

Introduction to Life Insurance

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Introduction

The basic matter of actuarial science is the analysis and management of financial risk, often within the framework of insurance and other risk arrangements. Actuaries develop risk models to describe and measure the various risks that areas in their work.

- ▶ **Experience** teaches that plans will not unfold with certainty and sometimes expectations will not be realized. (unrealistic assumptions)
- ▶ The **Insurance** is designed to protect against serious *financial reversal*. (random events intruding on the plans).
- ▶ Basic **limitation** on the insurance protection. (reduction of random events: "real life measurement", other losses are important but can't be reduced)

Examples

- ▶ **Medical Insurances:** pain and suffering may be caused by a random event. Insurance companies had difficulty of measuring the loss in monetary units.
- ▶ The **Economic loss:** fire a property set by its owner. The events are not insurable because of non-random nature of creating the losses, even the monetary terms of such losses may be easy to define.
- ▶ Basic **limitation** on the insurance protection is does not directly reduce the probability of loss. (well-designed insurance system often provides financial incentives for loss but will effect the probability of these economically adverse events).

Examples Cont's

- ▶ The destruction of property by fire or storm is usually considered a random event in which the loss can be measured in monetary terms.
- ▶ A damage award imposed by a court as result of a negligent act is often considered a random event with resulting monetary loss.
- ▶ Prolonged illness may strike at an unexpected time and result in financial losses, (extra health care expenses, reduced earned income).

We have the following definition:

An *insurance system* is a mechanism for reducing the adverse financial impact of random events that prevent the fulfillment of reasonable expectations.

Question: Can we predict what will be our lives in the future?

- ▶ If we could predict the consequences of our decisions, our lives will be simpler and less interesting.
- ▶ But we do not possess perfect foresight. We can select an action that will lead to one set of uncertainties rather than another.

Utility theory is an elaborate theory to provides insights into decision making taking into account certain uncertainty.

Background

Suppose that an insurance organization (*insurer*) was established to help reduce the financial consequences of the damage or destruction of property.

- ▶ The insurer would issue contracts (*policies*) that would promise to pay the owner of a property a amount equal to or less than the financial loss if the property were damaged or destroyed during the period of the policy.
- ▶ The contingent payment linked to the amount of the loss is called a (*claim*) payment.
- ▶ The owner of the property (*insured*) pays a consideration (*premium*).
- ▶ If the named life insured died during the years that the contract was in force, the insurer would pay a predetermined lump sum (*sum insured*)

Background

In the absence of a subsidy, an insurer, over the long term, must charge more than its expected losses.

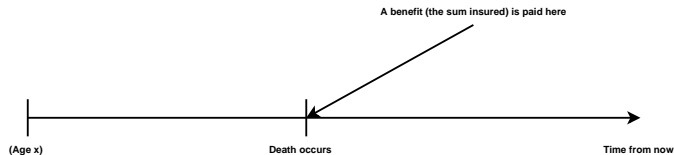
- ▶ An opportunity exists for a mutually advantageous insurance policy when the premium for the policy set by the insurer is **less** than the maximum amount that the property owner is willing to pay for insurance.
- ▶ The insurer must charge a premium in excess of expected losses and expenses to avoid a bias toward insufficient income.
- ▶ The property owner then cannot use a linear utility function.

We don't have any specification that would force a utility function to be linear, quadratic, exponential, logarithmic or any other particular functions.

Traditional Life Insurance Contracts

A whole life insurance

A whole life insurance pays a benefit on the death of the policyholder whenever it occurs. The following diagram illustrates a whole life insurance sold to a person age x .

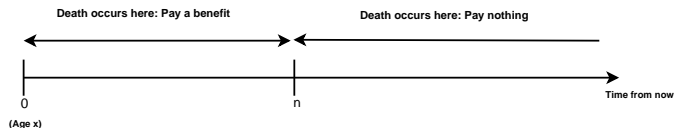


- ▶ The amount of benefit is often referred to as the *sum insured*.
- ▶ The policyholder, of course, has to pay the "*price*" of a policy.
- ▶ In insurance context, the "*price*" of a policy is called the *premium* which may be payable at the beginning of the policy, or periodically throughout the life time of the policy.

Traditional Life Insurance Contracts

Term life insurance

A term life insurance pays a benefit on the death of the policyholder, provided that death occurs before the end of a specified term.

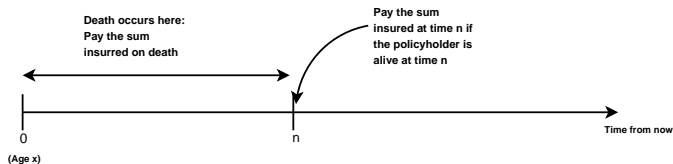


- ▶ The time point n in the diagram is called the *term* or the *maturity* date of the policy.

Traditional Life Insurance Contracts

Endowment insurance

An endowment insurance offers a benefit paid either on the death of the policyholder or at the end of a specified term, whichever occurs earlier.



- ▶ These 3 types of traditional life insurance will be discussed in Chapter 3 of this courses.

Traditional Life Insurance Contracts

Participating with profit insurance

Any premium collected from the policyholder will be invested, for example in bond market.

- ▶ The profit earned on the invested premiums are shared with the policyholder.
- ▶ The profit share can take different forms: cash dividends, reduced premiums or increased sum insured.

This product type will be discussed in details in Actuarial Mathematics II.

Modern Life insurance Contract

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Underwriting

Life Annuities

Pensions

This product type will be discussed in details in Actuarial Mathematics II.

Underwriting

Underwriting refers to the process of collecting and evaluating information such as age, gender, smoking habits, occupation and health history. The purposes of this process are:

- ▶ To classify potential policyholders into broadly homogeneous risk categories.
- ▶ To determine if additional premium has to be changed.

Underwriting

The following table summarizes a typical categorization of potential policyholders.

- ▶ The Category *Preferred lives*: Have very low mortality risk.
- ▶ The Category *Normal lives*: Have some risk but no additional premium has to be charged.
- ▶ The Category *Rated lives*: Have more risk and additional premium has to be charged.
- ▶ The Category *Uninsurable lives*: Have too much risk and therefore not insurable.

Underwriting is an important process, because with no (or insufficient) underwriting, there is a risk of adverse selection; that is, the insurance product tend to attract high risk individuals, leading to excessive claims.

In chapter 2 we will introduce the select-and-ultimate table, which is closely related to underwriting.

Life Annuities

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Pensions

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Pensions plans will be discussed in Actuarial Mathematics II.