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PRINCIPLES REGARDING PROVISIONS FOR LIFE RISKS

SOCIETY OF ACTUARIES COMMITTEE ON ACTUARIAL PRINCIPLES*

ABSTRACT

The Committee on Actuarial Principles is charged with identifying, circulating, and organizing actuarial principles (as distinct from standards) and recommending the resulting statements of principles to the Board of Governors for review and adoption. In October 1995, the Board accepted the Committee's statement entitled "Principles Regarding Provisions for Life Risks." This statement, which constitutes the following paper, is an expression of opinion by the Committee on Actuarial Principles and has been authorized by the Board of Governors. It has not been submitted to the vote of the membership and thus should not be construed as an expression of opinion by the Society of Actuaries.

BACKGROUND

The purpose of this statement is to describe principles and considerations regarding the provision made by insurance organizations relative to life actuarial risks. The terminology used to describe this provision is diverse and varies not only by jurisdiction but also in some cases by accounting purpose. For example, the provision is called a "reserve" in the U.S. and an "actuarial liability" in Canada. In addition, the provision sometimes consists of both an accounting liability item and a designated portion of accounting surplus. Some sense of adequacy or sufficiency adheres to each such provision but varies from system to system. This statement is intended to apply consistent notions of adequacy and sufficiency to provisions for life actuarial risks, however defined. It is hoped that the use of a neutral term ("provision") will permit a wide application of the principles without unnecessary confusion.

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This statement may be regarded as an extension of "Principles of Actuarial Science," an earlier expression of opinions of the committee [*TSA* XLIV (1992) 565–628], which articulates general principles that apply to the areas of actuarial practice within the purview of the Society of Actuaries. The Glossary appended to this statement contains the Principles and Definitions originally set forth in "Principles of Actuarial Science."

This statement consists of three parts:

A. Definitions
B. Principles with Discussions
C. Considerations.

Clear and precise Definitions are essential for accurately articulating Principles. This statement uses terms defined in "Principles of Actuarial Science" and defines additional terms as needed.

Principles are defined in "Principles of Actuarial Science" as "statements grounded in observation and experience." The Principles presented in this document represent applications of the general principles to a defined area of practice. Brief Discussions explain and illustrate the Principles.

The Considerations provide a current context for application of the Principles and discuss areas in which Standards (defined in "Principles of Actuarial Science" as "rules of behavior, including, in particular, directives as to when and how professional judgment should be employed") may be needed.

A. DEFINITIONS

1. Terms Previously Defined

The following terms defined in "Principles of Actuarial Science" are used in this statement: *actuarial assumption*, *actuarial model*, *actuarial risk*, *actuarial value*, *asset*, *benefit*, *cash flow*, *consideration*, *degree of accuracy*, *degree of actuarial soundness*, *insurance system*, *obligation*, *potentially valid*, *premium structure*, *risk* (or *risk subject*), *scenario*, and *valid*. Definitions of these terms are found in the Glossary.

2. Additional Terms

A *life insurance and annuity system* is an insurance system in which the actuarial risks to be financed arise primarily from human mortality. The obligations related to the payment of benefits by a life insurance and annuity system are called *life risk obligations*.

An *accounting method* is a set of rules that assigns values (called *accounting values*) to the assets and obligations of a life insurance and annuity system. A *block* (or *block of life risk obligations*) is a subset of the life risk obligations of a life insurance and annuity system, together with the future considerations associated with these obligations.

The insurance subsystem consisting of a block and a collection of assets or portions of assets is called a *component* of the life insurance and annuity system. A component is said to be *in full compliance* if on a given date all applicable contractual, legal, and regulatory constraints that require or prohibit the assignment of specific assets to the block are satisfied.

The accounting value assigned to a block of life risk obligations on a given date (the *valuation date*) is called the *provision* for that block on that date. The sum of the provisions for all blocks of a life insurance and annuity system is called the (*aggregate*) *provision* for the system. A component of a life insurance and annuity system is said to achieve *accounting balance* on the valuation date if the total accounting value of the assets in the component equals the provision for the block of life risk obligations in the component on that date. An *allowable asset allocation* is an assignment or reassignment on the valuation date of assets or portions of assets to each block of a life insurance and annuity system, so that each of the resulting components is in full compliance and achieves accounting balance on that date.

A provision for a block of life risk obligations on a given valuation date will have been *ultimately sufficient* relative to an allowable asset allocation if, in the end, all benefits could have been paid as promised from the net cash flows generated directly or indirectly by the assets assigned to the block and by the considerations associated with the block. The likelihood on a given date, based on a valid actuarial model, that a provision will be ultimately sufficient relative to a specific allowable asset allocation is called the *indicated level of adequacy* of the provisions relative to the asset allocation. If the actuarial value calculated using a valid actuarial model of the system, or of a component consisting of a block of life risk obligations and the assets assigned to the block by an allowable asset allocation, is negative for a given scenario under that model, the absolute value of that actuarial value is called the *indicated current deficiency* of the system or of the block for that scenario.

B. PRINCIPLES

1. **PRINCIPLE (Likelihood of Ultimate Sufficiency). The likelihood on a given valuation date that a provision for a block of life risk obligations will be ultimately sufficient relative to a specific allowable asset allocation depends upon:**
   (a) the risk subjects covered,
   (b) the actuarial risks involved,
   (c) the future obligations and considerations arising from the financing of these risks,
   (d) the assets allocated to the block on the valuation date, and
   (e) the strategy for reinvesting or financing net future cash flows.

DISCUSSION. The likelihood of ultimate sufficiency for a block of life risk obligations depends on the enumerated factors, which represent aspects of the life insurance and annuity system. Each of these factors is in turn affected by external influences, such as the economic environment. The enumeration is not complete; for example, factors such as management capability may come into play. The actuarial risks may include risks besides those for which the financial security system was instituted. Some of the actuarial risks may involve events that fail to qualify as insurable events, for example, by being subject to control by an insured. Future obligations may include contractual benefits, such as withdrawal benefits and the payment of nonguaranteed elements, in addition to life insurance and annuity benefits. The premium structure of the life insurance and annuity system may also affect ultimate sufficiency. For example, if this structure involves broad groupings, ultimate sufficiency may be affected by adverse selection. The extent to which future obligations and considerations may be varied to reflect future circumstances will also affect ultimate sufficiency.

The ultimate sufficiency of the provision is affected by the cash flows generated by the assets allocated to the block and by investments of positive net cash flows and financing requirements for negative net cash flows. The cash flows, in turn, are not certain as to receipt or timing of receipt. Alternative sets of such assets may have the same accounting value but may generate significantly different cash flows and thus may have a different result as regards ultimate sufficiency. Constraints on allowable allocations will reduce the ways available to fund the obligations and thus may require a larger provision to achieve ultimate sufficiency. Conversely, the adoption

of a strategy for reinvesting or financing net future cash flows that is capable of responding to potential changes in future obligations and considerations may reduce the provision that is required to achieve this goal.

The definition of ultimate sufficiency assumes that (a) the block of obligations is closed and (b) the net cash flows generated directly or indirectly from the initial assets and from subsequent considerations remain in the component until needed to fund the obligations. In theory, it is possible to track all cash flows deriving from the initial assets and subsequent considerations and reinvestments of cash flows. However, in real life applications, such investments may be in "assets" such as new business strain, which involve complex, hard-to-monitor cash flows.

Since ultimate sufficiency can be verified only in unrealistically simple situations, the ability to estimate the likelihood of ultimate sufficiency is of more theoretical than practical value. However, this theoretical possibility allows the use of actuarial models to test the choice of provisions (together with the choice of assets allocated to the block) and to determine relative likelihoods. As a practical matter, the model usually involves simplifying assumptions, such as a reinvestment assumption that ignores any use of future cash flows to fund new business.

2. PRINCIPLE (Estimation of the Likelihood of Ultimate Sufficiency). Any valid actuarial model that takes account of the dependencies enumerated in Principle 1 can be used to estimate the likelihood that a provision for a block of life risk obligations will be ultimately sufficient relative to a specific allowable asset allocation.

DISCUSSION. Models used to estimate the likelihood of ultimate sufficiency may vary with respect to the degree of summarization of in-force data, the extent of refinement of the actuarial assumptions used, and the stochastic representation of various actuarial risks, among other factors. Among the models incorporating appropriate dependencies, no one unique model is selected by the validation process. It is not possible to state that the indicated level of adequacy from one such valid model represents a better estimate of the likelihood of ultimate sufficiency than the indicated level of adequacy from another such valid model.

The indicated level of adequacy depends on the assumptions inherent in the actuarial model, including aspects of the assumed future economic environment. The indicated level of adequacy is prospective, but the actuarial model is generally validated against past experience. It is incorrect to

conclude on the basis of subsequent experience that the actuarial assumptions were inappropriate or that the indicated level of adequacy was overstated or understated.

Historical validation of economically sensitive elements, in particular, is useful only if the past period used for validation resembles the current period with respect to economic conditions.

If an actuarial risk variable is associated with events that do not qualify as insurable events, stochastic modeling may not result in useful estimates.

3. PRINCIPLE (Changes in the Indicated Level of Adequacy). The indicated level of adequacy calculated on a date subsequent to an original valuation date can differ from the originally calculated indicated level of adequacy, even if the respective models have the same degree of accuracy and the assumptions regarding future events are unchanged and remain appropriate.

DISCUSSION. Recalculation of the indicated level of adequacy after the passage of time will normally result in a changed value, even if the life insurance and annuity system appears unchanged. To begin with, the assumption set required to produce the estimate is reduced with the passage of time, especially for a closed block, that is, a block of life risk obligations into which no new business has been injected. This is true even if assumptions remain appropriate. Assumptions may be considered appropriate if deviations can be explained as random fluctuations and if no information is available indicating that changes in the assumptions should be made. While a later estimate may be considered to be a better estimate, this does not mean that the indicated level of adequacy will converge smoothly to a value. To be sure, for a closed block, as time passes, if the assets begin to exceed the expected value of future obligations, the indicated level of adequacy may approach one. Conversely, if the expected future obligations exceed the assets and all expected future investment income and considerations, the indicated level of adequacy will approach zero. However, there are many situations in which an intermediate value will remain appropriate until the cash flows and cash flow requirements of the block are nearly complete. Significant fluctuations may occur close to the end of this process.

Nevertheless, the indicated level of adequacy can be an important tool for managing a block of liabilities. For example, if the block is managed so that the indicated level of adequacy remains above a fixed level, possibly by

injecting additional assets from time to time, the likelihood of fulfilling the obligations of the block may be enhanced.

4. **PRINCIPLE (Aggregation). For some life insurance and annuity systems, the aggregate provision required to achieve a given indicated level of adequacy will be reduced if two or more selected blocks of life risk obligations are combined into a single block.**

DISCUSSION. Equivalently, for some blocks the indicated level of adequacy may be increased by combining the associated components without adding or substituting assets. This effect, sometimes referred to as "liability-side hedging," may arise from negative correlations between the risks in different blocks (for example, mortality improvement risks associated with life insurance and annuities) or from the fact that the combined block may require net cash flows that are easier to fund with the cash flows of available assets than would be the case for the blocks taken separately. An example of this latter situation is a combined block of deferred and immediate annuities. Note that this effect is distinct from the reduction in aggregate provision that occurs if provisions whose indicated levels of adequacy exceed the required level are reduced, provisions whose indicated levels of adequacy fall short of the required level are increased, and assets are appropriately reallocated.

5. **PRINCIPLE (Current Deficiencies). Two or more blocks of life risk obligations with provisions having the same indicated level of adequacy relative to a valid actuarial model may have different indicated current deficiencies relative to a given scenario under the model.**

DISCUSSION. The indicated current deficiency for a given scenario can be determined as the amount of cash that must be added to the component to pay all obligations under that scenario. The likelihood that benefits will be paid (indicated level of adequacy) is distinct from the indicated current deficiencies for those scenarios under which benefits are not expected to be able to be paid. The actuarial values for a given scenario under a valid actuarial model of two components may differ, even if the provisions for the associated blocks of obligations have the same indicated levels of adequacy relative to that actuarial model when all tested scenarios are considered. This may be caused either by differences in the initial assets or differences in the

actuarial risks, risk subjects, or obligations involved. Calculation of the indicated current deficiencies under various scenarios may be useful in surplus planning, solvency testing, and the management of industry guarantee associations.

C. CONSIDERATIONS

1. Provision Methodologies

One of the typical elements of an insurance accounting system is a methodology for establishing provisions for risk obligations.

Historically, the most common methodology involved formula reserves. A "formula reserve" is one of a set of values, assigned by a rule or formula, representing the provision to be established at each of a given set of future dates ("valuation dates") for the risk obligations remaining or projected to be remaining from a given block on that date. An "actuarial formula reserve" for a block as of a given valuation date relative to a given actuarial model is the formula reserve under which the provision at that valuation date equals the actuarial value at that date of the future cash flows arising from the obligations of the block less the actuarial value at that date of the future considerations payable to the block projected by the actuarial model. Statutory reserves and GAAP benefit reserves (under *SFAS 60*) in the U.S. are examples of an actuarial formula reserve. In both cases, calculated net premiums are used in place of actual gross premiums. This substitution represents an assumption in the actuarial model regarding expenses and profits. A desirable feature of actuarial formula reserves is the ability to calculate values as of future valuation dates.

An alternative approach is the "asset adequacy method," in which the provision for a block of risk obligations is taken to be the minimum aggregate accounting value of assets that allow the provision to attain a given indicated level of adequacy relative to an allowable asset allocation. The indicated level of adequacy for a provision calculated under the asset adequacy method is obviously predetermined, but, unlike the actuarial formula method, provisions as of future valuation dates are not easily projected.

When an accounting method includes a provision methodology that allows the projection of provisions required or desired as of future dates, another concept of adequacy may be of interest. The "indicated level of accounting adequacy" is an estimate of the likelihood as of a given valuation date that, in addition to paying all benefits as promised, the accounting values of the assets allocated to the block will exceed the projected provisions at each of

a defined set of future dates. It is clear that the indicated level of accounting adequacy, if available, will always be less than or equal to the indicated level of ("economic") adequacy on the same valuation date. In other words, accounting adequacy is a stricter test because it does not allow shortfalls of assets relative to projected provisions for a block to be financed from possible future excesses.

2. Actuarial Submodels

Actuarial models used in developing or testing the provision made by life insurance and annuity systems relative to life actuarial risks usually involve several actuarial submodels. Typical submodels are associated with such actuarial risks as mortality, lapse, and investment default.

The validity of the actuarial model depends on which actuarial risks are represented by submodels and whether the submodels are valid or potentially valid. Among valid or potentially valid submodels, those which take account of "induced experience" (see Principle 4.4 in the Glossary) and future "antiselection" (see Principle 4.3 in the Glossary) are more likely to remain valid at future times.

3. Dependence on Status

The actuarial model used to calculate or test provisions may depend on the status of an insured event. For example, an actuarial model used in connection with provisions for obligations associated with events that have already occurred (for example, claim provisions for death benefits) or that are currently occurring (for example, provisions for annuities in payment status) may incorporate greater detail on the amount and timing of payments in progress, while a model used in connection with provisions for events that have yet to occur may incorporate greater detail on present-value assumptions.

4. Provision for Expenses

Normally, the expenses incurred in fulfilling the benefit obligations of a block are considered obligations of that block. If, as in the case of expenses related to claim payment, expected future expenses are provided for by considerations already received, an expense provision can be established. Conversely, if an expense that has been incurred is to be provided for by cash flows at one or more later dates, an offset to the provision can be used to defer recognition of the expense, or a portion thereof, until those dates.

5. Asset Allocation

The range of allowable asset allocations will affect the indicated level of adequacy of provisions. Variations in this range from year to year may affect comparability. Absent separate accounts or other contractual arrangements, the allocation of assets to a block creates no legal or contractual right to specific assets. Moreover, again absent separate account or other contractual arrangements, the loss associated with the default of an asset need not be charged solely to the component to which the asset has been assigned.

6. Experience Adjustment

Provisions may be based, in whole or part, on the experience of the life insurance and annuity system. Provisions may be adjusted if the experience of the life insurance and annuity system differs materially from that originally assumed. If the adjustment is made only if the new provision is larger than the old, the process is called "loss recognition." If periodic experience adjustments are required and if a pattern can be discerned, projected provisions at future valuation dates may be adjusted to reflect this pattern. This process is referred to as "trending."

7. Treatment of Profit Margins or Contributions to Surplus

The actuarial model associated with an actuarial formula reserve may specify the treatment of profit margins or contributions to surplus. Some models recognize these margins currently; others spread the margins over the life of the block of obligations, either explicitly or by the inclusion in assumptions of "provisions for adverse deviation."

8. Other Obligations

The term "other obligations" is used to indicate obligations of the life insurance and annuity system not arising from the actuarial risks assumed by the system. The existence of other obligations may limit the allowable asset allocations. For example, an obligation for incurred expense may need to be backed by cash, reducing the cash available for assignment to other blocks of obligations.

Note: The following glossary of Principles and Definitions was originally published as part of "Principles of Actuarial Science," by the Society of Actuaries Committee on Actuarial Principles, in *Transactions of the Society of Actuaries*, Volume XLIV, 1992, pp. 565–91.

GLOSSARY

PRINCIPLES OF ACTUARIAL SCIENCE

1.1 PRINCIPLE (Statistical Regularity). Phenomena exist such that, if a sequence of independent experiments is held under the same specified conditions, the proportion of occurrences of a given event stabilizes as the number of experiments becomes larger.

1.2 PRINCIPLE (Stochastic Modeling). A phenomenon displaying statistical regularity can be described by a mathematical model that can estimate within any desired degree of uncertainty the proportion of occurrences of a given event in a sufficiently long sequence of experiments.

2.1 PRINCIPLE (Diversity of Preferences). Different people may assign different current monetary values to the same economic good.

2.2 PRINCIPLE (Time Preference). Money has time value; that is, people tend to prefer receiving money in the present to receiving that same amount of money in the future.

2.3 PRINCIPLE (Present Value Modeling). For many persons, there exists a mathematical model that can estimate the current monetary value that the person would assign to any future cash flow.

3.1 PRINCIPLE (Modeling of Actuarial Risks). Actuarial risks can be stochastically modeled based on assumptions regarding the probabilities that will apply to the actuarial risk variables in the future, including assumptions regarding the future environment.

3.2 PRINCIPLE (Validity of Actuarial Models). The change over time in the degree of accuracy of an initially valid actuarial model depends upon changes in:

a. the nature of the right to receive or the duty to make a payment;

b. the various environments (regulatory, judicial, social, financial, economic, etc.) within which the modeled events occur; and

c. the sufficiency and quality of the data available to validate the model.

3.3 **PRINCIPLE (Combinations of Cash Flows). The degree of uncertainty of the actuarial value of a combination of cash flows reflects both the uncertainties affecting each underlying actuarial risk variable and the process of combination.**

4.1 **PRINCIPLE (Risk Classification). For a group of risks associated with a given actuarial risk, it is possible to identify characteristics of the risks and to establish a set of classes based on these characteristics so that:**

- **a. each risk is assigned to one and only one class; and**
- **b. probabilities of occurrence, timing and/or severity may be associated with each class in a way that results in a actuarial model which, for some degree of accuracy, is:**
  - **(1) valid relative to observed results for each class or group of classes having sufficient available data, and**
  - **(2) potentially valid for every class.**

4.2 **PRINCIPLE (Pooling). If the actuarial risk associated with a risk classification system displays statistical regularity, it is possible to combine risk classes so as to ensure that there is an actuarial model associated with the new set of risk classes that is valid within a specified degree of accuracy.**

4.3 **PRINCIPLE (Antiselection). If the premium structure of a voluntary insurance system is based on a risk classification system such that a refinement of the system could result in significant differentials in considerations between risks originally assigned to the same class, there will be a tendency for relatively greater participation by those whose considerations would increase if the refinement were put in place.**

4.4 **PRINCIPLE (Induced Experience). The experience rates for events associated with a financial security system will tend to differ from those for the same events in the absence of any such system.**

4.5 **PRINCIPLE (Insured Experience). The experience rates for the insurable events of an insurance system will tend to differ from the overall rates of occurrence of the same events among all those subject to a given actuarial risk.**

4.6 PRINCIPLE (Avoidance of Ruin). For most ruin criteria, there are combinations of values of the financial parameters that will reduce, below a given specified positive level, the ruin probability relative to an actuarial model.

4.7 PRINCIPLE (Actuarial Soundness). For most financial security systems, there are combinations of margins that will produce, relative to a valid actuarial model, a degree of actuarial soundness that exceeds a given specified level less than one.

DEFINITIONS

The assumptions upon which an actuarial model is based are called **actuarial assumptions.**

A model described by Principle 3.1, together with a present value model if applicable, is called an **actuarial model.**

An **actuarial risk** is a phenomenon that has economic consequences and that is subject to uncertainty with respect to one or more of the **actuarial risk variables:** occurrence, timing, and severity.

The **actuarial value** of a future cash flow that is contingent upon actuarial risk variables is the present value developed by an actuarial model associated with the actuarial risk variables.

The **actuarial value of a financial security system** relative to a given actuarial model is the actuarial value, developed by the model, of the combination of cash flows associated with assets, obligations, and considerations of the system.

An **asset** is money or economic goods held, or a right to receive future cash flows; an *obligation* is a duty to provide current or future cash flows.

A *financial security system* is an arrangement for risk financing in which one person assumes the obligation to make a payment (or series of payments), called a **benefit (benefits),** that offsets undesirable economic consequences that may be experienced by a second person in return for the payment, by or on behalf of the second person, of one or more amounts, called *considerations.*

A **cash flow** is the receipt or disbursement at a point in time of an amount of money (or of an economic good with a monetary value).

A *financial security system* is an arrangement for risk financing in which one person assumes the obligation to make a payment (or series of payments), called a *benefit (benefits)*, that offsets undesirable economic consequences that may be experienced by a second person in return for the payment, by or on behalf of the second person, of one or more amounts, called **considerations.**

A cash flow whose occurrence or amount depends on the occurrence of an event that is not certain to occur is said to be **contingent.**

Credibility is the importance assigned to the experience of a given risk class or group of risk classes relative to other information for the purpose of experience adjustment.

The amount of money a person is willing to trade for a good at a specific point in time is the good's **current monetary value** to that person.

A measure of the probability that a financial security system is likely to be able to pay all benefits as promised is called the **degree of actuarial soundness** of the financial security system.

A **deterministic model** is a simplified stochastic model in which the proportion of occurrences of a given event estimated by the stochastic model is assumed to occur with probability one.

An **economic good** is something which has value to a person and which the person may consider exchanging for something else.

The result of an experiment is called an *outcome*; an **event** is a set of one or more possible outcomes.

The probability-weighted average of the numerical values taken on by a random variable is called the **expected value** of the random variable.

The **experience** of a financial security system is the data obtained in the operation of the system.

An **experience adjustment** is a change in considerations or benefits applicable to the various risk classes to reflect the experience of the financial security system.

Estimates, based on such data, of rates of occurrence or amounts of payment related to an actuarial risk are called **experience rates.**

An **experiment** is an observation of a given phenomenon made under specified conditions.

If the actuarial value can be expressed as a function of any variable associated with the financial security system and independent of the actuarial model, that variable is called a **financial parameter** of the financial security system.

A **financial security system** is an arrangement for risk financing in which one person assumes the obligation to make a payment (or series of payments), called a *benefit (benefits)*, that offsets undesirable economic consequences that may be experienced by a second person in return for the payment, by or on behalf of the second person, of one or more amounts, called *considerations.*

An event is said to be **insurable** if:

a. it is associated with a phenomenon that is expected to display statistical regularity;
b. it is contingent with respect to number of occurrences, timing and/or severity;
c. the fact of its occurrence is definitely determinable;
d. its occurrence results in undesirable economic consequences for one or more persons; and
e. its future occurrence, timing and/or severity are neither precisely known nor controllable by these persons.

A person is said to have an **insurable interest** in an insurable event to the extent that the occurrence of the event creates an economic need involving that person.

An **insurance system** is a financial security system in which:

a. the actuarial risks to be financed arise from insurable events;
b. the risk subjects are grouped according to a risk classification system;
c. the benefits payable are related to an insurable interest;
d. the actuarial value of benefits payable, developed by an actuarial model associated with the risk classification system, is finite; and
e. considerations are consistent with the actuarial value of the associated benefits.

An insurance system is **mandatory** if all persons in a group or in society are required legally or otherwise to participate; otherwise, it is **voluntary.** It is a **personal insurance system** if the decision to participate is made by each insured individually; it is a **group insurance system** if the decision is made on behalf of a group, although participation may be mandatory or voluntary for the members of the group; and it is a **social insurance system** if all members of society (or a defined subgroup of society) are eligible to participate.

The entities to which actuarial risk is transferred in an insurance system (whether private or governmental) are called **insurers.**

The amounts by which the values of financial parameters can be changed without reducing the expected actuarial value of the financial security system below zero are called **margins.**

A **mathematical model** is a scientific model in which the representation is expressed in mathematical terms.

Money is a means of exchange which may be traded for economic goods.

A *refinement of a risk classification system* is a risk classification system formed from another by subdividing one or more classes. If there are actuarial models associated with the original risk classification system and with

the refinement such that these models assign the same probabilities of occurrence, timing and/or severity to classes that were not subdivided, but they assign differing probabilities to one or more of the subdivisions of at least one class, the refinement is said to be **more homogeneous** than the original system.

An *asset* is money or economic goods held, or a right to receive future cash flows; an **obligation** is a duty to provide current or future cash flows.

The result of an experiment is called an **outcome;** an *event* is a set of one or more possible outcomes.

Phenomena are occurrences which can be observed.

The process of combining risk classes described in Principle 4.2 is called **pooling.**

A mathematical model is **potentially valid** if it produces results that are consistent with available observations of the modeled phenomena and of similar phenomena and is capable of being validated relative to the specified observed results when sufficient data are available.

The **premium structure** of an insurance system is a set of considerations that reflect the assignment of risks to various risk classes.

The estimate of the current monetary value of a future cash flow given by a present value model under a fixed assumption regarding future economic conditions is called the **present value** of the cash flow relative to that assumption.

A model described by Principle 2.3 is called a **present value model.**

Probability is a measure which takes on values from zero to one and gives the likelihood of occurrence of an event.

A rule which assigns a numerical value to every possible outcome is called a **random variable.**

A **refinement of a premium structure** is a premium structure based on a refinement of a risk classification system.

A **refinement of a risk classification system** is a risk classification system formed from another by subdividing one or more classes.

A set of classes, a set of characteristics and a set of rules for using the characteristics to assign each risk to a class in such a way that the conditions of Principle 4.1 are satisfied with respect to a given group of risks is called a **risk classification system.** These classes are called **risk classes,** and the rules used for assigning risks to risk classes are called *underwriting rules.*

Risk control is a process that reduces the impact of one or more of the actuarial risk variables associated with the actuarial risk.

Risk identification is a process for determining whether a given person or object is a risk subject for a given actuarial risk.

A **risk management system** is an arrangement involving one or more of risk identification, risk control, and risk transfer or risk financing.

A person or object involved in an event associated with an actuarial risk is called a **risk subject** or **risk.**

Risk transfer or **risk financing** is a mechanism that provides cash flows that are contingent upon the occurrence of an event associated with the actuarial risk and that tend to offset undesirable economic consequences.

Ruin occurs when a financial security system first fails to satisfy all conditions required to remain in operation.

The statement of the conditions under which ruin occurs is called the **ruin criterion.**

The probability that ruin will occur within a specified period of time, as calculated using an actuarial model, is called the **ruin probability** of the financial security system relative to that model within that period of time.

The estimate of the current monetary value of a future cash flow given by a present value model under a fixed assumption regarding future economic conditions is called the *present value* of the cash flow relative to that assumption. Such a fixed assumption regarding future economic conditions is called a **scenario.**

A **scientific model** is an abstract and simplified representation of a given phenomenon.

A phenomenon to which Principle 1.1 applies is said to display **statistical regularity.**

A model satisfying Principle 1.2 is called a **stochastic model.**

The rules used for assigning risks to risk classes are called **underwriting rules.**

A mathematical model is said to be **valid within a specified degree of accuracy** relative to certain observed results if it reproduces these results within that degree of accuracy.

The process of determining the actuarial value of a financial security system is called a **valuation.**