Age: 25, Term: 10, Gender: male
=====

1. Decrement Table
2. Premium Calculations
3. Unit and Non-Unit Fund Calculations
4. Profit Testing and Margin
5. Modify Assumptions
6. Restart Program

Enter your choice: 1

Multiple decrement table for male:
year(t)  age(x)  qxdi  qxm  qxdm  (aq)xdi  (aq)xm  (aq)xdi  (ap)x  t-l(ap)x
1        25  0.001767  0.000000  0.000531  0.001766  0.000000  0.000531  0.997703  1.000000
2        26  0.001795  0.100000  0.000531  0.001704  0.099884  0.000504  0.897908  0.997703
3        27  0.001795  0.100000  0.000531  0.001704  0.099884  0.000504  0.897908  0.895846
4        28  0.001774  0.100000  0.000531  0.001685  0.099885  0.000504  0.897926  0.804387
5        29  0.001739  0.100000  0.000540  0.001651  0.099886  0.000513  0.897950  0.722280
6        30  0.001697  0.100000  0.000549  0.001612  0.099888  0.000521  0.897979  0.648571
7        31  0.001656  0.050000  0.000567  0.001614  0.049944  0.000552  0.947889  0.582404
8        32  0.001623  0.050000  0.000585  0.001582  0.049945  0.000570  0.947904  0.552054
9        33  0.001604  0.050000  0.000621  0.001563  0.049944  0.000605  0.947887  0.523294
10       34  0.001608  0.000000  0.000657  0.001608  0.000000  0.000656  0.997736  0.496024

=====
Premium Model - Age: 25, Term: 10, Gender: male
=====

1. Decrement Table
2. Premium Calculations
3. Unit and Non-Unit Fund Calculations
4. Profit Testing and Margin
5. Modify Assumptions
6. Restart Program

Enter your choice:

```

Figure E. 2 Python output when the user enters option 1

Shows decrement table when the user chooses option “1” from the menu.

```

IDLE Shell 3.12.4
File Edit Shell Debug Options Window Help

10.000000 34.000000 7215000.000000 0.200886 0.000000 0.000000
TOTAL: 954745.052920

EPV of disability benefits:
year(t) age(x) amount discount probability EPV
1.000000 25.000000 33300000 0.851716 0.000531 15046.997990
2.000000 26.000000 33300000 0.725420 0.000504 12175.005307
3.000000 27.000000 33300000 0.617852 0.000504 10369.649354
4.000000 28.000000 33300000 0.526235 0.000504 8832.088315
5.000000 29.000000 33300000 0.448203 0.000513 7650.063646
6.000000 30.000000 33300000 0.381742 0.000521 6624.412753
7.000000 31.000000 33300000 0.325135 0.000552 5860.529307
8.000000 32.000000 33300000 0.276923 0.000570 5255.505769
9.000000 33.000000 33300000 0.235860 0.000605 4751.702428
10.000000 34.000000 33300000 0.200886 0.000656 4391.464175
TOTAL: 81077.419043

INCOME: 4807545.149507
OUTGO: 5382577.334344
EQN OF VALUE: -575032.184837

Calculating premium...

Actual Premium after Goal Seek: 1317216.343023

Verification - EPV with calculated premium:
Total EPV Income: 5705024.361039
Total EPV Outgo: 5705024.361039
Equation of Value: 0.000000

=====
Premium Model - Age: 25, Term: 10, Gender: male
=====
1. Decrement Table
2. Premium Calculations
3. Unit and Non-Unit Fund Calculations
4. Profit Testing and Margin
5. Modify Assumptions
6. Restart Program

Enter your choice: |
Ln: 1677 Col: 19

```

Figure E. 3 Python output when the user selects option 2 from the menu

Shows output of the EPV of all outgo and Income and further displays Actual Premiums when the users choose option “2” from the user menu.

```

IDLE Shell 3.12.4
File Edit Shell Debug Options Window Help

6. Restart Program

Enter your choice: 3

UNIT FUND:
Year(t) premium alloc_p b/o_spread cost of alloc fund_after_alloc fund_b4_mgt_charge mgt_charge bid value
1 1317216.343023 790329.805614 39516.490291 750813.315523 750813.315523 881529.913756 17630.598275 863899.315461
2 1317216.343023 1290872.016163 64543.600808 1226328.415355 2090227.730836 2454136.378774 49082.727575 2405053.651198
3 1317216.343023 1290872.016163 64543.600808 1226328.415355 3631382.066553 4263605.684340 85272.113687 4178333.570653
4 1317216.343023 1290872.016163 64543.600808 1226328.415355 5404661.986008 6345613.637772 126912.272755 6218701.365017
5 1317216.343023 1290872.016163 64543.600808 1226328.415355 7445029.780371 8741209.465134 174824.189303 8566385.275831
6 1317216.343023 1290872.016163 64543.600808 1226328.415355 9792713.691186 11497625.144822 229952.502896 11267672.641925
7 1317216.343023 1290872.016163 64543.600808 1226328.415355 12494001.057280 14669206.641352 293384.132827 14375822.508525
8 1317216.343023 1290872.016163 64543.600808 1226328.415355 15602150.923980 19318485.399727 366369.707995 17952115.691733
9 1317216.343023 1290872.016163 64543.600808 1226328.415355 19178444.107088 22517411.226132 450348.224523 22067063.001609
10 1317216.343023 1290872.016163 64543.600808 1226328.415355 23293391.416964 27348770.862657 546975.417253 26801795.445404

NON UNIT FUND:
Year(t) Unalloc_p b/o_spread sum expenses commission interest death_cost surr_penalty di_costs mgt_charge p_vector
1 526886.537209 39516.490291 566403.027500 197582.451453 329304.085756 6879.820960 57289.644639 0.000000 45.832532 17630.598275 6691.432354
2 26344.326860 64543.600808 90887.927669 65860.817151 46102.572006 -3669.237845 52658.128141 46048.978579 121.215978 49082.727575 17607.662702
3 26344.326860 64543.600808 90887.927669 67836.641666 46102.572006 -4013.228893 49635.704986 46048.978579 210.590226 85272.113687 54410.282159
4 26344.326860 64543.600808 90887.927669 69871.740916 46102.572006 -4367.539679 45625.635674 46049.455572 313.429033 126912.272755 97566.739694
5 26344.326860 64543.600808 90887.927669 71967.893143 46102.572006 -4732.479775 40845.631102 46050.057165 439.080205 174824.189303 147674.517504
6 26344.326860 64543.600808 90887.927669 74126.525937 46102.572006 -5108.368081 35518.207551 46050.803818 587.175465 229952.502896 205447.981442
7 26344.326860 64543.600808 90887.927669 76350.737836 46102.572006 -5495.533036 30546.389679 23025.671713 794.078994 293384.132827 248008.421658
8 26344.326860 64543.600808 90887.927669 78641.259971 46102.572006 -5894.312940 24275.344678 23025.848135 1023.120123 366369.707995 324346.874081
9 26344.326860 64543.600808 90887.927669 81000.497770 46102.572006 -6305.056241 17559.592431 23025.651405 1335.043232 450348.224523 411959.041917
10 26344.326860 64543.600808 90887.927669 83430.512703 46102.572006 -6728.121841 10447.629211 0.000000 1759.461951 546975.417253 489395.047211

=====
Premium Model - Age: 25, Term: 10, Gender: male
=====
1. Decrement Table
2. Premium Calculations
3. Unit and Non-Unit Fund Calculations
4. Profit Testing and Margin
5. Modify Assumptions
6. Restart Program

Enter your choice: |
Ln: 205 Col: 19

```

Figure E. 4 Python Output when the user selects option 3

Shows Unit-Fund and Non-Unit Fund whenever the users choose option “3” from the user menu.

```

IDLE Shell 3.12.4
File Edit Shell Debug Options Window Help

Net present value of premiums:
Year(t) Premium discount factor t-1(ap)x Discounted premium
0 1317216.343023 1.000000 1.000000 1317216.343023
1 1317216.343023 0.844523 0.997703 1109864.885344
2 1317216.343023 0.713220 0.895846 841615.030043
3 1317216.343023 0.602331 0.804387 638200.080161
4 1317216.343023 0.508682 0.722280 483959.736972
5 1317216.343023 0.429594 0.648571 367005.835271
6 1317216.343023 0.362802 0.582404 278324.095793
7 1317216.343023 0.306395 0.522054 222302.432673
8 1317216.343023 0.258758 0.523294 178359.281380
9 1317216.343023 0.218527 0.496024 142778.914809
NPV: 5580126.635469

Net present value of profits:
Year(t) Profit vector discount factor t-1(ap)x Discounted profits
1 6691.432354 0.844523 1.000000 5651.070310
2 17607.662702 0.713220 0.997703 12529.286199
3 54410.282159 0.602331 0.895846 29359.521232
4 97568.736694 0.508682 0.804387 39922.897486
5 147674.517904 0.429594 0.722280 45821.500015
6 205447.981442 0.362802 0.648571 48342.527891
7 248008.421658 0.306395 0.582404 44255.957740
8 324346.874081 0.258758 0.522054 46332.331345
9 411959.041917 0.218527 0.523294 47109.040822
10 489395.047211 0.184551 0.496024 44800.014553
NPV: 364124.147593

Profit Margin: 6.525374%

=====
Premium Model - Age: 25, Term: 10, Gender: male
=====
1. Decrement Table
2. Premium Calculations
3. Unit and Non-Unit Fund Calculations
4. Profit Testing and Margin
5. Modify Assumptions
6. Restart Program

Enter your choice: |

```

Figure E. 5 Python output when the user selects option 4.

Shows NPV of Profits Vector and EPV of premiums, and the Profits margin whenever the user choose option “4” from the menu.