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ECO College of Insurance
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**A New Algorithm and Software of Individual
Life Insurance and Annuity Computation**

Submitted in Partial Fulfillment of the Requirements
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Dedication

This work is dedicated to my wife and my mother

Acknowledgement

I am very grateful for all people that who made possible this work, First of all I would like to acknowledge my supervisor Dr.Farhad Khorrami, for his guidance and invaluable help in my thesis. I would also like to thank Dr. Hossein Behzadi my thesis advisor for revising this work. I would like to thank Central Insurance of Iran for supporting me in this work. And at last, but not least, I would like to acknowledge my family for their encouragement and invaluable help throughout the course of my study and thesis.

Abstract

The world importance of insurance and the allocation of a high percentage of global gross product to products of this sector of the economies is ever increasing. Among the most important kinds of insurances are life insurances and annuities. The expansion of life insurance and annuity, as a matter of fact, results in increased social security and individuals' relief of their prospective life status.

The rapid expansion of life insurance in Iran calls for the application of modern technologies in this sector. It is necessary to design a software product that can estimate and manage all necessary activities concerning life insurance, annuity, surrender value, and loan application.

Lack of a comprehensive software product for this purpose in Iran, inapplicability of foreign software solutions to the social conditions of Iran as well as their costs, non-open-source nature justifies the necessity of designing a comprehensive software solution that can meet this need.

LIAC (Life Insurance and Annuity Computation) is a solution to this problem. The software is composed of several modules that not only facilitates activities concerning the calculation of annuities and insurance policies, but also is compatible with various conditions. This software makes use of SQL as database and can be used in a network environment. Furthermore, this software can be installed in Windows operating system only, and requires SQL already installed.

An outstanding feature of LIAC is its focus on database and online access to all records. IP-based architecture implemented in the design of this software enables this software to be accessed via various network types such as VPN, internet, etc. This software also provides a simultaneous multiuser environment with every user having access to the software through network with his or her username and password. Only administrator is allowed to change indexes while users' permission for any change in indexes is restricted.

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Chapter One

History of Insurance

Early methods of transferring or distributing risk formally were practiced by Chinese, Babylonian, and Persian traders since few thousand years BC. Chinese traveling merchants when faced with dangerous rapids of rivers would redistribute their wares across several vessels in order to minimize the loss to that of a single vessel's capsizing. Babylonians also developed a system, which was recorded in the famous Code of Hammurabi and practiced by early Mediterranean sailing merchants. If a merchant received a loan to fund his shipment, he would have to pay the lender an additional sum in exchange for the lender's guarantee to cancel the loan should the shipment be stolen.

Achaemenian monarchs were the first to insure their people and made it official by registering the insuring process in governmental notary offices. The insurance tradition was performed every year in Norouz (beginning of the Iranian New Year) where the heads of different ethnic groups as well as others willing to take part presented their gifts to the monarch. The most important gift was presented during a special ceremony. When a gift was worth more than 10,000 Derrik, the issue was registered in a special office. This was advantageous to those who presented such special gifts. For others, the presents were fairly assessed by the confidants of the court. Then the assessments were registered in special offices. The purpose of this registering was that whenever the person who presented the registered gift by the court was in trouble, the monarch and the court would help him.

The Greeks and Romans introduced the origins of health and life insurance when they organized guilds called "benevolent societies" which cared for the families and paid funeral expenses of members upon death. In the middle Ages, guilds served a similar purpose too. Furthermore, the Talmud deals with several aspects of insuring goods.

Insurance, as we know it today, can be traced back to the Great Fire of London, which devastated 13200 houses in 1666. In the aftermath of this disaster, Nicholas Barbon

opened an office to insure buildings. In 1680, he established England's first fire insurance company, "The Fire Office," to insure brick and frame houses.

Insurance

Insurance is a contract between an insurance company and a person (policyholder) under which the insurance company agrees to pay the insured in the event of a specified loss in return for the payment (a premium) made by the insured. All types of the risks insured are set out in the insurance policy. The degree of risk will determine the level of premium. If the insurer considers the risk too high, it may refuse to cover the risk.

Importance of Insurance

All activities, whether they are business activities, sporting activities, recreational activities or simple day-to-day tasks, carry a certain level of risk. Insurance essentially protects people and assets against possible risks. Insurance also performs a social function because it insures those who have suffered losses, provided that they are not guilty of the losses.

Types of Insurance

Any risk that can be quantified can potentially be insured. Among different available types of insurance are:

- Life insurance
- Non- Life insurance

Life Insurance

Life Insurance

Life insurance or life assurance is a contract between the policy owner and the insurer, where the insurer agrees to pay a sum of money if the insured alive within a certain period or his death occurs within a certain period or whenever. In return, the policy owner

(policyholder) agrees to pay a stipulated amount called a premium at regular intervals. As with most insurance policies, life assurance is a contract between the insurer and the policy owner whereby a benefit is paid to the designated beneficiary (or beneficiaries) if an insured event covered by the policy occurs. In order for a life policy to be valid, the insured event must be within the life of the person whose name is mentioned in the policy.

Insured events that may be covered include:

- death
- diagnosis of a terminal illness
- diagnosis of a critical illness
- disability due to ill health
- permanent disability
- accidental death
- need for long term medical care

Life policy is typically presented as a kind of legal contract and the terms of the contract describe the limitations of the insured events. Specific disclaimers are often declared in the contract to limit the liability of the insurer; for example claims pertaining to war, riot, and civil commotion.

Beneficiary

A beneficiary is the person or entity whose name is mentioned in the life insurance policy as the one who is supposed to receive the death benefit. It is possible to name:

- An individual
- Two or more people
- The trustee of a trust already set up
- A charity
- Government

If no beneficiary is named, the death benefit will be regarded as the estate of the deceased.

Every life insurance policy should have both “primary” and “contingent” beneficiaries. The primary beneficiary gets the death benefit if he or she can be found after the death of the insured. Contingent beneficiaries get the death benefit if the primary beneficiary cannot be found. If no primary or contingent beneficiaries can be found, the death benefit will be regarded as the estate of the insured.

Contract Terms

The insurance policy is a legal contract specifying the terms and conditions of the risks assumed. Special provisions may apply, such as suicide clauses wherein the policy becomes null if the insured commits suicide. Any misrepresentations by the insured on the application are also grounds for nullification. Most contracts have a contestability period (also usually a two-year period); if the insured dies within this period, the insurer has a legal right to contest the claim and request additional information before deciding to pay or deny the claim.

Premium and Cost

The premium is an amount paid by the applicant to the insuring company for the life insurance contract and all of its benefits. Even for a given death, benefit and type of insurance (e.g. term life), the premium can vary widely among companies, either because the policies of some companies have features that those of others do not, or because some companies charge, more than others for the same coverage. Therefore, the first step in comparing policies is to make sure we compare similar insurance plans, based on:

- Age
- Type of policy and policy features
- Cost of protection to be purchased

The premium for the policy is not the same as the cost of the protection portion of the policy. A policy may have a higher premium but may also offer more benefits than

another may do (for example, it may pay policy dividends). Alternatively, two policies may both promise dividends, but in different amounts at different points in time.

Difference between Life Insurance and Other Types of Insurance

Life insurance is fundamentally different from all other kinds of insurance. The main difference is that other kinds of insurance protect the insured against things that may happen. Examples include the cases where an individual buys:

- Auto insurance because his or her car might be stolen or involved in an accident, or
- Health insurance because he or she might get sick.

If the insured is lucky, those things will never happen, and the insurance company will use his or her premiums to cover claims by other people who are also insured. Life insurance is different because it insures individuals against death, the one thing that is guaranteed to happen. It is not something we like to think about, but eventually we all die. Life insurance has its own language. Common English words often take on very different meanings when used to describe life insurance policies. Another difference is that the applicant usually insures his or her life to protect someone else.

Physical Examination

Life insurance companies often require the applicants to have physical examinations. Probably this will not be with the applicant's doctor. The insurance company may arrange for the applicant to go to a medical office or for a doctor or medical technician to go to the applicant. There should be no charge for the physical exam. Omissions, half-truths, and outright lies could invalidate the policy, leaving no benefits for the insured or his or her beneficiary.

Types of Life Insurance

Life insurance may be divided into two basic classes, namely temporary and permanent, and a number of subclasses including term, universal, whole life, variable, variable universal, and endowment life insurance.

Temporary (Term) Life Insurance

Term life insurance (term assurance in British English) provides life insurance coverage for a specified term of years for a specified premium. The policy does not accumulate cash value. Term is generally considered "pure" insurance, where the premium buys protection in the event of death and nothing else. Term insurance premiums are typically low because both the insurer and the policy owner agree that the death of the insured is unlikely during the term of coverage.

The three key factors to be considered in term insurance are face amount (protection or death benefit), premium to be paid (cost to the insured), and length of coverage (term). This period could be as short as one year or the policy may provide coverage for a specific number of years such as five, ten, and twenty years or to a specified age as high as 80. Policies are sold with various premium guarantees. The longer guarantee, the higher the initial premium. In case of death during the term period, the company will pay the face amount of the policy to the beneficiary. If the insured lives beyond the period that was selected, no benefit is payable. As a rule, term policies offer a death benefit without savings element or cash value.

Premiums are fixed for the period specified under the policy terms. The premiums for term insurance are lower at earlier ages as compared with the premiums paid for permanent insurance, but term rates rise, as the insured grows older. Term plans may be "convertible" to a permanent plan of insurance. The coverage can be "level" providing the same benefit until the policy expires or it can be "decreasing" during the term period with the premiums remaining the same. If the premium for our term insurance policy is not paid, it will generally lapse without cash value, as compared to a permanent type of policy that has a cash value component. Currently term insurance rates are very competitive and historically among the lowest experienced.

Permanent Life Insurance

Permanent life insurance is a kind of life insurance that remains in force until the policy matures (pays out), unless the owner fails to pay the premium when due (the policy expires). While term insurance is designed to provide protection for a specified period of time, permanent insurance is designed to provide coverage for the entire lifetime. To keep

the premium rate level, the premium at longer ages exceeds the actual cost of protection. This extra premium builds a reserve (cash value) which helps pay for the policy in later years as the cost of protection rises above the premium. Whole life policies stretch the cost of insurance over a longer period in order to level out the otherwise increasing cost of insurance. Under some policies, premiums are required to be paid for a set number of years. Under other policies, premiums are paid throughout the policyholder's lifetime. This type of policy, which is sometimes called cash value life insurance, generates a savings element. Cash values are critical to a permanent life insurance policy. The size of the cash value build-up differs from company to company. Sometimes, there is no correlation between the size of the cash value and the premiums paid. It is the cash value of the policy that can be accessed while the policyholder is alive. There are two basic categories of permanent insurance: traditional and interest-sensitive; in addition, each category is generally available in either fixed or variable forms.

Insurance Market Overview

In 2005, insurance companies worldwide reported \$3,426 billion in direct premiums. In other words, an amount equivalent to 7.7 percent of global gross domestic product (GDP) was used to purchase insurance products. During the same year, life insurance companies reported \$1,947 billion in direct premiums. In fact, an equivalent of 4.4 percent of global gross domestic product (GDP) was used to purchase life insurance products. In 2005, life insurance premium increased 3.9 percent compared to the year before. In contrast, non life insurance premium grew only 0.6 percent [SwissRe(2005)].

Table 1.1- Insurance Premium Volumes in the World (in million USD)

Region	Life	Non-life	Total Per Region
Europe	769.3	518.6	1287.9
America	574.8	705.4	1280.2
Asia	573.2	186.5	759.7
Pacific	28.5	29.2	57.7
Africa	27.8	12.2	40
Total Per Class	1973.6	1451.9	3425.5

Source: SwissRe (2005)

European countries demonstrated the high record of \$769.3 billion in life insurance direct premiums in 2005, about 39.0%. Second rank belongs to American countries, representing \$574.8 billion in life insurance direct premiums, about 29.1%. The third rank belongs to Asian countries representing \$573.2 billion in life insurance direct premiums, about 29.0%. The fourth and fifth rank belongs to Pacific and African countries representing \$28.5 billion and \$27.8 billion in life insurance direct premiums respectively, about 1.4% [SwissRe (2005)]. Therefore, these records, as discussed above, clearly reveal the importance of life insurance.

Life insurances benefited from the demand for old age insurance. Life and non-life sectors presented a completely different level of progress. Increased life expectancy and privatization of social security sector by governments were among the key factors that have affected this progress. In 2005, life insurance companies sold more life insurance and annuity products, compared to the year before. In United States, the biggest life insurance market of the world, high rate of short-term interest and poor performance of stock market resulted in a decrease in premiums.

Insurance Industry in Iran

The Iranian insurance industry's earnings have jumped from 4 trillion IRR to 21.5 trillion IRR in recent years (1997-2005). Additionally, the compensation paid by insurance firms has also increased from 2.4 trillion IRR to 14.5 trillion IRR in this period. During the same time, insurance companies reported 1420 billion IRR in life insurance direct premiums. All these records demonstrate that the insurance industry has experienced a favorable growth in recent years after the establishment of private insurance firms [CII (2005)]. Private insurance companies have boosted competition in the sector, calling for greater participation of private sector in insurance industry. Article 44 of the Constitution has been the main obstacle to privatization in recent years as it bans major industries, banks, and insurance institutions from offering their shares on the stock market, though the government is modifying it in favor of privatization.

However, the "State Expediency Council" overturned the key article in 2003 to allow large-scale privatizations in a bid to overhaul the state-controlled economy. The council gave the green light to privatization in downstream oil and gas, mines, banking,

insurance, telecommunications, railways, roads, airlines and shipping sectors. However, upstream oil and gas and the airwaves for telecommunications will remain under the control of the government.

Iranian Life Insurance Companies

Currently, there are four non-private and eleven private companies that actively participate in life insurance section. The non-private state-owned insurers have been active for a long time and, prior to private companies entering into this sector, they were the key players in the market and lead the industry for years. However, a few years ago, the government approved to open the market to other private companies. Central Insurance of Iran (CII) was made to breakdown the monopolistic market in 2000. Hence, in the short term (less than 7 years), eleven private insurers were established. On the other hand, the modification of Article 44 of the Constitution paves the way for other foreign life insurance companies to enter the market easily.

In 2005, Iranian life insurers reported 1,420.2 billion IRR in direct premiums (about 305,461 policies) and paid 680.8 billion IRR for about 56,398 losses incurred. [CII (2005)]. Four state-owned insurers along with eleven private insurance companies were active in the life insurance market in 2005. By that time, 93.16% of life insurance market share belonged to state-owned insurance companies and 6.84% of the total life insurance market belonged to private sector.

These private companies are in early stages of their activities and it is expected that their life insurance market will expand and their share of the market will increase in the future. According to CII, Iran Insurance Company has 52.87% of the total life insurance market share and Asia Insurance Company with 17.7% of the market share is currently the second in rank based on generated premiums. Among the private life insurers, Karafarin and Sina Insurance Companies were the first and second life insurance companies each with 2.76% and 1.93% of the life insurance market share respectively [CII (2005)].

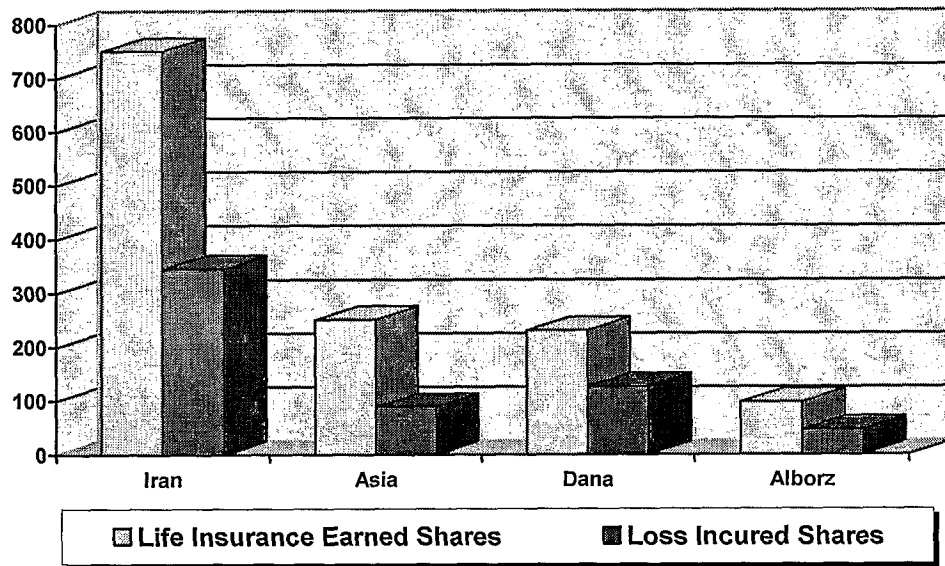
Non-Private Iranian Life Insurance Companies

Nowadays, the Iranian government completely owns four big insurance company's stock. In fact, these insurers are under direct control of the government. In 2005, these companies reported 1,323.1 billion IRR in direct premiums (about 296,097 policies) and

paid 662.6 billion IRR for about 55,816 losses incurred in the Iranian life insurance market. Iran, Asia, Dana and Alborz insurance companies each with 52.87%, 17.7%, 16.25% and 6.34% of life insurance market shares were the key players in the life insurance market [CII (2005)].

Figure 1.1 demonstrates the market shares of these four state-owned companies with respect to life insurance earned premiums and losses incurred in 2005.

Figure 1.1- Life Insurance Market Shares for State-Owned Insurers

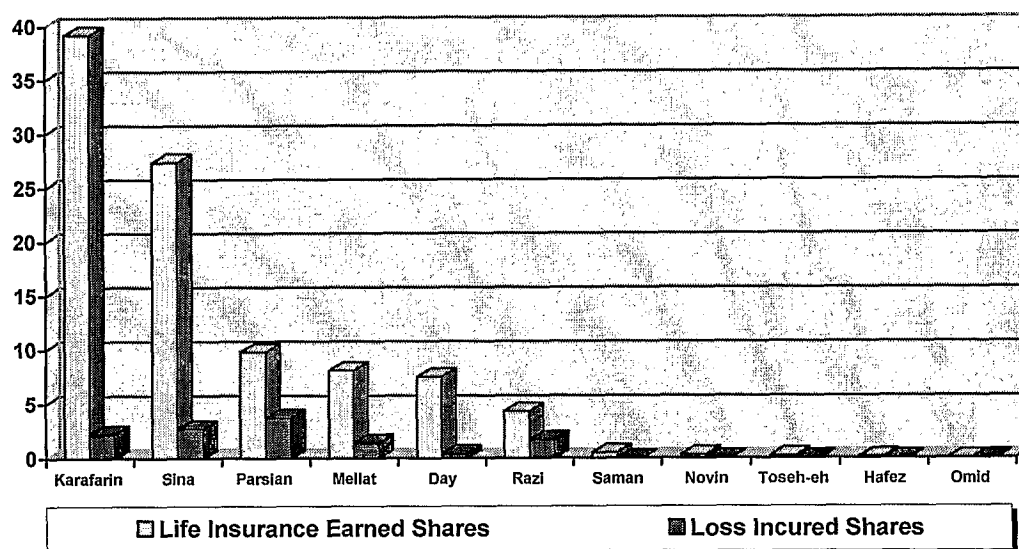


Private Iranian Life Insurance Companies

The private companies in the Iranian life insurance market (Parsian, Hafez, Mellat, Razi, Tose'eh, Karafarin, Omid, Dey, Sina, Saman and Novin) reported 97.1 billion IRR in direct premium (for 9,364 policies) and paid 18.2 billion IRR for about 582 losses incurred. Karafarin and Sina with 68.6% of the shares in direct premium and 60.4% of the shares in incurred losses had the biggest share of the Iranian private life insurance market in 2005 [CII (2005)].

Figure 1.2 shows the market shares of these eleven private insurance companies with respect to earned premiums and losses incurred in 2005.

Figure 1.2- Life Insurance Market Shares of Private Insurers



Iranian Insurance Performance

The ratio of premium to GDP of the Iranian insurance companies has grown from 0.55% in 1996 to 1.27% in 2005. For the Iranian life insurance companies, this ratio reached 0.084% while, for the country’s non-life insurance companies, it was 1.186% in 2005. In these eleven years, the industry issued about 115 million insurance policies and earned around 80 trillion IRR. In the same period, insurance companies paid about 50 trillion IRR as compensation for the insurance, liability, and property coverage in 2005 [CII (2005)].

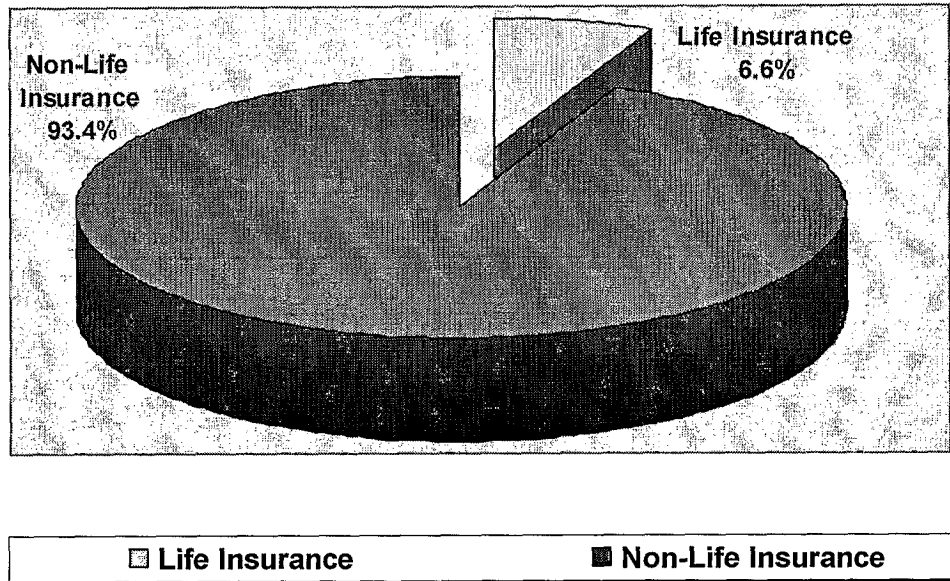
Table 1.3 shows the rising trend in the volume of premium in the years 2004 and 2005.

Table 1.3- Total Insurance Premiums of the Iranian Life Insurers (2000-2005)

Year	Total		Life	
	Amount (Million IRR)	Growth Rate (%)	Amount (Million IRR)	Growth Rate (%)
2004(1383)	17,317,627	35.89	1,063,974	2.46
2005(1384)	21,503,363	24.17	1,420,225	33.48

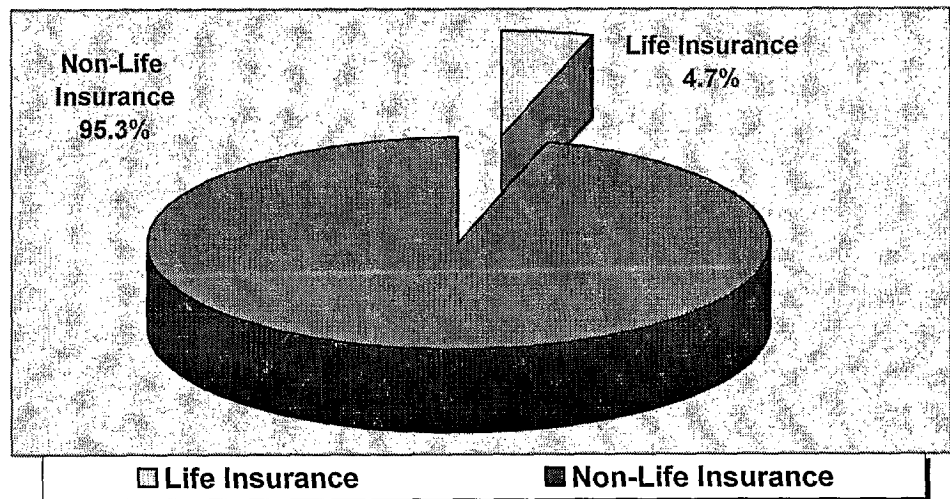
Figure 1.3 shows the proportion of earned premiums and Figure 1.4 shows the amount paid for losses in the Iranian insurance market in 2005.

Figure 1.3- Insurance Market Direct Premium in Iran (2005)



Source: CII (2005)

Figure 1.4- Insurance Market Direct Loss Payments in Iran (2005)



Source: CII (2005)

Iran and Asia Insurance Companies (among the state-owned insurers) and Karafarin and Sina (among the private insurers) possessed two-third of life insurance market share of their respective sector in 2005.

Annuities

Annuity is basically the exact opposite of life insurance. While proceeds of life insurance are paid lumpsum if insured alive or death occurs within a certain period or whenever, the proceeds of an annuity are paid instalment while the annuitant is alive. Generally, the annuitant can never outlive the income from the annuity. However, we can also purchase a certain annuity, which will provide income only for a specified period. Annuities are primarily intended to provide a source of retirement income. Payments can be made to the annuitant monthly, quarterly, semiannually or annually. While there are many types of annuity products available, they can be classified into three general categories:

- single premium immediate payment annuities
- deferred annuities and variable annuities
- both the deferred and variable types available on a single premium or flexible premium basis

Difference between Annuity and Life Insurance

Both annuities and life insurance should be considered in long-term financial planings. While both annuity and life insurance include death benefits, life insurance is suitable when death is expected too soon and an annuity is preferred when long life is expected. In other words, life insurance provides economic protection to the ones the insured loves and feels that at his or her death his or her financial obligations to them are not met, while annuities guard against outliving the assets.

Single and Flexible Premium Annuities

Single Premium

A single premium annuity is an annuity funded by a single payment. The payment might be invested for growth for a long period of time (single premium deferred annuity) or invested for a short time after which payment begins (single premium immediate annuity). Single premium annuities are often funded by rollovers or from the sale of an appreciated asset.

Flexible Premium Annuities

A flexible premium annuity is an annuity that is intended to be funded by a series of payments. Flexible premium annuities are only deferred annuities; that is, they are designed to have a significant period of payments into the annuity and investment growth before any money is withdrawn from them.

Immediate and Deferred Annuity

Immediate Annuity

This allows us to convert a lump sum of money into an annuity so that it is possible to receive incomes immediately. Payments generally start about a month after the annuity is purchased. This type of annuity offers financial security in the form of income payments for the rest of life. Immediate annuities can be fixed or variable.

Deferred Annuity

This type of annuity is good for long-term retirement planning for the following reasons:

- Payments on income taxes are deferred until the money is withdrawn.
- There are no limits on annual annuity contributions.
- There is a death benefit. If the investor dies before collecting on the annuity, the heirs get the contributed amount, plus investment earnings, minus whatever cash withdrawals were made.