A PROPOSED EMPLOYEES PROVIDENT FUND EQUIVALENT POST - EMPLOYMENT PENSION SCHEME

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Degree of Master of Science

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DECLARATION PAGE OF THE CANDIDATE & SUPEVISOR

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I dedicate my dissertation work to my family. A special gratitude to my loving parents whose words encouraged me to be who I am today. I also dedicate my work to my wife who was there for me throughout the entire Master's Program and also friends who have supported me throughout this process by giving support and advices.

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ABSTRACT

The labor force in Sri Lanka can be mainly divided in to two sub sectors as government sector and private sector. Government sector employees are benefited with a monthly pension income while private sector employees are received a lump-sum retirement benefit which is known as Employees Provident Fund (EPF) payment. However most of the employees like to have a monthly retirement benefit than a lump-sum benefit, thus majority of the private sector employees demand for a pension scheme which is similar to the government sector instead of EPF.

In Sri Lanka five main employment-based pension schemes can be found. The Public Service Pension Scheme (PSPS) is a non- contributory pension scheme which is governed by the Pension department of Sri Lanka. Employees Provident Fund (EPF), Farmers' Pension and Social Security Benefit Scheme (FMPS), Fishermen's Pension and Social Security Benefit Scheme (FSHPS), The Self-employed Persons Pension Scheme (SPPS) are the other mainpension schemes and these four schemes are being contributed by the employees and/or employers.Previous studies proved that 18 per cent of the working age population is covered by these schemes, while the effective coverage is estimated to be only 13 per cent.

These statistical measurements depict an upcoming crisis in Sri Lankan workforce within next few decades. This thesis was carried out to address the issue using an actuarial model and design a sustainable pension scheme which can fulfill the requirements in post-employment period of private sector labor force in Sri Lanka. This study has been introduced a contributory pension scheme for the private sector labor force in Sri Lanka. The contribution is equivalent to the existing total EPF contribution of employee and employer which is 20 percent of the salary (8% by employee and 12% by employer). The Employees, those who have longer service period or higher salary scales are the most benefited party from the EPF equivalent post-employment pension scheme. The lowest monthly benefit value at the benefit period of an employee is greater than his or her monthly contribution at the contribution period. Annuities and life tables are the basic tools which are used to develop the scheme.

According to the proposed scheme by this study, an employee who can contribute Rs. 17000.00 per month for a period of 21 years will be benefited with a monthly income of Rs. 59640.80 starting from his age of 55 to, until his death or age of 105. It is proved that the EPF equivalent pension scheme is more effective than the government pension scheme which is introduced for the Tri forces staff members in 2019 September, for 64 % of the employees in the considering sample. Employees' monthly benefit of the considering sample is varied between Rs. 3607.81 and Rs.63797.41 depending on the contributing amount and the contributing period. Thus, it is actuarial scientifically proved that EPF equivalent pension scheme for the private sector labour force in Sri Lanka is a realistic project.

Key words: Post- employment benefit, Actuarial, Annuities, Pension scheme

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LIST OF ABBREVIATIONS

Abbreviation	Description
DB	Defined Benefit
DC	Defined Contribution
EPF	Employees Provident Fund
GDP	Gross Domestic Product
RPI	Retail Prices Index
CPI	Consumer Prices Index
S&P 500	Standard & Poor's 500 indexes
ETF	Employees Trust Fund
FMP	Farmers Pension and Social Security Benefit Scheme
FSHPS	Fishermen's Pension and Social Security Benefit Scheme
SPPS	Self- employed Persons Pension Scheme

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1. INTRODUCTION

1.1. Introduction

Senior citizens are guaranteed a steady monthly retirement income in many countries. Most of these retirement benefit schemes are built up by occupational income of workforce and regulated by the governments. All these schemes can be divided in to two sub schemes called, Defined Benefit (DB) and Defined Contribution (DC) schemes. In developing countries, the access to any form of retirement coverage among the working population is limited. Therefore, many options have been introduced for the private sector employees by governments and non-government bodies such that pension trusts, insurance companies, social security institutes, and fund management institutes. This is a study of a pension scheme which is proposed for the private sector work force in Sri Lanka instead of existing EPF (Employees Provident Fund) benefit. This chapter will discuss the relationship between the insurance industry and pension schemes, existing post-employment benefit schemes among local and international work forces. Further, it will describe the objectives and significance of this study.

1.2. Pension Schemes and Insurance Industry

Insurance industry is highly specialized, technical, corporate business with huge capital, where client's trust is the prime requirement. Insurance works on the principal of sharing losses and risk pooling. With risk pooling, people who tolerate the uncertainty of a specific economic loss, for example the loss of income because of incapacity, transfer the risk to an insurance company. People, who wish to be insured against particular types of losses, decide to make regular payments called premiums.

In return, they receive a contract called a policy from the company. The company assures to pay them a certain sum of money for the types of losses mentioned in the policy. In real world, only a small percentage of the individuals who purchase these policies will actually affect such kind of losses. Meanwhile, insurance companies invest the money collected via premiums in many income generating financial instruments.

The individuals who pay premiums are called policy holders or insures. The company is known as an insurer. The amount of paid by the insurance company to the policy holder is called as the benefit or claim.

Insurance companies play an important role in the economy as follows.

i. Insurance companies help to compensate for financial losses. Insurance is a risk financing method which provides a cover against risk or negative surprises.
ii. They are financial intermediaries who accept the surplus money from savers and supply that money to borrowers.
iii. Insurance companies contribute to economic stability and general welfare by compensating individuals and businesses for potential financial losses.
iv. Insurance systems increase total production by encouraging individuals and corporations to embark on ventures where the possibility of large losses inhibits such projects in the absence of insurance.
v. They invest huge sums of money in stocks, bond, mortgages, government securities and other income generating enterprises. Thus, the industry helps increasing the production of goods and services.
vi. Further, insurance industry provides large amount of employments to many individuals and pays large amount in taxes.

1.3. Life Insurance

All life insurance policies provide the payment of a benefit upon the death of insured while the policy is in force. However, the features of life insurance policies vary, depending on the type of policy. Three major types of life insurance policies can be identified as follows.

i) Term life insurance

Also known as the temporary insurance, that covers a specified period of time, called the policy term. The plan benefit is payable only if the person dies during the stated term. This type of insurance costs less than Whole life insurance or Endowment insurance for the same amount of coverage.

ii) Endowment insurance

This method offers a definitevalue whether the person lives to the end of the term coverage or dies during the term. Each endowment policy states a maturity date, which is the date on which the insurer will pay the policy's face value to the policy owner if the insured is still living or to the beneficiary, if the insured dies before that date.

iii) Whole life insurance

These types of insurance policies provide lifetime coverage and contain a savings portion. Whole life insurance builds cash value which represents the policy owner's ownership interest in the policy.

1.4.Current Post-Employment Benefit Schemes of Sri Lanka.

In Sri Lanka,studies have identified group of active individuals who leads the country is in between 25-54 years of age(World Population Review, 2019, Sri Lanka Demographics) and around 42.6% of the population lies in that age group.Though,Sri Lanka is a developing economy, country's development projects are creating a large number of job opportunities for its' citizens to be utilized.

Further, the estimated median age of population in Sri Lanka is to be 31.1 years, (females' median age is 32.2 years and the men's is 30.1 years). Moreover,people in Sri Lanka have a high life expectancy of 75.94 years(males 72.43 years and females 79.59 years). In Sri Lanka, 9.1% of the population is in the 54-65 year age group, and above the age of 65 years group is 8.1% of the total population. An estimate of the

number of deaths each year in the Sri Lanka lies at 5.96 deaths per a population of 1000 people(Sri Lanka Population 2019.n.d.) .

Studies have identified 24 income support structures, which include the state's Public Service Pension Scheme (PSPS) and the private sector's Employee Provident Fund (EPF). Further, contributory pension schemes are available for the self-employment sector workers. Some of them are, Farmers Pension and Social Security Benefit Scheme (FMPS), Fishermen's Pension and Social Security Benefit Scheme (FSHPS) and the Self-employed Persons Pension Scheme (SPPS). These five major pension schemes covered 18% of the Sri Lankan working population. However, the effective coverage of these pension schemes is 13 percent.(Arunatilake, Samarakoon&Gunasekara, 2015).

Existing pension scheme for the public sector is fully funded by the government and the pension salary is purely calculated on the basic salary at the retirement age of the considering employee.Therefore the public sector pension salaries are relatively low. In addition, since the public sector pension schemes are fully funded by government, existing and potential taxpayers abide the expenditure of the public sector pension. Other than that, in Sri Lanka the Employees Provident Fund (EPF) is the biggest social security cover with a fund of assets worth 1.80 trillion rupees and 2.4 million on going accounts. (Employee's provident fund, 2016). But, it cannot be mentioned as a retirement plan since it is not a periodical payment system. However, if recipients invest the lump sum at a financial institute, share market or at any other financial instrument, EPF could be transformed into an annuity plan.

These statistical measurements depict a forthcoming crisis in Sri Lankan workforce within next few decades. Through this thesis, we try to address the issue using an actuarial model and design a sustainable pension scheme which can fulfill the requirements in post-employment period of private sector labor force in Sri Lanka.

1.5.International Post-Employment Benefit Schemes

In general, most of the countries have established mandatory public schemes to bear the burden of the country's pension schemes. Those are often accompanied by work-related pension schemes – Defined Benefit (DB) Defined Contribution plans. The percentage that the work-related pension schemes supplement, community pension schemes varies significantly among developed economies. It is evident that the accesses to any type of pension scheme in developing countries are very low. Public pension schemes are of two types, Funded and unfunded. Funded schemes are burdened by retirement fund assets and unfunded schemes are considered to as pay-as-you-go schemes. Deductions of monthly salaries or payroll taxes compensated by the existing work force contribute for the current pension overheads. In developed economies, when a great portion of retirement fund liabilities are coupled to upcoming government income it demonstrate by a relatively low pension assets to gross domestic product (GDP).

1.6.Objectives of the Research

- Primary Objective

Developing an EPF equivalent post-employment pension scheme for the private sector labour force in Sri Lanka using Actuarial Science.

- Secondary Objective

Assisting the government and private organizations to implement a post–employment pension scheme instead of EPF to encourage private sector workforce in Sri Lanka to plan their retirement period with an adequate monthly income stream.

To deliver the estimated retirement revenue stream, sponsored schemes requires valuation of what the proper contribution proportions (as a ratio of employee earnings) into the retirement fund. For DB schemes, there will be a liability of the schemes' sponsor if there is any asset deficit causing from low returns of reserves on

pension assets. In DC schemes, risk is taken by the employees that the after the service period, pension income could be lesser than which they predicted for.

In estimating the present value of retirement fund liabilities, contract value (pre agreed amount) that emphasizes the pension income, will provide the inputs to the actuarial calculations for DB schemes (Unfunded and Occupational).There are certain assumptions which are applied in actuarial formulas to assess the future value of economic, monetary and demographic variables and risks. Investment methods that convey the pre agreed amount with least risk to the pension fund for funded pension schemes can be extremely challenging, as a result of the inbuilt uncertainties lies with the estimating these variables over a lengthy period.

Among these challenges, the regulatory restrictions on investments and compliance with pension-related accounting standards are significant. However these limitations and the costs those impose on the pension schemes from this contribution are relatively not considered by government and community.

Hence, in the ultimate stage, the government should assign the suitable professionals to construct the retirement fund if the government is willing to introduce a doable and secured pension scheme.

1.7. Significant of the Study

Currently Sri Lanka government pays EPF as a lump sum to employees when they retire at the age of 55. If the employee does not invest the lump sum for a long term in any bank / financial institution the lump sum would be wasted on normal household expenses. Therefore, in order to provide the employees with monthly payment during their retirement period we are analyzing several options in this study.

1.8.Key Stakeholders

- Private sector workforce in Sri Lanka
- Sri Lanka Government
- Employer's Federations and Trade Unions
- Insurance Companies.

1.9.Outline of the Thesis

This report consists of five chapters. Chapter two presents a systematic review of literature illustrating the previous research studies and factors related to the pension schemes at local and international level. Chapter three explains methodology that used by the study and basic actuarial science theories which are related to the topic. The chapter four illustrates the applications of the theories which are discussed in chapter three. This chapter further discusses the two stages of proposed pension scheme and calculates the monthly benefits for the selected employees according to their salary scales and contribution period. Finally the chapter five presents the conclusion and recommendations of this study. Further this chapter gives a brief overview of the limitations of the study.

2. LITERATURE REVIEW

2.1. Introduction

In essence, a literature review recognizes, assesses and creates the relevant literature within a specific field of research and it lights up how information has developed within the field, focus on to what has already been done, what is commonlybelieved, what is developing and what is the present state of thinking on the topic. Furthermore, within research-based version such as a thesis, a literature review recognizes a research gap (i.e. not yet explored or under-research areas) and expresses how a particular research study fill this gap.

In this research, I have reviewed literature on aging impact on the economy, types of pension, trust in pension, comparison between defined benefit and defined contribution and pension plans in other countries such as Canada, Japan and United Kingdom.

2.2.Definitions and Approaches

There are different definitions and approaches to social security. The social security is “collective remedies against adversity and deficiency” (de Swaan 1988).

Dreze and Sen have differentiated between protection (preventing decline in living standards or adversity) and promotion (enhancing general living standards or counteracting deficiency (Dreze & Sen 1989) .

According to Patricia (2007), more than a third of the world population lives under extreme conditions of poverty and deprivation. They are people living in rural and remote areas who don’t have easy access to markets and uneducatedwith low health conditions and also employed in areas where there is low security. Further, they will not have adequate access to productive assets too. Such conditions make the poor,people in risk to amazement caused by life cycle changes, economic restructuring and other types of conditions such as illness or bad weather conditions. The policies that protect poor people livelihoods, improvee their human capital and

help them in times of economic crises can reduce the vulnerability of the poor to socio-economic shocks.

On the other hand, despite the need for social security policies, it is not immediately clear that developing countries are able to implement programmes of social security. Patricia (2007) claims that sufficient social security policies can be an important endogenous factor in the process of sociopolitical development and economic growth of developing economies.

2.3.Does Aging Affect the Economy?

Aging is defined as a decreasing the share of working – age population caused by a lesser fertility rate and increasing share of the elderly due to a reducing mortality rate which implies an extension of life expectancy. Many studies have been conducted to examine the relationship between aging and economic growth. Studies suggests that a statistically significant positive relationship.There is a positively relationship between per capita GDP growth and the working population. Further, negative relationship found between per capita GDP growth withyouthand the elderly (IMF2005; Bloom, Canning, & Sevilla,2001). The relationship is evident when the work force has reduced as a result of the slowing population growth. Aging directly affects to the economic growth due to reduced labor force on the supply and lower investment demand in the economy on demand side.

2.4.Types of Pension

Defined Contribution(DC)- Employee contribution is pre-defined in terms of fixed proportion to salaries. The collection from employees' salaries are pooled and invested in financial markets. The system does not promise the level of return, which depends on the total sum of the collected contribution by the participant and earning from investment.In a Defined Contribution (DC) scheme, each employee has an account into which the employer and, if it is a contributory plan, the employee make fixed contributions. Return from the pension scheme is depending on the accumulated contribution and the return received from the investment. Generally,

there are investment options which the employees can choose and they have the ability to find out the value of the accumulated contribution at any time.

Defined Benefit - This is a system where the pension income is fixed in terms of amount or in proportion to their salary. This fixed benefit can be identified by the employees when they are active in the labor force in order to let them choose among different plans while the employee contribution is vary depending on the financial state of the pension system account. In a Defined Benefit (DB) plan, pension salary is determined on the basis of service period and most of the times on wages. Many DB plans take into consideration the social security benefits to which an employee is entitled. These are the so-called integrated plans (Bodie, Marcus & Merton,1988).

2.5.Trust in Pension

Trust can be defined as 'a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" (Rousseau *et al.*, 1998: 395). When it is to Pension, studies are finding about the risks that individuals recognize in relation to their future (which is necessarily unpredictable) , Specially organisationslike insurance companies,who are developing policies or products to reduce the existing risk and those who are seeking to provide guidance, advice and regulation to the individuals facing risks.

Who needs trust and why

Table: 2.1: Interesting Parties and Their Interests

Individuals	**Government**
In order to plan their future activities and evaluate risk related to its impact on future security	To facilitate a propersetting for transactions between actors and to implement policies effectively
Financial Services Industry	**Voluntary and Regulatory Services**
In selling their product and services	To provide advice

Luhmann (2000) argue in differentiating between confidence and trust. Confidence lies with institutions and trust refers with individuals. Moreover, Luhmann (2000) argues that trust accompanywith a selection and an awareness of the possibility for being let down: Trust is important when there is a regret about our own action and its' outcome. In a situation where the possibilities of bad outcomes are not considered, the confidence exists. In addition to that, Newton and Zmerli also discuss about the differences between trust in people and confidence in institutions, even it talked about political trust and confidence without differentiating them (2007).
The confidence is closer to the notion of legitimacy and as such is something that institutions have to earn and sustain.

Approaches to measuring trust

Table 2.2: Trust Measuring Methods

Surveys and trust scales for measuring	Mixed methods
Experimental designs: games or tests	Qualitative methods: focus groups, interviews, testing models of attitudes and behavior

2.6.Comparison Between Defined Benefit and Defined Contribution

In actuarial journalism related to quantitative comparisons of different pension plans focused on defined benefit and defined contribution schemes. In a sample of both DB and DC plans, Samwick & Skinner (1998) have tested post-employment benefit schemes in the survey of consumer finance to estimate the average pension income. They have concluded with a strong conclusion that DC plans could strengthen retired people in terms of their financial security. But, we should take into consideration that the paper we are considering have published in a time period when the return of the stocks are high. Not only that, thekey variable of the paper "annuity purchase rate" was considered as fixed for the entire period and they didn't assume for a descending tendency in a longer period. Accordingly, study conclusions might be changed at present.

Blake, Cairns & Dowd (2003) analyzed alternative decumulation strategies , including a conventional life annuity, an equity – linked annuity, and an equity

linked return distribution series. They calculated expected discounted lifetime utility to measure the performance of different strategies. An individual's attitude towards the risk has captured by the framework and it allowed researchers to optimize asset portfolics by maximizing the utility function. The conclusion of this research is the optimal selection of distribution programme was quite insensitive to an employee's risk aversion level, but was highly affected by equity proportions.

A stochastic life cycle model was used to make a comparison in between value given by DB and DC plans to a risk – averse persons in different economic contexts (McCarthy, 2003). A DC scheme will convey fine welfare solutions for new employees who are in early age groups, when wages and assets risks are there. Because, over thelong run, the returns of advanced equity exposure attached with a reasonable equity risk premium and it would outweigh the value of assured wage – indexed benefits. On the other hand, DB plans would be more appropriate for the older working population. Because, employees who have only a short working period before their retirement, their smaller capacity to abide financial risk and the minimum cost of annuities provided through DB schemes.

Bloomestein et al. (2009) analysed the transaction between the uncertainty in payments to the pension funds and the returns at the retirement embedded in a range of pension plans. The main measurementin assessing risk sharing characteristics were the funding ratio (assets to liabilities) and the replacement rate (benefits to salaries). The stochastic simulation results revealed that hybrid plans are most efficient and sustainable in sharing the risk when compared with old styled DB and DC plans. In concluding, it is apparent that selection of a particular retirement plan based on the employees' decisions, their attitude of risk aversion and their capability to oblige to an intergenerational risk sharing contract.

2.7.Pension Plans in Other Countries

Canada

Private sector–In Canada, providing a DB pension plan for employee is voluntarily done by employers. In early 90's private sector DB pension plan coverage was 30%

and now it has reduced to 12%. Plans are majorly contributed by an individual company, institute or a employer. However in some instance, pension schemes are funded by a cluster of companies in cooperatively contributing DB.

DB plans normally offer,

- Periodic income streams depending on range of formulas including ,
  - ✓ a % of salary at the retirement age, multiplied by no of service years
  - ✓ a fixed amount times years of service
- A life time returns usually starts at the age of 65 years. Surviving spouse benefits or other death benefits are generally available on an actuarially equivalent basis.
- Usually on a reduced basis,early retirement benefits are available.
- Lump sum payment instead of life time pension salary are progressively more available in pension plans on an actuarial equivalent basis

Public sector – Nearly 83% of DB plan coverage is available for public workers and it is a higher rate compared to private sector workers. Public sector benefit scheme structure is also similar to the private sector plans. The benefit is calculated by average salary at the retirement, multiplied by no of service years. Nevertheless, the indexing of returns for inflation is similar in the government sector.

Taxation – For the pension plans both the workers' and institutes' contribution are excepted from the taxation. Moreover, returns received by investing the accumulated contribution are also exempt from the taxation always. But, the returns earned by the pensioners are taxed as a normal income.

Japan

Private sector - A DB benefit structure. This is specially designed for small scale employers.These plans are unfunded and retirement benefits are lump sum "allowances".

Main features,

- Voluntary

- Wide range of benefit calculating formulas are available - most popular schemes are
    1) Point based plans
    2) Fixed Yen plans reduce
- Returns are not vested within the service period of the job.
- Returns may be decreased or canceled in case of major misbehavior

DB business pension schemes have build up as external funding mediums generally by amending all or part of pre-existing unfunded lump-sum payment schemes.The key features are similar to lump sum allowances. And some other are discussed below.

- at least 5 years Return period (Large scale institutions normally offers a life time pension income with an assured payment period. However, the return received only for a period like 20, 15,10,5 years) with a lump sum value.
- Rate of interest can be deferred payments until the retirement age, to accumulated fund to annuity and to revert it to lump-sum may be stable or variable connected to financial institutes' interest rates.
- Generally not indexation.amalgamation

Public sector - Typically DB benefit model–Government sector workers are qualified for both non-contributed pension accumulated fund (based on the basic salary at the retirement age) and , before October 2015 , a non-contributed pension scheme mentioned as an extra coverage to social security (the "occupational addition") . The occupational addition generally similar to 20% of the salary related social security pension benefit for non-government sector workers. After the amalgamation of social security pensions for both the private and public sectors effective from October 2015. Further, contributed professional type retirement schemes were introduceded as successor plans to the occupational addition. The main features of the new pension schemes are,

- Can be applied to the term starting since October 2015

- Cash balance payments with the interest received rate based on the interest rate of JGB
- Whole life annuity payable at 65 is a transform of the notional account and that conversion comprises of 50% from the notional account
- Balance of the notional account is changed to an annuity payable for either 10 or 20 years certain. In addition, for this feature a lump sum option is also available.
- Retirement benefits obtained prior to the pre-set time period are available on actuarially neutral terms.

Taxation - Exempt –suspended from 1999

United Kingdom

Private sector – DB structure is used. In the UK context new entrants are not allowed to DB schemes and many of them are closed to all accrual of benefits. Their pension return estimate on 2/3 of final salary after 40 years' service, guaranteed.

- Assured increase of payment based on inflation indexes. (pension payments increase based inflation rates. (RPI and CPI measures , often with 3% or 5% caps)
- The spouse will be returned 50% or 2/3 of the member's pension return pay.
- On resigning the job before retirement age a vested returnt is delivered that improves (according to the CPI inflation) before the pension age. Employees can decide to take a lump sum amount of their benefits to an optional retirement plan.
- An employee can adjust his pension income by early or late retirement to change the normal retirement income, generally on actuarially neutral terms.

Public Sector – Both Public sector DB pension plans and private sector plans above are very similar. Public sector pension plans can be categorized in to two major sections. (regulated by different governing bodies):

- Local authority plans (funded)
- Central Public Sector plans (unfunded)

Taxation - Contributions amount and investment income are Exempted.

– Taxed (benefits out, some exemptions).

The next chapter discusses the methodology of the thesis. Further, it will explain important theories that are used to build up the proposed pension scheme such that annuities, contributory stage, annuity payment for n years, compound interest and discount factor, life tables, Curtate future-life time, benefit payment stage, life annuities with monthly payments and monthly retirement benefit.

3. METHODOLOGY

3.1. Introduction

This research is based on actuarial statistics which is the core science of insurance industry. It is unthinkable to develop the insurance business without actuarial techniques

Actuarial science is the dicipline that practices mathematical and statistical techniques to measure risk in finance, insurance and other industries. Actuaries use mathematical skills to decrease the adverse monetaryeffect of the expected and unexpected things that happen to people like illness, accidents, unemployment and premature deaths. They design plans to protect people themselves financially from these events and evaluate the financial risk a company takes. In performing these duties, actuaries must make sure that the availability of the funds in the company to pay benefits according to the policies are enough, and also analyze that the price charged to participants' insurance or pension plan is fair. Thus, actuarial calculations and judgments can commit organizations financial sustainability. Accordingly, insurance industry highly uses actuarial statistics in their technical calculations.

This study usestwo major areas of actuarial sciences to improve a sustainable EPF equivalent post-employment pension scheme for the private sector labour force in Sri Lanka.

1. Annuities
2. Life table

3.2 Annuties

An annuity is a sequence of cash outflows made at equal interims. Instances of annuities are systematic credits to a bank savings account, monthly loan installment payments, annual insurance payments and pension contributions.

In financial industry, the term annuity means a agreement under which one party, the insurer contracted to make a series of intermittent payments in exchange for a

premium or a series of premiums. In this scenario, annuities are savings plans offered by insurance companies to provide income after retirement.

An insurerconsiders several factors to calculate the amount of the periodic annuity benefit payments. Every annuity calculation is formed on the following concepts.

Principal: A sum of money, which is invested for a specific period of time.

Interest: The price that can be earned by the investor for his opportunity cost of funds.

Term: The period of time.

3.2.1. Types of annuities

There are various types of annuities.

(i)Annuity Immediate or annuity payable in arrear

This is an annuity under which benefit payments are planned to originate one annuity period after the annuity is obtained.An annuity period can be a month, quarter, six month or a year. An immediate annuity is purchased with a single premium because benefit payments begins soon after it is purchased.

(ii)Annuity Due

Payments are due at the beginning of the payment intervals are known as Annuity Due or annuities payable annually in advance.

(iii)Deferred Annuity

An annuity under which periodic benefit payments are planned to commence more than one annuity period. Employees usually obtain deferred annuities during their service period in expectation of the need for income after retirement.

(iv)Life Annuity

An annuity that delivers periodic benefit payments for the lifetime of a person.

(v)Annuity Certain

This type of annuity can be obtained to offer periodic payments over a stated term of time that is separate to the lifetime of an annuitant. It is payable for aassured period of time regardless of whether the person lives or dies.

(vi)Temporary Life Annuity,

is an annuity which provides periodic benefit payments until the end of specific number of years or until the death of the annuitant, whichever occurs first.

(vii)Fixed Annuities.

These are permanent interest funds issued by insurance companies. They paydefinite rates of interest,usually higher than bank call deposits, and the investor can accept income or draw income immediately. These are famous among pensioners and pre-retirees who want a free modest and guaranteed fixed benefit.

(viii)Variable Annuities.

These types of annuities permit investors to select from a basket of subaccounts or mutual funds. Account worth is determined by the performance of the mutual funds, and a rider can be obtained to lock in a definite income stream notwithstanding of market performance.

(ix)Fixed-indexed annuities

These annuities are basically fixed annuities with a variable rate of interest that is added to the contract value if an underlying market index, such as the S&P 500, is positive. These annuities are generally offered a certain minimum income value, and the opportunity of capital upside attached to a market-based index. A disadvantage is that upside potential is restricted by a so-called participation rate, caps or a spread — all methods in which investors 'profit in a rising stock market is trimmed.

3.2.2. Annuities Certain

An annuity is payable for a stated period of time. The stated period of time is known as the period certain.

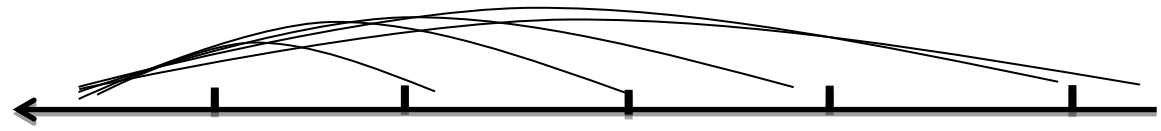


Figure 3.1: Annuities certain

Present value of a unit paid at the end of the first year is v, that of paid at the second year is v^2. Thus,

$$a_{n=}v^1+v^2\ +v^3+v^4\ \cdots\cdots\cdots\cdots\ +v^n$$

$$=\left(\frac{1-v^n}{i}\right)$$

a_n is the present value of n level payments each of one unit for n years.The insurer has to charge at least a_n amount of money to the annuitant.

All the payment would accumulate at a given rate of interest(i),the accumulated value of a_n at theend of n years is denoted by s_n,

$S_n = (1+i)^n a_n$

3.3. Contributory Stage

In this paper, employee's contribution stage annuity payment method is similar to the above scenario. The contribution is 20% of annual salary and the period is the gap between the current age and the age 55, which is a certain value for an employee.

Therefor annuity certain method can be applied to find out the present value of the contributory payments. However, in this case annuity payments are made 2 times a year (contribution payments are made at 30 th June and 31 st December as a collection of six months contribution).

3.4. Annuity Payment is Made m times a Year for n Years

Amount of annuity is one unit,1/m unit amount is paid at the end of every m th part , the present value is denoted by a_n^m is given by ,

$$a_m^n=\frac{1}{m}\left\{v^{\frac{1}{m}}+v^{\frac{2}{m}}+v^{\frac{3}{m}}+\cdots\ldots\ldots\ldots\ldots v^{\frac{nm}{m}}\right\}$$

$$=\frac{1}{m}\frac{(1-v^n)}{\left\{(v^{-1})^{\frac{1}{m}}-1\right\}}$$

$$=\frac{1-v^n}{i^m}$$

These payments would accumulate at a given rate of interest (i),the accumulated value a_n^m of at theend of n years is denoted by S_n,

$$S_n = (1+i)^n * a_n^m$$

3.5. Compound Interest and Discount Factor

Compound interest is computed on both the principal and interest.

Suppose the payment of one unit is to be made at the end of each year for n years and the interest for the certain period is i.The compound interest is$(1+i)^n$

To get the amount $(1+i)$ at the end of one year, one has to invest 1 rupee at the beginning of the year. Thus the discount on $(1+i)$is i or discount value of 1 due at the end of the year and is denoted by v,$v = \frac{1}{(1+i)}$

Sometimes, it is convenient to work with a rate of a discount. The effective rate of discount in the n th year can be defined as follows.

To get amount a (n) at the end of n thyear, one has to invest (a-1) at the beginning of the n th year. Thus, the discount is a (n)-a (n-1) on the amount a(n).So the effective rate of discount in the n th year is defined as,

$$d_n = \frac{a(n)-a(n-1)}{a(n)}$$

$$=\frac{(1+i)^n-(1+i)^{n-1}}{(1+i)^n}$$

$$= i(1+i)^{-1}$$

$$= iv$$

Most of the time, the interest is paid several times a year. There is relation between the nominal rate of interest $i^{(m)}$,when the interest is paid m times per year, and i, the

effective rate of interest in a year. Suppose, the interest is paid at the end of each m^{th}part of the year. Then the rate of interest paid in the m^{th} part is denotes by $\frac{i^{(m)}}{m}$

With the interest$\frac{i^{(m)}}{m}$, the accumulated value of 1 at the end of m parts,

$$1 + i = \left(1 + \frac{i^{(m)}}{m}\right)^m$$

$$i^{(m)} = m\left\{(1+i)^{\frac{1}{m}} - 1\right\}$$

The nominal rate of discount payable at m times per year is denoted by d^m, that mean annual rate payable monthly, the effective rate of discount is $\frac{d^m}{m}$ for each m th part of a year. The nominal rate of discount is measure of interest paid at the beginning of m th of a year. It is possible to develop a formula relating $d^m$and d.

Consider an investment of 1 unit to be repaid at the end of the year on which interest is collected in advance at the nominal rate of discount d^mDuring the $m^{th}$of a year the ending balance is 1 and the of amountof discount is d ^{m}/m, forming a balance at the beginning of the m th of the year 1-$\frac{d^m}{m}$During the (m-1) thof a year the ending balance is 1- $\frac{d^m}{m}$and the amount of discount is (1- $\frac{d^m}{m}$). $\frac{d^m}{m}$, forming a balance at the beginning of the (m-1) th of a year of,

(1- d$^{(m)}$/m)- d $^{(m)}$/m. (1- d $^{(m)}$/m)= (1- d $^{(m)}$/m)$^{2.}$

This process is continued until at the beginning of the year the balance is (1- d $^{(m)}$/m)$^{m.}$. However, the balance at the beginning of the year must also be $((1-d)$ Thus,

$$(1-d) = \left[1 - \frac{d^{(m)}}{m}\right]^m$$

$$d=1-\left[1 - \frac{d^{(m)}}{m}\right]^m$$

$$d^{(m)} = m\left[1 - (1-d)^{\frac{1}{m}}\right]$$

$$= m\left[1 - v^{\frac{1}{m}}\right]$$

3.6. Life Tables

A distribution of a curtate residual random variable $K(x)$ is summarized in a table, known as life table or a mortality table. More generally, a life table is a table which depicts, for each age, what the probability is that a person of that age will die before his or her next birthday. In simple terms, it represents the survivorship of people from a certain population.

Life tables can be created using forecasts of future mortality rates, but more often they are a picture of age-specific mortality rates in the recent past, and do not necessarily significance to be forecasts

The time until death random variable is a basic building block in the life table. In insurance industry, life tables play an important role to build models. Especially in life insurance the size and the time of payment of benefit depends on time of death insured. The premiums are calculated on the basis of years an individual is expected survive after he has signed the contract.

A life table usually contains tabulations, by ages, of the basic functions$p_{x,}q_{x,}l_{x,}d_{x,}$and some additional formulas.

$p_{x,}$-Probability value of survivorship at age x

$q_{x,}$-Probability value of deaths occurs at age x

$l_{x,}$ - expected number of survivors to age x

$d_{x,}$ - expected number of deaths in age group $(x, x+1)$

$l_{0,}$ -new births (radix).Usually taken as 100,000

w-maximum or limiting age of the population

T_x-Expected no of years lived beyond age x, by survivorship group with $l_{0,}$ initial numbers.

e_x- Average no of years of future life time of an individual of the $l_{x,}$ survivors of the group at age x.

$$e_x = \frac{T_x}{l_x}$$

Assumptions: Each newborn's age at death random variable x has the same distribution and specified the survival function $S(x)$.

Suppose a number l_0 of individuals born simultaneously and followed until death, resulting in data $d_{x,}$, $l_{x,}$ for each age x = 0, 1, 2, . . ., where

$l_{x,}$ = number of lives aged x (alive at birthday x) and

$d_{x,} = l_{x,} - l_{x+1,}$= number dying between ages $x, x + 1$

3.7. Curtate Future –Life time

A discrete random variable associated with future life time is used in life tables. Suppose,

$K(x)$-A random variable specifying the largest integer strictly smaller than

$T(x)$- Curtate future life time of age x.

Then the probability mass function of $K(x)$,

$$P(K(x) = k) = P(k < T(x) \leq k + 1)$$

$= {}_{k+1}q_x - {}_kq_x = {}_kp_x - {}_{k+1}p_x$

$= {}_kp_x - {}_kp_x \, {}_1p_{x+k}$

$= {}_kp_x (1 - {}_1p_{x+k})$

$= {}_{k|}q_x$

$E(K(x))$ −Expected number of complete future years of life of (x),and it is denoted bye_x(curtate expectation)

Distribution of a curtate residual random variable $K(x)$ is summarized in a table known as a life table or a mortality table. Starting age will be the lowest age in the table and it is denoted by α.

These are some tabulations, by individuals' age of the basic functions p_x,q_x ,l_x , $d_x$and some additional functions

In this study English life table no 15, 1990-9 2is used to calculate theA_x −the net single premium for the retirement plan.

3.8. Benefit Payment Stage

The accumulated value of annual payment (S_n) is the capital value at the beginning of the benefit payment stage. Benefit payments are made according to the following conditions.

i. The retirement age is 55 year
ii. Annual interest rate is 6%
iii. The retirement benefit will be paid by monthly basis until the beneficiaries' death occurs.
iv. The retirement benefit will be calculated according to the
v. English life table no 15.1990-92 is used to calculate the $A_{x,}$ (the net single premium) for the retirement plan, because it is the available life table.
vi. Net single premium $A_{x,}$ at the end of the year of death can be modeled as follows,

$A_x = \sum_{k=0}^{\alpha} v^{k+1}{}_k \mathrm{p}_x \mathrm{q}_x$

When the life table terms applied to the formula,

$$A_x = \sum_{k=0}^{\alpha} v^{k+1} \frac{l_{x+k}}{l_x}\left[1 - \frac{l_{x+k+1}}{l_{x+k}}\right]$$

$$= \sum_{k=0}^{\alpha} v^{k+1}\left[\frac{l_{x+k} - l_{x+k+1}}{l_x}\right]$$

3.9. Life Annuities with monthly Payments

Usually life annuities are payable on a monthly, quarterly or semiannual basis. In actuarial notation, the actuarial present value of a life annuity of 1 per year, payable in installments of 1/m at the beginning of each m th part of the year while (x) survivors, is denoted by$\ddot{a}_x^m$, The present value random variable *Y* of the life annuity-due, with payments made on m- thly basis is expressed in terms of the interest rate and the random variables, $K\ and\ J = [(T-K)m]$.The "[ ]" in the expression of J denotes the greatest integer function so that J is the number of complete $m-th$of a year lived in the year of death. For an annuity due there would be m payments for each of the k complete years and then $J+1$ payments of $1/m$in the year of death. Thus,

$$Y = \sum_{j=0}^{mK+J} \frac{1}{m} v^{\frac{j}{m}}$$

$$=\frac{\ddot{a}_x^{(m)}}{K+(J+1)/m|}=\frac{1-v^{K+(J+1)/m}}{d^{(m)}}$$

The actuarial present value $E(Y)$ is denoted by$\ddot{a}_x^{(m)}$,

$$E(Y) = \ddot{a}_x^{(m)} = \frac{1-A^{(m)}}{d^{(m)}}$$

$$1 = d\ddot{a}_x + A_x = d^{(m)}\ddot{a}_x^{(m)} + A_x^{(m)}$$

Using relations among $d, d^{(m)}$and$\ddot{a}_x^{(m)}$ the above formula can be rewritten as, $\ddot{a}_x^{(m)}=\frac{d}{d^{(m)}}\ddot{a}_x-\frac{1}{d^{(m)}}\left(A_x^{(m)}-A_x\right)$

Assumption: The deaths have a uniform distribution in each year of age.

$$A_x^{(m)} = E(v^{K+(J+1)/m}) = \frac{i}{i^{(m)}}A_x$$

3.10. Calculating the Monthly Retirement Benefit

To be a sustainable retirement scheme,

Future value of contribution payments=present value of benefit payments

$$S_n^m = \ddot{a}_x^{(m)} * (12P)$$

$$P = \frac{S_n^m}{12\ddot{a}_x^{(m)}}$$

*P*is the monthly retirement benefit of an individual retiree.

In the next chapter we will discuss about the benefit and contributory schemes and propose benefit payments.

4. ANALYSIS

4.1 Introduction

This chapter focuses on applications of actuarial science to develop an EPF equivalent post-employment pension scheme for private sector labour force in Sri Lanka. Annuities and Life table functions are the main tools that have been used in this study.

4.2 Data Collection

Data were collected by visiting a garment factory. In this study, 75 employees were selected based on the cluster sampling technique.Each cluster consistsof employees who are representing same age group and these age groups vary from 21 to 55.Further, each cluster can be contained of different job levels and different salary scales. Below tabled data were collected as the primary data from the selected sample.Annual contribution is equal to 20% of the gross salary into 12 months.

Table4.1:Primary Data-Age vs. salary scales

Employee No	Birth Year	Age(x) as at 2018.12.31	Gross Salary(y)	20% of Gross Salary	Annual Contribution	Contribution Period
S08	1973	45	17,251.44	3,450.29	41,403.46	10
S07	1999	19	18,068.19	3,613.64	43,363.66	36
S01	1976	42	18,251.74	3,650.35	43,804.18	13
S24	1991	27	19,000.00	3,800.00	45,600.00	28
S30	1998	20	21,000.00	4,200.00	50,400.00	35
S37	1994	24	22,000.00	4,400.00	52,800.00	31
S42	1994	24	23,500.00	4,700.00	56,400.00	31
S22	1975	43	23,980.89	4,796.18	57,554.14	12
S48	1991	27	24,598.98	4,919.80	59,037.55	28
S52	1992	26	25,670.08	5,134.02	61,608.19	29

The rest of the table is included in the appendix A

There are two stages in this pension scheme as,

1. Contributory Stage
2. Benefit Payment Stage

4.3. Contributory Stage

In this period 20% of monthly salary should be funded to build up the pension fund. This portion is equivalent to the total contribution of existing EPF (Employee's provident fund (2016), *Annual report 2016*.) as employee (8%) and employer (12%) .

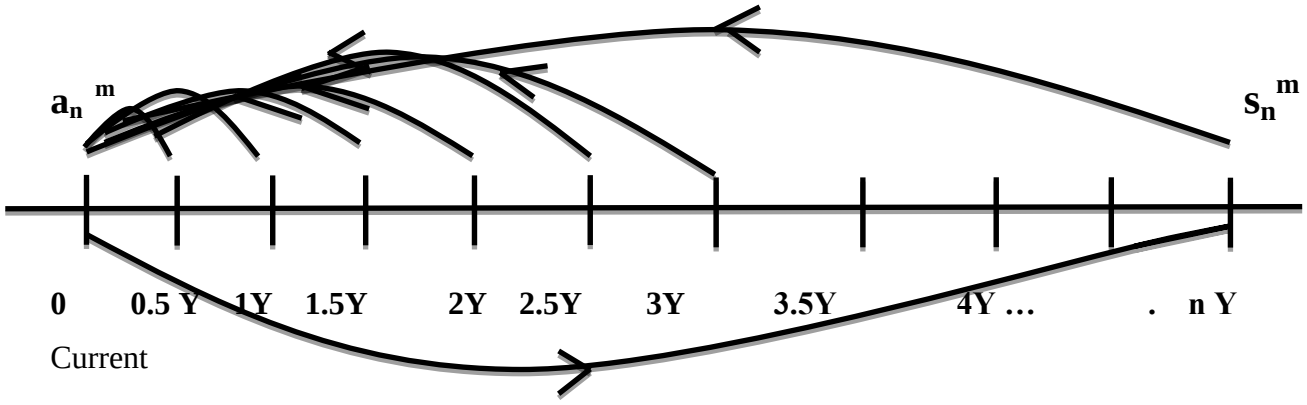


Figure 4.1: pension fund build up from 20% of monthly salary

The payment will be made as an Annuity certain and once in a six months ($m = 2$ times per year).We propose 6% of interest (i) during the contributory stage. The retirement age is 55 and the total no of years from the current age to age 55 is equal to the contribution period (n) . According to these facts, we can calculate the present value ($a_{\overline{n|}}$)and the accumulated value ($s_{\overline{n|}}$) as follows.

$i^{(m)} = m\{(1+i)^{1/m} - 1\}$

$i^{(2)} = 2\{(1+.06)^{1/2} - 1\}$

$i^{(2)}$=0.059126

$\frac{i}{i^{(m)}}$=1.014782

$v \quad = (1+i)^{-1}$ =0.943396

$a_{\overline{n}|} = (1 - v^n)/i$

$$a_{\bar{n}|}^{(m)} = a_{\bar{n}|} * \frac{i}{i^{(m)}}$$

$$s_{\bar{n}|}^{(m)} = a_{\bar{n}|}^{(m)}(1+i)^n$$

The table 4.2 depicts the data which were analyzed by the above formulas and the descriptions of the formulas are,

$a_{\overline{n}|} = (1 - v^n)/i$- This represents the present value of the retirement benefit

$a_{\bar{n}|}^{(m)} = a_{\bar{n}|} * \frac{i}{i^{(m)}}$- This represents benefit of the retirement if paid semiannually.

$s_{\bar{n}|}^{(m)} = a_{\bar{n}|}^{(m)}(1+i)^n$- This represents the benefit of the retirement after paying interest at the rate of 6% per annum.

Table: 4.2: Contributory benefit table

Employee No	Birth Year	Age(x) as at 2018.12.31	Gross Salary(y)	20% of Gross Salary	Annual Contribution	Contribution Period	$a_{\overline{n}\|} = (1 - v^n)/i$	$a_{\overline{n}\|}^{(m)} = a_{\overline{n}\|} * \frac{i}{i^{(m)}}$	$s_{\overline{n}\|}^{(m)} = a_{\overline{n}\|}^{(m)}(1+i)^n$
S08	1973	45	17,251.44	3,450.29	41,403.46	10	304,733.04	309,237.45	553,797.18
S07	1999	19	18,068.19	3,613.64	43,363.66	36	634,019.46	643,391.22	5,241,870.40
S01	1976	42	18,251.74	3,650.35	43,804.18	13	387,784.48	393,516.52	839,342.51
S24	1991	27	19,000.00	3,800.00	45,600.00	28	611,321.09	620,357.34	3,171,072.35
S30	1998	20	21,000.00	4,200.00	50,400.00	35	730,711.62	741,512.64	5,699,330.47
S37	1994	24	22,000.00	4,400.00	52,800.00	31	735,455.74	746,326.88	4,543,713.19
S42	1994	24	23,500.00	4,700.00	56,400.00	31	785,600.45	797,212.81	4,853,511.81
S22	1975	43	23,980.89	4,796.18	57,554.14	12	482,524.89	489,657.34	985,286.77
S48	1991	27	24,598.98	4,919.80	59,037.55	28	791,467.12	803,166.20	4,105,533.97
S52	1992	26	25,670.08	5,134.02	61,608.19	29	837,299.75	849,676.30	4,603,875.79

For Employee No: S08, $n = 10$, $m = 2$, annual contribution =41,403.46

$a_n = (1 - v^n)/i$ = {(1-0.943396 ^{10})/0.06}*41,403.46 = 304,733.99.04

$a_n^m = a_n * \frac{i}{i^{(m)}}$ =304,733.99*1.014782=309,237.45

$S_n^m = a_n^m(1 + i)^n$= 309,238.57*(1.06) ^{10} = 553,797.18

For Employee No: S24, $n = 28$, $m = 2$, annual contribution =45,600.00

$a_n = (1 - v^n)/i$ = {(1-0.943396 ^{28})/0.06}*45,600.00= 611,321.09

$a_n^m = a_n * \frac{i}{i^{(m)}}$ =611,321.09*1.014782=620,357.34

$S_n^m = a_n^m(1 + i)^n$= 620,357.34*(1.06) ^{28} =3,171,072.35

For Employee No: S30, $n = 35$, $m = 2$, annual contribution =50,400.00

$a_n = (1 - v^n)/i$ = {(1-0.943396 ^{35})/0.06}*50,400.00= 730,711.62

$a_n^m = a_n * \frac{i}{i^{(m)}}$ = 730,711.62*1.014782= 741,512.64

$S_n^m = a_n^m(1 + i)^n$ = 741,512.64*(1.06) ^{35} =5,699,330.47

For Employee No: S37, $n = 31$, $m = 2$, annual contribution =52,800.00

$a_n = (1 - v^n)/i$ = {(1-0.943396 ^{31})/0.06}*52,800.00= 735,455.74

$a_n^m = a_n * \frac{i}{i^{(m)}}$=735,455.74*1.014782= 746,326.88

$S_n^m = a_n^m(1 + i)^n$ = 746,326.88*(1.06) ^{31} =4,543,713.19

For Employee No: S22, $n = 12$, $m = 2$, annual contribution =57,554.14

$a_n = (1 - v^n)/i$ = {(1-0.943396 ^{12})/0.06}*57,554.14= 482,524.89

$a_n^m = a_n * \frac{i}{i^{(m)}}$=482,524.89*1.014782= 489,657.34

$S_n^m = a_n^m(1 + i)^n$ = 489,657.34*(1.06) ^{12} = 985,286.77

For Employee No: S22, $n = 12$, $m = 2$, annual contribution =57,554.14

$a_n = (1 - v^n)/i$ = {(1-0.943396 ^{12})/0.06}*57,554.14= 482,524.89

$a_n^m = a_n * \frac{i}{i^{(m)}}$= 482,524.89*1.014782= 489,657.34

$S_n^m = a_n^m(1 + i)^n$ = 489,657.34*(1.06) ^{12} = 985,286.77

4.4. Benefit Payment Stage

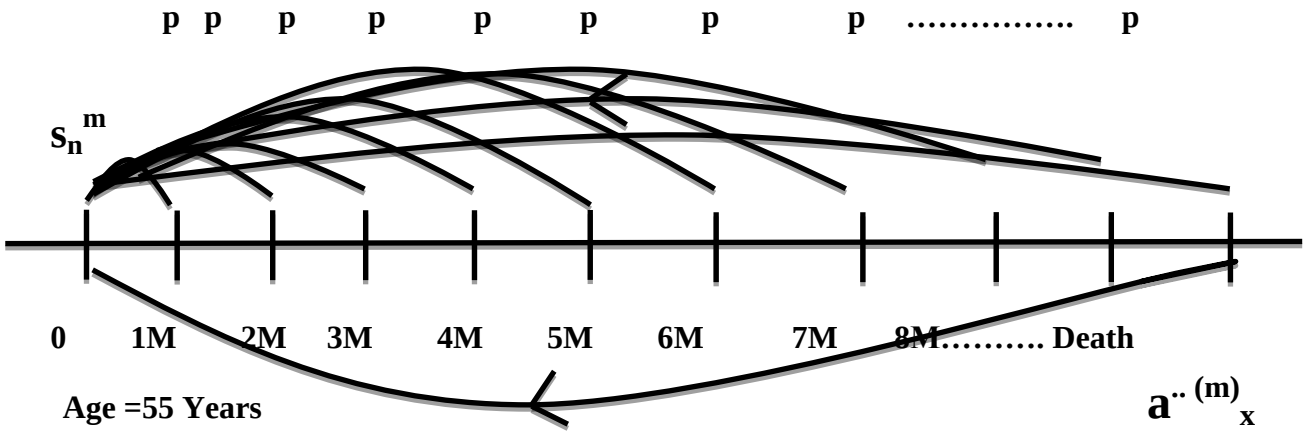


Figure 4.2: Benefit payment stage

The retirement age is 55 year

Annual interest rate is 6%

The retirement benefit will be paid by monthly basis until the beneficiary's death occurs.

Since the retirement benefit is paid monthly basis until the beneficiary's death occurs, Whole life annuity method is applied to calculate the payment.

4.4.1. Calculating the Discount Value (v)

$\boldsymbol{v} = (1+i)^{-1}$

The annual interest rate is 6%, i=0.06Thus,

$v = (1.06)^{-1}$ =0.9433962.

4.4.2. Expected number of years lived beyond age x (T_x)

$$T_x = L_x + T_{x+1}$$

$L_x = \frac{l_x + l_{x+1}}{2}$ L_x – Expected population in age group (x,x+1)

Since the benefit payment stage is commenced at the age of 55, T_{55} value of the English life table No 15.2, 1990-92 is very important.T_{55} = 1993595

4.4.3.Calculating the Net Single Premium for the Whole Life Insurance Model

For a whole life insurance issued to an individual of age (x), the Net Single Premiumis,

$A_x = \sum_{k=0}^{\infty} v^{k+1}{}_k p_x q_{x+k}$

When these terms are assigned by life table terms, the above formula can be rewritten as follows,

$$A_x = \sum_{k=0}^{\infty} v^{k+1} \left[\frac{l_{x+k} - l_{x+k+1}}{l_x}\right]$$

The retirement benefit payment is commenced at the age of 55 years. Therefor x=55.Although the payments are made until the death of beneficiary, it has been set up the upper age limit as 105 years. Thus, above Formula is modified as,

$$A_{55} = \sum_{k=0}^{49} v^{k+1} \left[\frac{l_{55+k} - l_{55+k+1}}{l_{55}}\right]$$

The value of A_{55}, can be calculated by applying English Life Table no 15.1990-92 (Appendix A) figures to the above formula. Table 1.3 shows the result of the calculation relating to the above formula starting from $k = 0\ to\ k = 49$.The entering age limit of the proposed pension scheme can be considered as 55 years, when. $k = 0$, and the upper limit of the scheme can be considered as 105years, when $k = 50$.Table 1.5 shows the result of the calculation relating to the above given formula starting from $k = 0\ to\ k = 49$

Table 4.3: Net single premium for whole life insurance

K	k+1	l_{55}	$l_{(55+k)}$	$l_{(55+k+1)}$	$l_{(55+k)}-l_{(55+k+1)}$	$v=(1+i)^{-1}$	$v^{(k+1)}$	$v^{(k+1)}/l_{55}$	$\{v^{(k+1)}/l_{55}\} *\{l_{(55+k)}-l_{(55+k+1)}\}$
0	1	91217	91217	90490	727	0.9433962	0.943396	0.0000103423	0.00751887
1	2	91217	90490	89684	806	0.9433962	0.889996	0.0000097569	0.00786407
2	3	91217	89684	88792	892	0.9433962	0.839619	0.0000092046	0.00821054
3	4	91217	88792	87805	987	0.9433962	0.792094	0.0000086836	0.00857073

4	5	91217	87805	86714	1091	0.9433962	0.747258	0.0000081921	0.00893757
5	6	91217	86714	85507	1207	0.9433962	0.704961	0.0000077284	0.00932817
6	7	91217	85507	84173	1334	0.9433962	0.665057	0.0000072909	0.00972611
7	8	91217	84173	82701	1472	0.9433962	0.627412	0.0000068782	0.01012477
8	9	91217	82701	81076	1625	0.9433962	0.591898	0.0000064889	0.01054447
9	10	91217	81076	79293	1783	0.9433962	0.558395	0.0000061216	0.01091483
10	11	91217	79293	77353	1940	0.9433962	0.526788	0.0000057751	0.01120370
11	12	91217	77353	75256	2097	0.9433962	0.496969	0.0000054482	0.01142490
12	13	91217	75256	73001	2255	0.9433962	0.468839	0.0000051398	0.01159030
13	14	91217	73001	70598	2403	0.9433962	0.442301	0.0000048489	0.01165188
14	15	91217	70598	68055	2543	0.9433962	0.417265	0.0000045744	0.01163276
15	16	91217	68055	65381	2674	0.9433962	0.393646	0.0000043155	0.01153963
16	17	91217	65381	62562	2819	0.9433962	0.371364	0.0000040712	0.01147677
17	18	91217	62562	59593	2969	0.9433962	0.350344	0.0000038408	0.01140326
18	19	91217	59593	56484	3109	0.9433962	0.330513	0.0000036234	0.01126506
19	20	91217	56484	53266	3218	0.9433962	0.311805	0.0000034183	0.01100001
20	21	91217	53266	49965	3301	0.9433962	0.294155	0.0000032248	0.01064502
21	22	91217	49965	46579	3386	0.9433962	0.277505	0.0000030423	0.01030107
22	23	91217	46579	43124	3455	0.9433962	0.261797	0.0000028700	0.00991602
23	24	91217	43124	39630	3494	0.9433962	0.246979	0.0000027076	0.00946033
24	25	91217	39630	36128	3502	0.9433962	0.232999	0.0000025543	0.00894528
25	26	91217	36128	32654	3474	0.9433962	0.21981	0.0000024097	0.00837147
26	27	91217	32654	29254	3400	0.9433962	0.207368	0.0000022733	0.00772938
27	28	91217	29254	25954	3300	0.9433962	0.19563	0.0000021447	0.00707740
28	29	91217	25954	22779	3175	0.9433962	0.184557	0.0000020233	0.00642389
29	30	91217	22779	19756	3023	0.9433962	0.17411	0.0000019087	0.00577014
30	31	91217	19756	16917	2839	0.9433962	0.164255	0.0000018007	0.00511220
31	32	91217	16917	14280	2637	0.9433962	0.154957	0.0000016988	0.00447968
32	33	91217	14280	11874	2406	0.9433962	0.146186	0.0000016026	0.00385590
33	34	91217	11874	9730	2144	0.9433962	0.137912	0.0000015119	0.00324153
34	35	91217	9730	7857	1873	0.9433962	0.130105	0.0000014263	0.00267151
35	36	91217	7857	6249	1608	0.9433962	0.122741	0.0000013456	0.00216371
36	37	91217	6249	4880	1369	0.9433962	0.115793	0.0000012694	0.00173784
37	38	91217	4880	3726	1154	0.9433962	0.109239	0.0000011976	0.00138200
38	39	91217	3726	2773	953	0.9433962	0.103056	0.0000011298	0.00107668
39	40	91217	2773	2011	762	0.9433962	0.097222	0.0000010658	0.00081217
40	41	91217	2011	1421	590	0.9433962	0.091719	0.0000010055	0.00059325
41	42	91217	1421	979	442	0.9433962	0.086527	0.0000009486	0.00041928
42	43	91217	979	657	322	0.9433962	0.08163	0.0000008949	0.00028816
43	44	91217	657	428	229	0.9433962	0.077009	0.0000008442	0.00019333
44	45	91217	428	271	157	0.9433962	0.07265	0.0000007965	0.00012504
45	46	91217	271	166	105	0.9433962	0.068538	0.0000007514	0.00007889

46	47	91217	166	98	68	0.9433962	0.064658	0.0000007088	0.00004820
47	48	91217	98	56	42	0.9433962	0.060998	0.0000006687	0.00002809
48	49	91217	56	31	25	0.9433962	0.057546	0.0000006309	0.00001577
49	50	91217	31	16	15	0.9433962	0.054288	0.0000005952	0.00000893
								Total	A_{55}=0.31890051

When $k = 0$ l_{55}=91217$l_{55+0+1=56}$ =90490

$v^{(0+1)}$= 0.9433962$l_{55} - l_{56}$=91217-90490=727

$\left\{\frac{v^{0+1}}{l_{55}}\right\}(l_{55} - l_{56})$= $\left\{\frac{0.9433962}{91217}\right\}$(727)=0.00751887

$When\ k = 1$ l_{56}=90490$l_{55+1+1=57}$ =89684

$v^{(1+1)}$= 0.889996$l_{56} - l_{57}$=90490-89684=806

$\left\{\frac{v^{1+1}}{l_{55}}\right\}(l_{56} - l_{57})$= $\left\{\frac{0.889996}{91217}\right\}$(806)=0.00786407

$When\ k = 2$ l_{57}=89684$l_{55+1+2=58}$ =88792

$v^{(2+1)}$ = 0.839619$l_{57} - l_{58}$=89684-88792=892

$\left\{\frac{v^{2+1}}{l_{55}}\right\}(l_{57} - l_{58})$= $\left\{\frac{0.839619}{91217}\right\}$(892)=0.00821054

This calculation can be proceeded up to k=50 to generate the above table and according to the table,Net Single Premium for the pension scheme, A_{55} =0.22687445.

$A_{55}$is the net single premium for a whole life insurance issued to person at his age 55.

4.4.4.Calculating the Interest Rate ($i^{(m)}$) for the Monthly Benefit Payment(P)

Since the interest is paid at the end of each month, the rate of interest paid by monthly is denotes by$\frac{i^{(12)}}{12}$

With the interest$\frac{i^{(12)}}{12}$, the accumulated value of 1 at the end of months,

$i^{(m)} = m\left\{(1+i)^{\frac{1}{m}} - 1\right\}$

i$^{(12)}$=12{(1+0.06) $^{1/12}$ -1}=0.058410607

i$^{(12)}$is the nominal rate of interest ,when interest is paid 12 times (at the end of each month) and i is the effective rate of interest in a year.

4.4.5. Calculating the Nominal Rate of Discount Payable at Monthly$d^{(12)}$,

According to the 3.5,

$$1 - d = \left[1 - \frac{d^{(m)}}{m}\right]^m$$

d=1-$\left[1 - \frac{d^{(m)}}{m}\right]^m$

$d^{(m)} = m\left[1 - (1-d)^{\frac{1}{m}}\right]$

d$^{(m)}$=m[1-v $^{1/m}$] $d^{(m)} = m\left[1 - v^{\frac{1}{m}}\right]$

Where d is the effective rate of discount, m is number of discounting times per year

In this case m=12, v=0.9433962,

$d^{(m)} = m\left[1 - v^{\frac{1}{m}}\right]$=12[1- (0.9433962) $^{1/12}$]

$d^{(12)}$ =0.058127695

4.4.6. Relationship between Net Single Premium (A_x) and Monthly Annuities ($A_x^{(m)}$)

According to the 3.9, the Relationship between Net Single Premium (A_x) and Monthly Annuities ($A_x^{(m)}$) can be formulated as follows,

$$A_x^{(m)} = \frac{i}{i^{(m)}} A_x$$

$$A_{55}^{(12)} = \frac{i}{i^{(12)}} A_{55}$$

$A_{55}^{(12)}$=(0.06/0.058410607) * 0.3189005= 0.327578013

4.4.7. Calculating the Actuarial Present Value of the Monthly Benefits($\ddot{a}_x^{(m)}$)

As per the derivation on 3.11,

$$\ddot{a}_x^{(m)} = \frac{1-A^{(m)}}{d^{(m)}} = \frac{1-A^{(12)}}{d^{(12)}}$$

$$\ddot{a}_x^{(m)} = \frac{1-0.327578013}{0.058127695}$$

$\ddot{a}_x^{(m)}$ = 11.56801944

4.5.Monthly Retirement Benefit

Actuarial future value of contribution payments=Actuarial present value of benefit payments

$$s_{\bar{n}|}^{(m)} = \ddot{a}_x^{(m)} * (12P)$$

$$P = \frac{s_{\bar{n}|}^{(m)}}{12\ddot{a}_x^{(m)}}$$

*P*is the monthly retirement benefit of an individual retiree. Table 4.4 depicts the summery of the proposed benefit payments.

Table 4.4: Proposed benefit payments

Employee No	Monthly Contribution	Annual Contribution	Contribution Period	$S_n^{(m)}$	Monthly Benefit(P)
S08	3,450.29	41,403.46	10	553,797.18	3,989.43
S07	3,613.64	43,363.66	36	5,241,870.40	37,761.22
S01	3,650.35	43,804.18	13	839,342.51	6,046.43
S24	3,800.00	45,600.00	28	3,171,072.35	22,843.67

S30	4,200.00	50,400.00	35	5,699,330.47	41,056.66
S37	4,400.00	52,800.00	31	4,543,713.19	32,731.86
S42	4,700.00	56,400.00	31	4,853,511.81	34,963.58
S22	4,796.18	57,554.14	12	985,286.77	7,097.78
S48	4,919.80	59,037.55	28	4,105,533.97	29,575.32
S52	5,134.02	61,608.19	29	4,603,875.79	33,165.26

The rest of the table is included in the appendix C.

For Employee No: S08, $s_{\bar{n}|}^{(m)}$=553,797.18,$\ddot{a}_x^{(m)}$= 11.56801944

$$P8 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{553{,}797.18}{12 * 11.56801944} = 3989.43$$

For Employee No: S07, $s_{\bar{n}|}^{(m)}$= 5,241,870.40, $\ddot{a}_x^{(m)}$= 11.56801944

$$P7 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{5{,}241{,}870.40}{12 * 11.56801944} = 37{,}761.21$$

For Employee No: S01, $s_{\bar{n}|}^{(m)}$= 839,342.51, $\ddot{a}_x^{(m)}$= 11.56801944

$$P1 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{839{,}342.5}{12 * 11.56801944} = 6046.43$$

For Employee No: S24, $s_{\bar{n}|}^{(m)}$= 3,171,072.35, $\ddot{a}_x^{(m)}$= 11.56801944

$$P24 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{3{,}171{,}072.35}{12 * 11.56801944} = 22{,}843.67$$

For Employee No: S30, $s_{\bar{n}|}^{(m)}$= 5,699,330.47, $\ddot{a}_x^{(m)}$= 11.56801944

$$P30 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{5{,}699{,}330.47}{12 * 11.56801944} = 41{,}056.66$$

For Employee No: S37, $s_{\bar{n}|}^{(m)}$= 4,543,713.19, $\ddot{a}_x^{(m)}$= 11.56801944

$$P37 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{4{,}543{,}713.19}{12 * 11.56801944} = 32{,}731.86$$

For Employee No: S42, $s_{\bar{n}|}^{(m)}$= 4,853,511.81, $\ddot{a}_x^{(m)}$= 11.56801944

$$P42 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{4{,}853{,}511.81}{12 * 11.56801944} = 34{,}963.58$$

For Employee No: S22, $s_{\bar{n}|}^{(m)}$= 985,286.77, $\ddot{a}_x^{(m)}$= 11.56801944

$$P22 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{985{,}286.77}{12 * 11.56801944} = 7{,}097.78$$

For Employee No: S48, $s_{\bar{n}|}^{(m)}$= 4,105,533.97, $\ddot{a}_x^{(m)}$= 11.56801944

$$P48 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{4{,}105{,}533.97}{12 * 11.56801944} = 29{,}575.32$$

For Employee No: S52, $s_{\bar{n}|}^{(m)}$= 4,603,875.79, $\ddot{a}_x^{(m)}$= 11.56801944

$$P52 = \frac{s_n^m}{12\ddot{a}_x^{(m)}} = \frac{4{,}603{,}875.79}{12 * 11.56801944} = 33{,}165.26$$

Figure 4.3 illustrates the comparison of the monthly contribution and the monthly retirement benefit.

4.6.Comparison of EPF Equivalent Post Employment Pension Scheme with a Government Pension Scheme.

The proposed EPF equivalent post-employment pension scheme can be compared with the government pension scheme that is recently introduced for the tri forces pensioners by the Pension department of Sri Lanka. The percentages of the present salaries used to calculate the monthly benefit of the sample group is based on the table (Appendix B) in the pension circular no 01/2019 amendment III (Pension Department of Sri Lanka, 2019, Annexure 01, Table 01) .

The contribution period of the proposed EPF equivalent pension scheme is considered as the service period of the government pension scheme. There should be at least 10 years of service period to entitle to the government pension schemes' benefit while there are no such conditions for the contribution period of proposed scheme in the study. Thus, S04, S12, S15, S16, S51, S67, are not eligible for the government pension whose service periods are less than 5 years. According to the

pension department scheme, Employee- S09 is eligible for the government scheme monthly benefit which is equivalent to 61% of his present salary.

$$90{,}924.00 * \frac{66}{100} = 60{,}009.84$$

This is less than proposed monthly benefit value of 63,797.41

Further, Employee- S41 is eligible for the government scheme monthly benefit which is equivalent to 71% of his present salary.

$$34{,}988.67 * \frac{71}{100} = 24{,}841.96$$

This is a lesser amount than proposed monthly benefit value of 45,204.70

According to the above calculations, monthly benefit of the proposed pension scheme is greater than the government scheme monthly benefit, for 48 employees out of the sample group.

Table 4.5 depicts the comparison of proposed EPF Equivalent Post Employment Pension Scheme and Tri forces Non-Contribution Pension Scheme introduced by the Government.

Table 4.5: Proposed EPF Equivalent Post Employment Pension Scheme VS Tri forces Non-Contribution Pension Scheme introduced by the Government.

Employee No	According to the Tri forces Non-Contribution Pension Scheme introduced by the Government				Proposed EPF Equivalent Post Employment Pension Scheme	
	Monthly Gross salary	Service Period (Contribution Period)	Considered Percentage of Present Salary for the Benefit (According to the Appendix F)	Monthly Benefit	Monthly Contribution	Monthly Benefit (P)
S09	90,924.00	21	66	60,009.84	18,184.80	63,797.41
S05	85,000.00	21	66	56,100.00	17,000.00	59,640.80
S62	58,779.03	24	69	40,557.53	11,755.81	52,403.80
S47	46,789.01	27	72	33,688.09	9,357.80	52,295.72

S59	39,900.02	29	74	29,526.01	7,980.00	51,550.07
S06	36,162.50	30	75	27,121.88	7,232.50	50,158.99
S33	43,098.37	27	72	31,030.83	8,619.67	48,170.72
S45	53,980.00	24	69	37,246.20	10,796.00	48,125.28
S75	62,987.94	22	67	42,201.92	12,597.59	47,952.75
S41	34,988.67	29	71	24,841.96	6,997.73	45,204.70

The rest of the table is included in the appendix D.

Figure 4.4 illustrates the comparison of two pension schemes mentioned in table 4.4. Finally it is clearly verified that the proposed EPF Equivalent post-employment pension scheme is more effective than the government tri-forces non-contributory pension scheme, in the sense of monthly benefit.

Next chapter will describe the conclusion and limitations of the study. Furthermore, itwill compare the EPF equivalent post-employment pension scheme and the pension scheme which was introduced for the tri forces staff members by the government in 2019.Contribution amount, contribution period and the benefit of the proposed pension scheme will be analyzed by the next chapter. Moreover next chapter will recommend certain suggestions for the future researchers to improve the model by mitigating the limitations of the study.

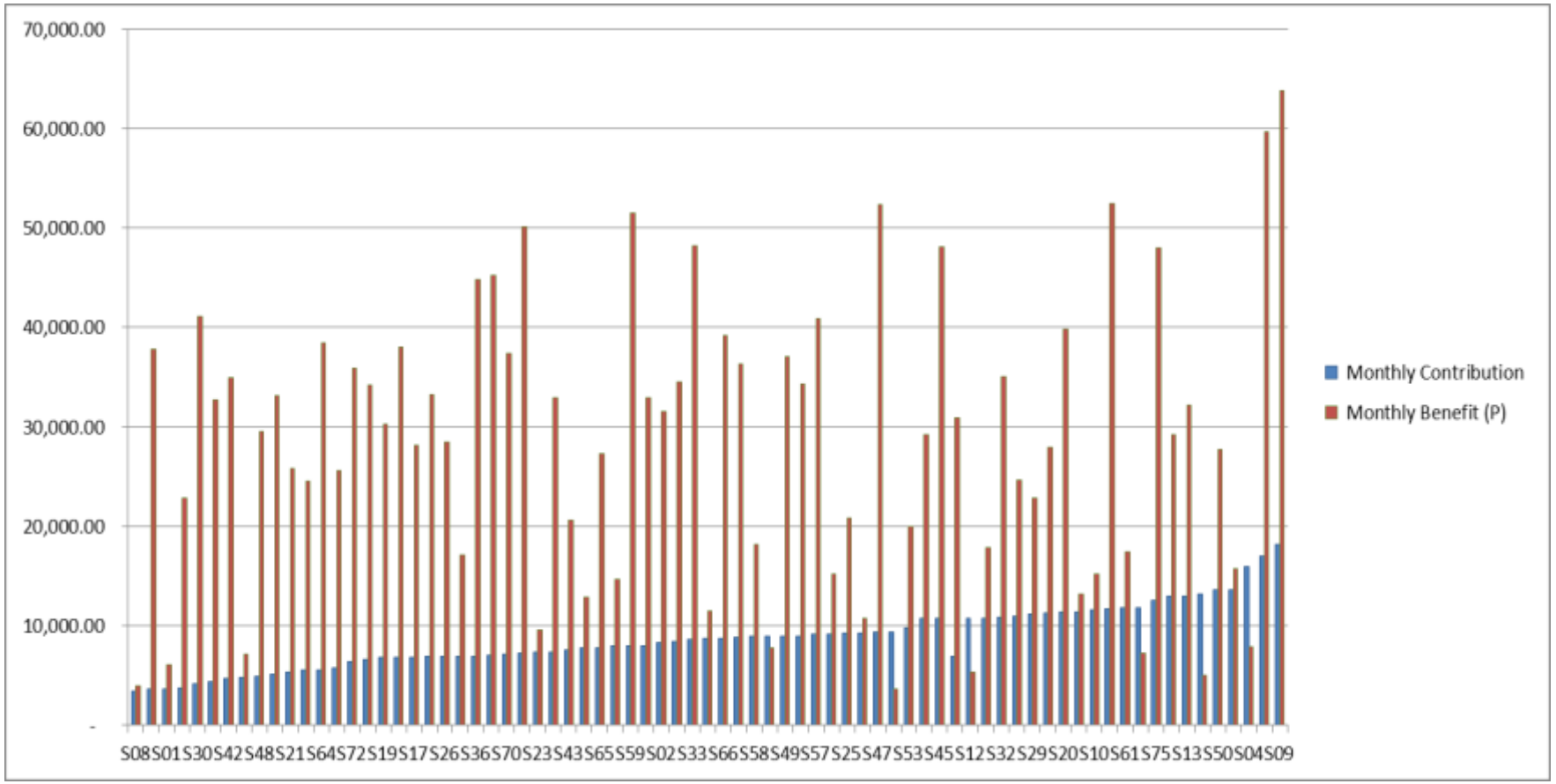


Figure 4.3: Employee's Monthly Benefit vs. Employee's Monthly Contribution

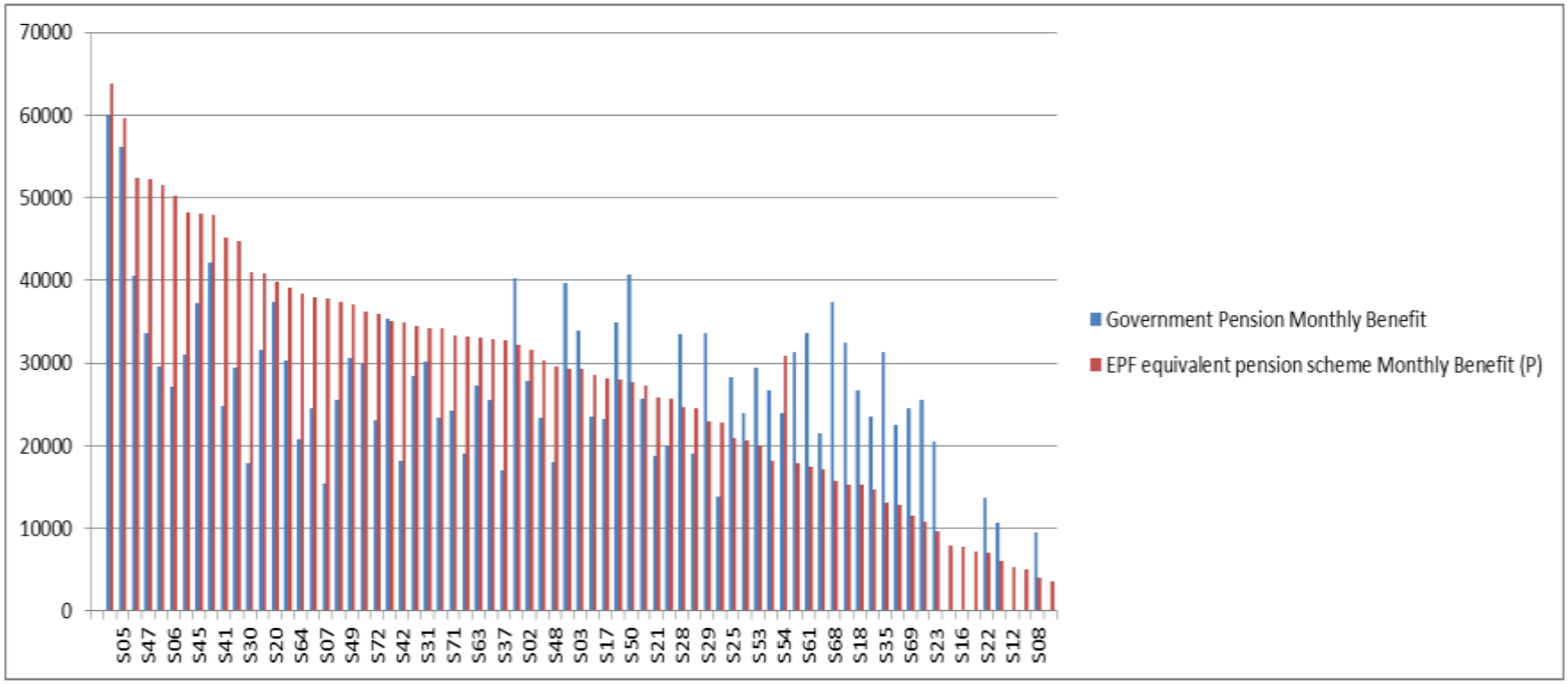


Figure 4.4: Government Pension Monthly Benefit vs. EPF Equivalent Pension Scheme Monthly Benefit

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

In conclusion, both defined benefit plans and defined contribution retirement plans have certain similarities and differences. The similarities in both plans are that it helps employees plan for their retirement. Both plans have the intent to help save cash for their retirement.

The difference for the retirement plan is how it is offered and put together. The defined benefits retirement plan uses a fixed rate of contribution by the employer to the employee's retirement plan and is usually combined by using the employees time in service and pre-retirement pay. The defined contribution plan is based on the contribution of the employee's pay which is then matched by the employers. In this plan, the contributors to the retirement plan are both the employee and the employer and this proves the difference between the defined benefit and defined contribution retirement plans. Both these plans are used to help with providing retirement income for the employees. Ultimately these retirements plan are very beneficial for the employees when they reach their retirement due to the provided income support.

The table 4.3 is the essence of the study which narrates the findings in simple terms. Employees, whose salary scales are high, contribute a higher portion to the scheme. Further, employees with a longer service period are also contributing a greater portion to the benefit scheme. Accordingly, employees with a longer service period or a higher salary scales are the most benefited party from the EPF equivalent post-employment pension scheme.

It is concluded that, the EPF Equivalent Post Employment Pension Scheme is more effective for 64% (48/75) of the considering sample than the Tri forces Non-Contribution Pension Scheme introduced by the Government.

5.2. Recommendation

According to the Table 4.4 employees' monthly benefit is depending on the number of years he or she contributes to the scheme and the annual contribution amount. When the both figures are high beneficiary parties' beneficial amount is high. Thus,

it is recommended to contribute a higher portion from the employer when the employee's salary scales are lower than a pre-defined level.

It is recommended for the employers to force employees to contribute for the EPF equivalent post-employment pension scheme from the very beginning of each and every employee's carrier life. There should be a proper mechanism to manage the pension fund too.

Finally, the study highly recommends this type of post-employment pension scheme instead of existing EPF lump sum payment scheme, for the reason that this scheme provides employees a long term steady monthly income which helps them a financial security over a long period of their life time.

5.3. Future Analysis

When it is to limitations of the study, the study have used the Standard English life table no 15.2. But, in Sri Lankan context this life table doesn't match with Sri Lankan population as same as in United Kingdom. However, currently other insurance companies also are using this same tale for their calculations as well.

In addition to that, the considering sample is small in quantity. Thus it affects to the accuracy of data we collected.

This study considers a repayment period of 50 years. There it assumes that an employee retires at 55 years of age and the repayment is up to 105 years of age. It is acceptable with the existing life expectancy period. However, for a case deviate from that assumption it is unfair for the considering employee.

Even though employees' salaries are increased by periodically, in this study gross salaries and the contributed amounts are considered as constant values throughout the service period of an employee. It is recommended for the future researchers to avoid above mentioned limitations to increase the accuracy of the study.

LIST OF REFERENCES

Arunatilake, N., Samarakoon, S. &Gunasekara, N. (2015).*Income Security for Older Persons in Sri Lanka* (Working paper number 108).SDD SPPS Project working paper series. Retrieved from https://www.unescap.org/resources/income-security-older-persons-sri-lanka

Blake, D., Cairns, A.J.G., & Dowd, K. (2003). *Pensionmetrics 2: stochastic pension plan design during the distribution phase. Insurance: Mathematics and Economics*, 33 (2003) 29–47. doi: 10.1016/S0167-6687(03)00141-0.

Blommestein, H. J., Janssen, P., Kortleve, & N., Yermo, J. (2009). *"Evaluating the Design of Private Pension Plans: Costs and Benefits of Risk-Sharing".* OECD Working Papers on Insurance and Private Pensions, No. 34, OECD Publishing. doi:10.1787/225162646207.

Bodie, Z., Marcus, A. J., & Merton, R. C. (1988). *Defined benefit versus defined contribution pension plans: What are the real trade-offs?. In Pensions in the US Economy* (pp. 139-162). University of Chicago Press

Bloom, D. E., Canning, D., & Sevilla, J. (2001). *The effect of health on economic growth: theory and evidence* (No. w8587). National Bureau of Economic Research.

Dreze, J., & Sen, A. (1989). *Public action for social security: Foundations and strategy.*

Employee's provident fund (2016), *Annual report 2016*, Retrieved from http://www.epf.lk/assets/library/annualreport/annualreport_2016_english.pdf

International Monetary Fund (2005), *International Monetary Fund Annual Report 2005 Making the Global Economy Work for All*, Retrieved from https://www.imf.org/en/Publications/AREB/Issues/2016/12/31/Annual-Report-of-the-Executive-Board-for-the-Financial-Year-Ended-April-30-2005

Justino, P. (2007). *Social security in developing countries: Myth or necessity? Evidence from India.* Journal of International Development: The Journal of the Development Studies Association, *19*(3), 367-382.

Luhmann, N. (2000). Familiarity, *confidence, trust: Problems and alternatives. Trust: Making and Breaking Cooperative Relations*, electronic edition, Department of Sociology, University of Oxford: 94-107.

McCarthy, D. (2003). *A life-cycle analysis of defined benefit pension plans. Journal of Pension Economics and Finance*, 2(02), 99-126. doi:10.1017/S1474747203001288.Pdfs.semanticscholar.org. (2019). [online] Available at:https://pdfs.semanticscholar.org/345c/631ef7831b8f99cac17d7ead86078edf1f19.pdf [Accessed 17 Aug. 2019].

Pauw, J. C., Van der Linde, G. J. A., Fourie, D. J., & Visser, C. B. (2015). *Managing public money*. Pearson Holdings Southern Africa.

Pension Department. (2019, September 05). *Adjusting the Pension salaries to State Administration Circular number 03/2016, According to budget proposals 2019.*Retrieved from http://pensions.gov.lk/images/circulars/2019/S/1567741915-01-2019-revision.pdf.

Rousseau, D. M., Sitkin, S. B., Burt, R. S. &Camerer, C. (1998*). Not so Different After All: A Cross- Discipline View of Trust, Academy of Management Review*, 23, (3):393-404

Samwick, A.A., & Skinner, J. (1998). *How will defined contribution pension plans affectretirement income?* (No. w6645). National Bureau of Economic Research. Retrievedfrom http://www.nber.org/papers/w6645

Sri Lanka Population 2019.(n.d.). Retrieved from http://worldpopulationreview.com/countries/sri-lanka-population/

Swaan, A. D. (1988). *In care of the state: health care, education and welfare in Europe and the USA in the modern era*.

Vickerstaff, D., Macvarish, J., Taylor-Gooby, P., Loretto, W. & Harrison, T. (2012).*Trusts and confidence in pensions :A Literature review* (Working paper

number 108). Retrived from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/214405/WP108.pdf

Zmerli, S., & Newton, K. (2007). *Trust in people, confidence in political institutions, and satisfaction with democracy.* In *Citizenship and involvement in European democracies* (pp. 59-89). Routledge.

Appendix A: Primary Data -Age vs. salary scales

Employee No	Birth Year	Age(x) as at 2018.12.31	Gross Salary(y)	20% of Gross Salary	Annual Contribution	Contribution Period
S08	1973	45	17,251.44	3,450.29	41,403.46	10
S07	1999	19	18,068.19	3,613.64	43,363.66	36
S01	1976	42	18,251.74	3,650.35	43,804.18	13
S24	1991	27	19,000.00	3,800.00	45,600.00	28
S30	1998	20	21,000.00	4,200.00	50,400.00	35
S37	1994	24	22,000.00	4,400.00	52,800.00	31
S42	1994	24	23,500.00	4,700.00	56,400.00	31
S22	1975	43	23,980.89	4,796.18	57,554.14	12
S48	1991	27	24,598.98	4,919.80	59,037.55	28
S52	1992	26	25,670.08	5,134.02	61,608.19	29
S21	1988	30	26,789.67	5,357.93	64,295.21	25
S27	1987	31	27,556.65	5,511.33	66,135.96	24
S64	1993	25	27,689.09	5,537.82	66,453.82	30
S34	1987	31	28,776.00	5,755.20	69,062.40	24
S72	1990	28	32,098.78	6,419.76	77,037.07	27
S39	1989	29	33,000.00	6,600.00	79,200.00	26
S19	1987	31	33,945.72	6,789.14	81,469.73	24
S60	1990	28	34,000.98	6,800.20	81,602.35	27

S17	1986	32	34,098.90	6,819.78	81,837.36	23
S71	1988	30	34,555.06	6,911.01	82,932.14	25
S26	1986	32	34,555.67	6,911.13	82,933.61	23
S38	1980	38	34,589.09	6,917.82	83,013.82	17
S36	1992	26	34,677.00	6,935.40	83,224.80	29
S41	1992	26	34,988.67	6,997.73	83,972.81	29
S70	1989	29	36,000.00	7,200.00	86,400.00	26
S06	1993	25	36,162.50	7,232.50	86,790.00	30
S23	1974	44	36,578.89	7,315.78	87,789.34	11
S73	1987	31	36,899.09	7,379.82	88,557.82	24
S43	1981	37	37,980.00	7,596.00	91,152.00	18
S55	1976	42	38,779.03	7,755.81	93,069.67	13
S65	1984	34	38,909.07	7,781.81	93,381.77	21
S74	1977	41	39,890.90	7,978.18	95,738.16	14
S59	1992	26	39,900.02	7,980.00	95,760.05	29
S63	1986	32	39,997.78	7,999.56	95,994.67	23
S02	1985	33	41,500.00	8,300.00	99,600.00	22
S40	1986	32	41,876.07	8,375.21	100,502.57	23
S33	1990	28	43,098.37	8,619.67	103,436.09	27
S69	1974	44	43,788.69	8,757.74	105,092.86	11
S66	1987	31	43,900.89	8,780.18	105,362.14	24
S46	1986	32	44,000.59	8,800.12	105,601.42	23
S58	1978	40	44,567.97	8,913.59	106,963.13	15

S16	1971	47	44,889.98	8,978.00	107,735.95	8
S49	1986	32	44,980.78	8,996.16	107,953.87	23
S31	1985	33	45,000.00	9,000.00	108,000.00	22
S57	1987	31	45,889.09	9,177.82	110,133.82	24
S18	1976	42	45,987.09	9,197.42	110,369.02	13
S25	1979	39	46,360.00	9,272.00	111,264.00	16
S11	1973	45	46,500.00	9,300.00	111,600.00	10
S47	1990	28	46,789.01	9,357.80	112,293.62	27
S51	1967	51	47,006.81	9,401.36	112,816.34	4
S53	1978	40	48,990.78	9,798.16	117,577.87	15
S03	1981	37	53,932.00	10,786.40	129,436.80	18
S45	1987	31	53,980.00	10,796.00	129,552.00	24
S12	1968	50	54,000.00	10,800.00	129,600.00	5
S14	1976	42	54,009.56	10,801.91	129,622.94	13
S32	1983	35	54,334.70	10,866.94	130,403.28	20
S28	1979	39	54,786.00	10,957.20	131,486.40	16
S29	1978	40	56,000.00	11,200.00	134,400.00	15
S56	1980	38	56,433.90	11,286.78	135,441.36	17
S20	1984	34	56,723.80	11,344.76	136,137.12	21
S35	1973	45	56,889.00	11,377.80	136,533.60	10
S10	1974	44	58,000.00	11,600.00	139,200.00	11
S62	1987	31	58,779.03	11,755.81	141,069.67	24
S61	1975	43	58,900.87	11,780.17	141,362.09	12

S67	1969	49	59,000.89	11,800.18	141,602.14	6
S75	1985	33	62,987.94	12,597.59	151,171.06	22
S44	1979	39	64,980.84	12,996.17	155,954.02	16
S13	1980	38	65,000.89	13,000.18	156,002.14	17
S15	1967	51	66,000.89	13,200.18	158,402.14	4
S50	1978	40	67,888.98	13,577.80	162,933.55	15
S68	1973	45	67,890.78	13,578.16	162,937.87	10
S04	1968	50	80,000.00	16,000.00	192,000.00	5
S05	1984	34	85,000.00	17,000.00	204,000.00	21
S09	1984	34	90,924.00	18,184.80	218,217.60	21

Appendix B: Contributory Benefit Table

Employee No	Birth Year	Age(x) as at 2018.12.31	Gross Salary(y)	20% of Gross Salary	Annual Contribution	Contribution Period	$a_{\overline{n}\|} = (1 - v^n)/i$	$a_{\overline{n}\|}^{(m)} = a_{\overline{n}\|} * \frac{i}{i^{(m)}}$	$s_{\overline{n}\|}^{(m)} = a_{\overline{n}\|}^{(m)}(1+i)^n$
S08	1973	45	17,251.44	3,450.29	41,403.46	10	304,733.04	309,237.45	553,797.18
S07	1999	19	18,068.19	3,613.64	43,363.66	36	634,019.46	643,391.22	5,241,870.40
S01	1976	42	18,251.74	3,650.35	43,804.18	13	387,784.48	393,516.52	839,342.51
S24	1991	27	19,000.00	3,800.00	45,600.00	28	611,321.09	620,357.34	3,171,072.35
S30	1998	20	21,000.00	4,200.00	50,400.00	35	730,711.62	741,512.64	5,699,330.47
S37	1994	24	22,000.00	4,400.00	52,800.00	31	735,455.74	746,326.88	4,543,713.19
S42	1994	24	23,500.00	4,700.00	56,400.00	31	785,600.45	797,212.81	4,853,511.81
S22	1975	43	23,980.89	4,796.18	57,554.14	12	482,524.89	489,657.34	985,286.77
S48	1991	27	24,598.98	4,919.80	59,037.55	28	791,467.12	803,166.20	4,105,533.97
S52	1992	26	25,670.08	5,134.02	61,608.19	29	837,299.75	849,676.30	4,603,875.79

S21	1988	30	26,789.67	5,357.93	64,295.21	25	821908.5431	834,057.59	3,579,667.35
S27	1987	31	27,556.65	5,511.33	66,135.96	24	830029.9434	842,299.04	3,410,413.75
S64	1993	25	27,689.09	5,537.82	66,453.82	30	914725.5566	928,246.58	5,331,376.03
S34	1987	31	28,776.00	5,755.20	69,062.40	24	866,757.81	879,569.80	3,561,320.63
S72	1990	28	32,098.78	6,419.76	77,037.07	27	1,017,700.87	1,032,744.02	4,980,248.94
S39	1989	29	33,000.00	6,600.00	79,200.00	26	1,029,850.76	1,045,073.51	4,754,439.61
S19	1987	31	33,945.72	6,789.14	81,469.73	24	1,022,474.21	1,037,587.92	4,201,125.69
S60	1990	28	34,000.98	6,800.20	81,602.35	27	1,078,010.66	1,093,945.28	5,275,382.58
S17	1986	32	34,098.90	6,819.78	81,837.36	23	1,006,876.05	1,021,759.20	3,902,864.36
S71	1988	30	34,555.06	6,911.01	82,932.14	25	1,060,151.13	1,075,821.77	4,617,287.93
S26	1986	32	34,555.67	6,911.13	82,933.61	23	1,020,363.61	1,035,446.12	3,955,144.97
S38	1980	38	34,589.09	6,917.82	83,013.82	17	869,757.31	882,613.63	2,376,677.97
S36	1992	26	34,677.00	6,935.40	83,224.80	29	1,131,085.04	1,147,804.18	6,219,248.28
S41	1992	26	34,988.67	6,997.73	83,972.81	29	1141251.007	1,158,120.42	6,275,145.65
S70	1989	29	36,000.00	7,200.00	86,400.00	26	1123473.559	1,140,080.19	5,186,661.40

S06	1993	25	36,162.50	7,232.50	86,790.00	30	1194649.696	1,212,308.42	6,962,882.70
S23	1974	44	36,578.89	7,315.78	87,789.34	11	692,383.48	702,617.95	1,333,778.65
S73	1987	31	36,899.09	7,379.82	88,557.82	24	1,111,432.25	1,127,860.90	4,566,635.05
S43	1981	37	37,980.00	7,596.00	91,152.00	18	986,957.71	1,001,546.43	2,858,753.20
S55	1976	42	38,779.03	7,755.81	93,069.67	13	823,916.30	836,095.02	1,783,330.71
S65	1984	34	38,909.07	7,781.81	93,381.77	21	1,098,550.27	1,114,788.50	3,789,794.42
S74	1977	41	39,890.90	7,978.18	95,738.16	14	889,884.66	903,038.49	2,041,683.30
S59	1992	26	39,900.02	7,980.00	95,760.05	29	1,301,448.10	1,320,685.46	7,155,986.12
S63	1986	32	39,997.78	7,999.56	95,994.67	23	1,181,058.83	1,198,516.66	4,578,033.60
S02	1985	33	41,500.00	8,300.00	99,600.00	22	1,199,341.54	1,217,069.61	4,385,755.89
S40	1986	32	41,876.07	8,375.21	100,502.57	23	1,236,521.18	1,254,798.83	4,793,017.40
S33	1990	28	43,098.37	8,619.67	103,436.09	27	1366445.972	1,386,644.10	6,686,877.56
S69	1974	44	43,788.69	8,757.74	105,092.86	11	828854.1742	841,105.89	1,596,670.09
S66	1987	31	43,900.89	8,780.18	105,362.14	24	1322332.477	1,341,878.54	5,433,178.52

S46	1986	32	44,000.59	8,800.12	105,601.42	23	1,299,254.24	1,318,459.18	5,036,184.00
S58	1978	40	44,567.97	8,913.59	106,963.13	15	1,038,852.53	1,054,208.34	2,526,471.63
S16	1971	47	44,889.98	8,978.00	107,735.95	8	669,018.05	678,907.14	1,082,074.84
S49	1986	32	44,980.78	8,996.16	107,953.87	23	1,328,197.40	1,347,830.16	5,148,373.79
S31	1985	33	45,000.00	9,000.00	108,000.00	22	1,300,490.83	1,319,714.04	4,755,638.92
S57	1987	31	45,889.09	9,177.82	110,133.82	24	1,382,218.77	1,402,650.04	5,679,238.35
S18	1976	42	45,987.09	9,197.42	110,369.02	13	977,061.91	991,504.36	2,114,807.66
S25	1979	39	46,360.00	9,272.00	111,264.00	16	1,124,422.33	1,141,042.99	2,898,650.48
S11	1973	45	46,500.00	9,300.00	111,600.00	10	821,385.71	833,527.03	1,492,719.97
S47	1990	28	46,789.01	9,357.80	112,293.62	27	1,483,458.75	1,505,386.51	7,259,494.52
S51	1967	51	47,006.81	9,401.36	112,816.34	4	390920.5468	396,698.94	500,823.27
S53	1978	40	48,990.78	9,798.16	117,577.87	15	1141945.568	1,158,825.24	2,777,192.13
S03	1981	37	53,932.00	10,786.40	129,436.80	18	1401490.346	1,422,206.49	4,059,459.66
S45	1987	31	53,980.00	10,796.00	129,552.00	24	1,625,923.92	1,649,957.52	6,680,570.18

S12	1968	50	54,000.00	10,800.00	129,600.00	5	545,922.35	553,991.90	741,366.13
S14	1976	42	54,009.56	10,801.91	129,622.94	13	1,147,510.83	1,164,472.77	2,483,736.87
S32	1983	35	54,334.70	10,866.94	130,403.28	20	1,495,715.35	1,517,824.28	4,867,868.07
S28	1979	39	54,786.00	10,957.20	131,486.40	16	1,328,787.79	1,348,429.27	3,425,484.58
S29	1978	40	56,000.00	11,200.00	134,400.00	15	1,305,326.26	1,324,620.95	3,174,531.20
S56	1980	38	56,433.90	11,286.78	135,441.36	17	1,419,054.30	1,440,030.06	3,877,673.76
S20	1984	34	56,723.80	11,344.76	136,137.12	21	1,601,527.51	1,625,200.50	5,524,972.47
S35	1973	45	56,889.00	11,377.80	136,533.60	10	1,004,899.18	1,019,753.11	1,826,222.50
S10	1974	44	58,000.00	11,600.00	139,200.00	11	1097852.941	1,114,080.86	2,114,858.09
S62	1987	31	58,779.03	11,755.81	141,069.67	24	1770474.82	1,796,645.11	7,274,498.61
S61	1975	43	58,900.87	11,780.17	141,362.09	12	1185157.685	1,202,676.10	2,420,020.61
S67	1969	49	59,000.89	11,800.18	141,602.14	6	696,303.63	706,596.04	1,002,319.99
S75	1985	33	62,987.94	12,597.59	151,171.06	22	1,820,338.62	1,847,245.97	6,656,619.98
S44	1979	39	64,980.84	12,996.17	155,954.02	16	1,576,054.95	1,599,351.42	4,062,915.07

S13	1980	38	65,000.89	13,000.18	156,002.14	17	1,634,474.89	1,658,634.89	4,466,326.90
S15	1967	51	66,000.89	13,200.18	158,402.14	4	548,880.13	556,993.41	703,191.34
S50	1978	40	67,888.98	13,577.80	162,933.55	15	1,582,451.23	1,605,842.24	3,848,494.38
S68	1973	45	67,890.78	13,578.16	162,937.87	10	1,199,236.92	1,216,963.45	2,179,396.19
S04	1968	50	80,000.00	16,000.00	192,000.00	5	808,773.85	820,728.74	1,098,320.20

Appendix C: Proposed benefit payments

Employee No	Monthly Contribution	Annual Contribution	Contribution Period	$S_n^{(m)}$	Monthly Benefit (P)
S08	3,450.29	41,403.46	10	553,797.18	3,989.43
S07	3,613.64	43,363.66	36	5,241,870.40	37,761.22
S01	3,650.35	43,804.18	13	839,342.51	6,046.43
S24	3,800.00	45,600.00	28	3,171,072.35	22,843.67
S30	4,200.00	50,400.00	35	5,699,330.47	41,056.66
S37	4,400.00	52,800.00	31	4,543,713.19	32,731.86
S42	4,700.00	56,400.00	31	4,853,511.81	34,963.58
S22	4,796.18	57,554.14	12	985,286.77	7,097.78
S48	4,919.80	59,037.55	28	4,105,533.97	29,575.32
S52	5,134.02	61,608.19	29	4,603,875.79	33,165.26
S21	5,357.93	64,295.21	25	3,579,667.35	25,787.09
S27	5,511.33	66,135.96	24	3,410,413.75	24,567.83
S64	5,537.82	66,453.82	30	5,331,376.03	38,406.00
S34	5,755.20	69,062.40	24	3,561,320.63	25,654.93
S72	6,419.76	77,037.07	27	4,980,248.94	35,876.56
S39	6,600.00	79,200.00	26	4,754,439.61	34,249.88
S19	6,789.14	81,469.73	24	4,201,125.69	30,263.94
S60	6,800.20	81,602.35	27	5,275,382.58	38,002.63
S17	6,819.78	81,837.36	23	3,902,864.36	28,115.33
S71	6,911.01	82,932.14	25	4,617,287.93	33,261.87
S26	6,911.13	82,933.61	23	3,955,144.97	28,491.95
S38	6,917.82	83,013.82	17	2,376,677.97	17,121.04
S36	6,935.40	83,224.80	29	6,219,248.28	44,802.02
S41	6,997.73	83,972.81	29	6,275,145.65	45,204.70
S70	7,200.00	86,400.00	26	5,186,661.40	37,363.51
S06	7,232.50	86,790.00	30	6,962,882.70	50,158.99
S23	7,315.78	87,789.34	11	1,333,778.65	9,608.23
S73	7,379.82	88,557.82	24	4,566,635.05	32,896.98
S43	7,596.00	91,152.00	18	2,858,753.20	20,593.80
S55	7,755.81	93,069.67	13	1,783,330.71	12,846.70
S65	7,781.81	93,381.77	21	3,789,794.42	27,300.80
S74	7,978.18	95,738.16	14	2,041,683.30	14,707.81
S59	7,980.00	95,760.05	29	7,155,986.12	51,550.07
S63	7,999.56	95,994.67	23	4,578,033.60	32,979.09
S02	8,300.00	99,600.00	22	4,385,755.89	31,593.97
S40	8,375.21	100,502.57	23	4,793,017.40	34,527.79
S33	8,619.67	103,436.09	27	6,686,877.56	48,170.72

S69	8,757.74	105,092.86	11	1,596,670.09	11,502.04
S66	8,780.18	105,362.14	24	5,433,178.52	39,139.36
S46	8,800.12	105,601.42	23	5,036,184.00	36,279.50
S58	8,913.59	106,963.13	15	2,526,471.63	18,200.12
S16	8,978.00	107,735.95	8	1,082,074.84	7,795.02
S49	8,996.16	107,953.87	23	5,148,373.79	37,087.69
S31	9,000.00	108,000.00	22	4,755,638.92	34,258.52
S57	9,177.82	110,133.82	24	5,679,238.35	40,911.92
S18	9,197.42	110,369.02	13	2,114,807.66	15,234.58
S25	9,272.00	111,264.00	16	2,898,650.48	20,881.21
S11	9,300.00	111,600.00	10	1,492,719.97	10,753.21
S47	9,357.80	112,293.62	27	7,259,494.52	52,295.72
S51	9,401.36	112,816.34	4	500,823.27	3,607.81
S53	9,798.16	117,577.87	15	2,777,192.13	20,006.25
S03	10,786.40	129,436.80	18	4,059,459.66	29,243.41
S45	10,796.00	129,552.00	24	6,680,570.18	48,125.28
S54	6,935.58	83,226.97	24	4,291,740.85	30,916.71
S12	10,800.00	129,600.00	5	741,366.13	5,340.63
S14	10,801.91	129,622.94	13	2,483,736.87	17,892.27
S32	10,866.94	130,403.28	20	4,867,868.07	35,066.99
S28	10,957.20	131,486.40	16	3,425,484.58	24,676.40
S29	11,200.00	134,400.00	15	3,174,531.20	22,868.59
S56	11,286.78	135,441.36	17	3,877,673.76	27,933.86
S20	11,344.76	136,137.12	21	5,524,972.47	39,800.62
S35	11,377.80	136,533.60	10	1,826,222.50	13,155.68
S10	11,600.00	139,200.00	11	2,114,858.09	15,234.95
S62	11,755.81	141,069.67	24	7,274,498.61	52,403.80
S61	11,780.17	141,362.09	12	2,420,020.61	17,433.27
S67	11,800.18	141,602.14	6	1,002,319.99	7,220.48
S75	12,597.59	151,171.06	22	6,656,619.98	47,952.75
S44	12,996.17	155,954.02	16	4,062,915.07	29,268.30
S13	13,000.18	156,002.14	17	4,466,326.90	32,174.38
S15	13,200.18	158,402.14	4	703,191.34	5,065.63
S50	13,577.80	162,933.55	15	3,848,494.38	27,723.66
S68	13,578.16	162,937.87	10	2,179,396.19	15,699.87
S04	16,000.00	192,000.00	5	1,098,320.20	7,912.04
S05	17,000.00	204,000.00	21	8,279,111.41	59,640.80
S09	18,184.80	218,217.60	21	8,856,116.77	63,797.41

Appendix D: Proposed EPF Equivalent Post Employment Pension Scheme VS Tri forces Non-Contribution Pension Scheme introduced by the Government.

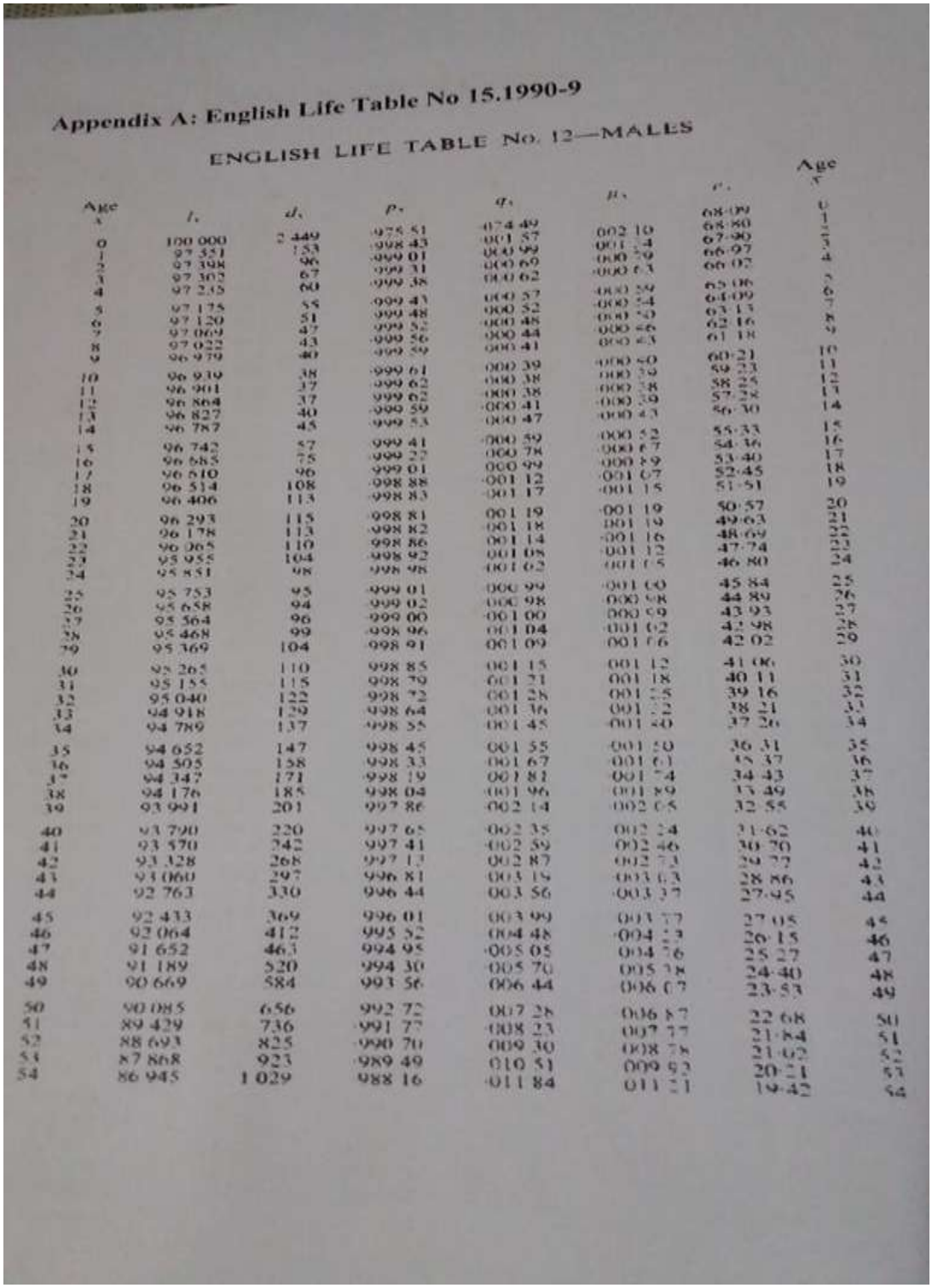
Employee No	According to the Tri forces Non-Contribution Pension Scheme introduced by the Government				Proposed EPF Equivalent Post Employment Pension Scheme	
	Monthly Gross salary	Service Period (Contribution Period)	Considered Percentage of Present Salary for the Benefit (According to the Appendix B)	Monthly Benefit	Monthly Contribution	Monthly Benefit (P)
S09	90,924.00	21	66	60,009.84	18,184.80	63,797.41
S05	85,000.00	21	66	56,100.00	17,000.00	59,640.80
S62	58,779.03	24	69	40,557.53	11,755.81	52,403.80
S47	46,789.01	27	72	33,688.09	9,357.80	52,295.72
S59	39,900.02	29	74	29,526.01	7,980.00	51,550.07
S06	36,162.50	30	75	27,121.88	7,232.50	50,158.99
S33	43,098.37	27	72	31,030.83	8,619.67	48,170.72
S45	53,980.00	24	69	37,246.20	10,796.00	48,125.28
S75	62,987.94	22	67	42,201.92	12,597.59	47,952.75
S41	34,988.67	29	71	24,841.96	6,997.73	45,204.70
S36	34,677.00	29	85	29,475.45	6,935.40	44,802.02
S30	21,000.00	35	85	17,850.00	4,200.00	41,056.66
S57	45,889.09	24	69	31,663.47	9,177.82	40,911.92
S20	56,723.80	21	66	37,437.71	11,344.76	39,800.62
S66	43,900.89	24	69	30,291.61	8,780.18	39,139.36
S64	27,689.09	30	75	20,766.82	5,537.82	38,406.00
S60	34,000.98	27	72	24,480.71	6,800.20	38,002.63

S07	18,068.19	36	85	15,357.96	3,613.64	37,761.22
S70	36,000.00	26	71	25,560.00	7,200.00	37,363.51
S49	44,980.78	23	68	30,586.93	8,996.16	37,087.69
S46	44,000.59	23	68	29,920.40	8,800.12	36,279.50
S72	32,098.78	27	72	23,111.12	6,419.76	35,876.56
S32	54,334.70	20	65	35,317.56	10,866.94	35,066.99
S42	23,500.00	31	77	18,095.00	4,700.00	34,963.58
S40	41,876.07	23	68	28,475.73	8,375.21	34,527.79
S31	45,000.00	22	67	30,150.00	9,000.00	34,258.52
S39	33,000.00	26	71	23,430.00	6,600.00	34,249.88
S71	34,555.06	25	70	24,188.54	6,911.01	33,261.87
S52	25,670.08	29	74	18,995.86	5,134.02	33,165.26
S63	39,997.78	23	68	27,198.49	7,999.56	32,979.09
S73	36,899.09	24	69	25,460.37	7,379.82	32,896.98
S37	22,000.00	31	77	16,940.00	4,400.00	32,731.86
S13	65,000.89	17	62	40,300.55	13,000.18	32,174.38
S02	41,500.00	22	67	27,805.00	8,300.00	31,593.97
S19	33,945.72	24	69	23,422.55	6,789.14	30,263.94
S48	24,598.98	28	73	17,957.26	4,919.80	29,575.32
S44	64,980.84	16	61	39,638.31	12,996.17	29,268.30
S03	53,932.00	18	63	33,977.16	10,786.40	29,243.41
S26	34,555.67	23	68	23,497.86	6,911.13	28,491.95
S17	34,098.90	23	68	23,187.25	6,819.78	28,115.33
S56	56,433.90	17	62	34,989.02	11,286.78	27,933.86

S50	67,888.98	15	60	40,733.39	13,577.80	27,723.66
S65	38,909.07	21	66	25,679.99	7,781.81	27,300.80
S21	26,789.67	25	70	18,752.77	5,357.93	25,787.09
S34	28,776.00	24	69	19,855.44	5,755.20	25,654.93
S28	54,786.00	16	61	33,419.46	10,957.20	24,676.40
S27	27,556.65	24	69	19,014.09	5,511.33	24,567.83
S29	56,000.00	15	60	33,600.00	11,200.00	22,868.59
S24	19,000.00	28	73	13,870.00	3,800.00	22,843.67
S25	46,360.00	16	61	28,279.60	9,272.00	20,881.21
S43	37,980.00	18	63	23,927.40	7,596.00	20,593.80
S53	48,990.78	15	60	29,394.47	9,798.16	20,006.25
S58	44,567.97	15	60	26,740.78	8,913.59	18,200.12
S54	34,677.90	24	69	23,927.75	6,935.58	30,916.71
S14	54,009.56	13	58	31,325.54	10,801.91	17,892.27
S61	58,900.87	12	57	33,573.50	11,780.17	17,433.27
S38	34,589.09	17	62	21,445.24	6,917.82	17,121.04
S68	67,890.78	10	55	37,339.93	13,578.16	15,699.87
S10	58,000.00	11	56	32,480.00	11,600.00	15,234.95
S18	45,987.09	13	58	26,672.51	9,197.42	15,234.58
S74	39,890.90	14	59	23,535.63	7,978.18	14,707.81
S35	56,889.00	10	55	31,288.95	11,377.80	13,155.68
S55	38,779.03	13	58	22,491.84	7,755.81	12,846.70
S69	43,788.69	11	56	24,521.67	8,757.74	11,502.04
S11	46,500.00	10	55	25,575.00	9,300.00	10,753.21

S23	36,578.89	11	56	20,484.18	7,315.78	9,608.23
S04	80,000.00	5	0	-	16,000.00	7,912.04
S16	44,889.98	8	0	-	8,978.00	7,795.02
S67	59,000.89	6	0	-	11,800.18	7,220.48
S22	23,980.89	12	57	13,669.11	4,796.18	7,097.78
S01	18,251.74	13	58	10,586.01	3,650.35	6,046.43
S12	54,000.00	5	0	-	10,800.00	5,340.63
S15	66,000.89	4	0	-	13,200.18	5,065.63
S08	17,251.44	10	55	9,488.29	3,450.29	3,989.43
S51	47,006.81	4	0	-	9,401.36	3,607.81

Appendix E: English Life Table No 15.1990-9



Appendix A: English Life Table No 15.1990-9

ENGLISH LIFE TABLE No. 12—MALES

Age x	l_x	d_x	p_x	q_x	μ_x	e°_x	Age x
0	100 000	2 449	·975 51	·024 49	·025 19	68·09	0
1	97 551	153	·998 43	·001 57	·001 54	68·80	1
2	97 398	96	·999 01	·000 99	·000 99	67·90	2
3	97 302	67	·999 31	·000 69	·000 63	66·97	3
4	97 235	60	·999 38	·000 62	·000 59	66·02	4
5	97 175	55	·999 43	·000 57	·000 54	65·06	5
6	97 120	51	·999 48	·000 52	·000 50	64·09	6
7	97 069	47	·999 52	·000 48	·000 46	63·13	7
8	97 022	43	·999 56	·000 44	·000 43	62·16	8
9	96 979	40	·999 59	·000 41	·000 40	61·18	9
10	96 939	38	·999 61	·000 39	·000 39	60·21	10
11	96 901	37	·999 62	·000 38	·000 38	59·23	11
12	96 864	37	·999 62	·000 38	·000 38	58·25	12
13	96 827	40	·999 59	·000 41	·000 39	57·28	13
14	96 787	45	·999 53	·000 47	·000 43	56·30	14
15	96 742	57	·999 41	·000 59	·000 52	55·33	15
16	96 685	75	·999 22	·000 78	·000 67	54·36	16
17	96 610	96	·999 01	·000 99	·000 89	53·40	17
18	96 514	108	·998 88	·001 12	·001 07	52·45	18
19	96 406	113	·998 83	·001 17	·001 15	51·51	19
20	96 293	115	·998 81	·001 19	·001 19	50·57	20
21	96 178	113	·998 82	·001 18	·001 19	49·63	21
22	96 065	110	·998 86	·001 14	·001 16	48·69	22
23	95 955	104	·998 92	·001 08	·001 12	47·74	23
24	95 851	98	·998 98	·001 02	·001 05	46·80	24
25	95 753	95	·999 01	·000 99	·001 00	45·84	25
26	95 658	94	·999 02	·000 98	·000 98	44·89	26
27	95 564	96	·999 00	·001 00	·000 99	43·93	27
28	95 468	99	·998 96	·001 04	·001 02	42·98	28
29	95 369	104	·998 91	·001 09	·001 06	42·02	29
30	95 265	110	·998 85	·001 15	·001 12	41·06	30
31	95 155	115	·998 79	·001 21	·001 18	40·11	31
32	95 040	122	·998 72	·001 28	·001 25	39·16	32
33	94 918	129	·998 64	·001 36	·001 32	38·21	33
34	94 789	137	·998 55	·001 45	·001 40	37·26	34
35	94 652	147	·998 45	·001 55	·001 50	36·31	35
36	94 505	158	·998 33	·001 67	·001 61	35·37	36
37	94 347	171	·998 19	·001 81	·001 74	34·43	37
38	94 176	185	·998 04	·001 96	·001 89	33·49	38
39	93 991	201	·997 86	·002 14	·002 05	32·55	39
40	93 790	220	·997 65	·002 35	·002 24	31·62	40
41	93 570	242	·997 41	·002 59	·002 46	30·70	41
42	93 328	268	·997 13	·002 87	·002 73	29·77	42
43	93 060	297	·996 81	·003 19	·003 03	28·86	43
44	92 763	330	·996 44	·003 56	·003 37	27·95	44
45	92 433	369	·996 01	·003 99	·003 77	27·05	45
46	92 064	412	·995 52	·004 48	·004 23	26·15	46
47	91 652	463	·994 95	·005 05	·004 76	25·27	47
48	91 189	520	·994 30	·005 70	·005 38	24·40	48
49	90 669	584	·993 56	·006 44	·006 07	23·53	49
50	90 085	656	·992 72	·007 28	·006 87	22·68	50
51	89 429	736	·991 77	·008 23	·007 77	21·84	51
52	88 693	825	·990 70	·009 30	·008 78	21·02	52
53	87 868	923	·989 49	·010 51	·009 93	20·21	53
54	86 945	1 029	·988 16	·011 84	·011 21	19·42	54

Appendix A: English Life Table No 15.1990-9

Age x	l_x	d_x	p_x	q_x	p_x	e_x	Age x
55	85 916	1 144	·986 69	·013 31	·012 63	18·65	55
56	84 772	1 265	·985 08	·014 92	·014 20	17·89	56
57	83 507	1 393	·983 32	·016 68	·015 90	17·16	57
58	82 114	1 526	·981 41	·018 59	·017 76	16·44	58
59	80 588	1 664	·979 35	·020 65	·019 78	15·74	59
60	78 924	1 805	·977 13	·022 87	·021 97	15·06	60
61	77 119	1 947	·974 75	·025 25	·024 33	14·40	61
62	75 172	2 088	·972 22	·027 78	·026 84	13·76	62
63	73 084	2 228	·969 51	·030 49	·029 53	13·14	63
64	70 856	2 366	·966 61	·033 39	·032 43	12·54	64
65	68 490	2 499	·963 52	·036 48	·035 53	11·95	65
66	65 991	2 625	·960 22	·039 78	·038 84	11·39	66
67	63 366	2 745	·956 68	·043 32	·042 39	10·84	67
68	60 621	2 856	·952 88	·047 12	·046 22	10·31	68
69	57 765	2 959	·948 78	·051 22	·050 36	9·79	69
70	54 806	3 051	·944 34	·055 66	·054 87	9·29	70
71	51 755	3 130	·939 53	·060 47	·059 76	8·81	71
72	48 625	3 195	·934 30	·065 70	·065 09	8·35	72
73	45 430	3 243	·928 61	·071 39	·070 92	7·90	73
74	42 187	3 273	·922 41	·077 59	·077 30	7·47	74
75	38 914	3 282	·915 66	·084 34	·084 32	7·05	75
76	35 632	3 266	·908 33	·091 67	·092 00	6·66	76
77	32 366	3 225	·900 37	·099 63	·100 42	6·28	77
78	29 141	3 154	·891 76	·108 24	·109 62	5·92	78
79	25 987	3 054	·882 48	·117 52	·119 64	5·57	79
80	22 933	2 923	·872 53	·127 47	·130 53	5·25	80
81	20 010	2 763	·861 92	·138 08	·142 31	4·94	81
82	17 247	2 576	·850 66	·149 34	·155 03	4·66	82
83	14 671	2 365	·838 78	·161 22	·168 63	4·39	83
84	12 306	2 137	·826 34	·173 66	·183 11	4·14	84
85	10 169	1 897·4	·813 41	·186 59	·198 49	3·90	85
86	8 271·6	1 654·1	·800 03	·199 97	·214 68	3·68	86
87	6 617·5	1 414·1	·786 31	·213 69	·231 65	3·48	87
88	5 203·4	1 184·6	·772 35	·227 65	·249 28	3·30	88
89	4 018·8	971·6	·758 23	·241 77	·267 48	3·13	89
90	3 047·2	779·9	·744 07	·255 93	·286 10	2·97	90
91	2 267·3	612·2	·729 97	·270 03	·305 18	2·83	91
92	1 655·1	470·0	·716 04	·283 96	·324 39	2·70	92
93	1 185·1	352·73	·702 36	·297 64	·343 72	2·58	93
94	832·37	258·83	·689 04	·310 96	·362 94	2·47	94
95	573·54	185·74	·676 15	·323 85	·381 97	2·38	95
96	387·80	130·39	·663 77	·336 23	·400 66	2·29	96
97	257·41	89·59	·651 94	·348 06	·418 86	2·21	97
98	167·82	60·30	·640 71	·359 29	·436 51	2·14	98
99	107·52	39·771	·630 11	·369 89	·453 54	2·07	99
100	67·749	25·733	·620 17	·379 83	·469 72	2·00	100
101	42·016	16·349	·610 88	·389 12	·485 12		101
102	25·667	10·209	·602 24	·397 76	·499 67		102
103	15·458	6·272 1	·594 25	·405 75	·513 35		103
104	9·185 9	3·794 9	586 88	·413 12			104
105	5·391 0						105

Appendix F: The pension circular no 01/2019 amendment III (Pension Department of Sri Lanka, 2019,
AnnexureTable 01)

විශ්‍රාම වැටුප් ප්‍රතිශත වගුව (සේවා කාලය අනුව හිමි සියයට ප්‍රමාණය)				
	නිලධාරී			
	2009.05.19 ට පෙර		2009.05.19 ට පසු	
	පැරණි ප්‍රතිශතය		නව ප්‍රතිශතය	
අවුරුදු	අඩු නොකළ	අඩු කළ	අඩු නොකළ	අඩු කළ
10	55	45		
11	56	46		
12	57	47		
13	58	48		
14	59	49		
15	60	50	75	65
16	61	51	76	66
17	62	52	77	67
18	63	53	78	68
19	64	54	79	69
20	65	55	80	70
21	66	56	81	71
22	67	57	85	75
23	68	58	85	75
24	69	59	85	75
25	70	60	85	75
26	71	61	85	75
27	72	62	85	75
28	73	63	85	75
29	74	64	85	75
30	75	65	85	75
31	77	67	85	75
32	79	69	85	75
33	81	71	85	75
34	83	73	85	75
35	85	75	85	75