
Introduction to Actuarial Science
Draft Lecture Notes By
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STA 2190: INTRODUCTION TO ACTUARIAL SCIENCES

The objective of the course is to provide students with the necessary knowledge to understand the work in the general areas of actuarial science, mainly life and health insurance, pension funds, and financial security.

Course Purpose

The purpose of this course is to give the students an overview and introduction to the Actuarial Sciences. This is a course that introduces the students to the basics of Actuarial Science and gives a background to the entire course.

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate good understanding of the general areas of actuarial science, mainly life and health insurance, pension funds, risk management and financial security.
2. demonstrate good understanding of the history of Actuarial Science
3. demonstrate good understanding of the Roles/Functions and types of Actuaries
4. demonstrate good understanding of the elementary concepts of the Actuarial Control Cycle and its function in the branches of Actuarial Science

Course Description

History of Actuarial Science. Roles/Functions and types of Actuaries: General (Non-life) Insurance, Life Assurance, Finance and Investments, Pensions, Health. Elementary concepts of the Actuarial Control Cycle and its function in the branches of Actuarial Science. Modeling: Purpose and steps. Introduction to Modern Actuarial Practices. Principles of Insurance. Classes of Insurance. Risks: Non-insurable and Insurable Risks. Role of Financial Management: development of financial thought, goal of the firm, financial decisions, and risk-return relationships, prices and value. Ethics and Professionalism.

Teaching Methodology

The method of instruction will be lectures, interactive tutorials, and any other presentations/ demonstrations the lecturer will deem fit towards enhancing understanding of the concepts taught in class.

Instruction Materials/Equipment

Whiteboard, LCD/Overhead Projector, Handouts

Course Evaluation

The final grade for the course will be based on a final examination at the end of the semester (70%) and the continuous assessment tests (30%) which will be based on question exams and assignments throughout the semester.

Prerequisites: None.

Required Text Books

1. Booth, PM; Chadburn, Modern Actuarial Theory and Practice, Chapman and Hall, 1999.

Reference Books

1. Bellis Shepherd and Lyon Understanding Actuarial Management: The Actuarial Control Cycle, 2003.
2. Bellis, C. Actuarial control cycle. John Wiley and Sons Ltd., 2004.

LECTURE ONE
INTRODUCTION TO ACTUARIAL SCIENCE

What is Actuarial Science?

Actuarial science is the discipline that applies mathematical and statistical methods to assess risk in the insurance and financial institutions.

Actuarial science includes a number of interrelating subjects, including probability and statistics, finance, and economics. Historically, actuarial science used deterministic models in the construction of tables and premiums. The science has gone through revolutionary changes during the last 30 years due to the proliferation of high speed computers and the synergy of stochastic actuarial models with modern financial theory (Frees 1990).

In 2002, a Wall Street Journal survey on the best jobs in the United States listed “actuary” as the second best job (Lee 2002).

What is an Actuary?

An actuary is a professional who analyzes the financial consequences of risk. Actuaries use mathematics, statistics, and financial theory to study uncertain future events, especially those of concern to insurance and pension programs. They evaluate the likelihood of those events, design creative ways to reduce the likelihood and decrease the impact of adverse events that actually do occur. Actuaries may work for insurance companies, consulting firms, government, employee benefits departments of large corporations, hospitals, banks and investment firms, or, more generally, in businesses that need to manage financial risk. A career as an Actuary is better described as a “business” career with a mathematical basis than as a “technical” mathematical career.

An actuary is a business professional who deals with the financial impact of risk and uncertainty. Actuaries have a deep understanding of financial security systems, with a focus on their complexity, their mathematics, and their mechanisms. (Trowbridge 1989, p. 7). Actuaries evaluate the likelihood of events and quantify the contingent outcomes in order to minimize losses, emotional and financial, associated with uncertain undesirable events. Since many events, such as death, cannot be avoided, it is helpful to take measures to minimize their financial impact when they occur. These risks can affect both sides of the balance sheet, and require asset management, liability management, and valuation skills. Analytical skills, business knowledge and understanding of human behavior and the vagaries of information systems are required to design and manage programs that control risk (Be An Actuary 2005).

An actuary is a business professional who manages financial risks related to insurance product design, pension and other financial corporate planning. By applying his knowledge in probability, statistics, risk theory and financial principles, an actuary is able to quantify future risk with respect to insurance, annuity and pension programs.

To achieve all this, an actuary must initially collect and analyze data to formulate mathematical models. Models on the probability of sickness, death, accident and so on together with unemployment, marriage and other demographic tables are constructed. After all probabilities and company's expenses are calculated, an actuary is able to determine the value of periodical or single premium needed to pay for expected insurance benefits to be paid in the future.

An actuary is also known as a financial architect and a social mathematician due to his unique combination of quantitative analysis and business expertise to solve the ever increasing financial and social problems. The calculations and planning of an actuary is the backbone of the insurance industry and financial securities. Even though an actuarial career involved a lot mathematics, an actuary must always observe current issues and trends in business, social science, legal environment and the economy.

An actuary deals with the business of insurance and is responsible for many areas under the broad category of insurance. The actuary is an individual who will analyze important data such as mortality, sickness, injury and disability rates and use that information to aid those involved with insurance. An actuary is responsible for collecting the data to forecast future risks and see how these predictions will affect various aspects of insurance.

Actuaries are an important part of the management team of the companies that employ them. Their work requires a combination of strong analytical skills, business knowledge and understanding of human behavior to design and manage programs that control risk.

Actuaries are professionals who are qualified in this field through education and experience. In the United States, Canada, the United Kingdom, Kenya and several other countries, actuaries must demonstrate their qualifications by passing a series of professional examinations.

Why would I want to be an Actuary?

Actuaries describe their work as challenging and interesting and generally enjoy a good working environment. The Jobs Rated Almanac has consistently rated "Actuary" as one of the top two or three jobs on a variety of factors. According to several studies, the profession is more open than others to women and members of under-represented minority groups. Actuaries are in high demand, with starting salaries ranging from £45,000 to £55,000. The salary increments are based both on experience and exams passed. The increments can be quite large and many actuaries earn in triple digits.

Where are Actuaries employed?

Early history has shown that actuaries are greatly involved in human lives and businesses especially in the aspects of mortality and compound interest. The role of actuaries also involved financial risks. Beginning with these activities, the functions of actuaries have

expanded beyond insurance and investment.

Actuaries work in life insurance, Pensions and retirement systems, health benefit systems, financial and investment management, Risk management, Asset and Fund Management and other emerging areas of practice. The majority of actuaries work within the insurance industry, although a growing number of actuaries work in other fields.

There are also actuaries who work as consultants. They offer advice to companies and other bodies that do not employ actuarial personnel. Normally, a consultant advice comprised of extended issues and the target of individual consultant is normally concentrated on actuarial expertise in a business environment.

An actuary may also work in the government sector. They are employed to manage the pension and national insurance plans.

They are also employed in higher learning academic institutions to train actuaries.

Who can be an Actuary?

To consider being an actuary, one must have the following qualities:

- An outstanding student in Mathematics.
- Love to do research and to learn and solve complicated problems.
- Love strategic games like chess and computer games.
- Love to write and communicate with other people.
- Interested in history, socioeconomic, legal and political issues.
- Self motivated and good leadership qualities.

Actuarial Science in Kenya

In Kenya, the Actuarial Science course was pioneered by the University of Nairobi (UoN) in the year 2002. It was followed by Jomo Kenya University of Agriculture and Technology in the year 2004. Other public universities offering the course include; Maseno University, Moi University, Kenyatta University (KU), Egerton University, Kimathi University College of Technology and other constituent colleges of the universities. The private universities offering the course include; Strathmore University.

An actuary is a professional career. Thus, there are professional bodies which set and regulate the professional examinations. One has to sit and pass all these examinations before being conferred as a qualified actuary.

Objectives of Actuarial Science Programme

The main objective of the programme is to produce skilled actuarial executives for various institutions and firms to fill the gaps in the in areas such as the actuarial departments, underwriting, policy servicing, corporate planning and so on. In addition, the programme is also intended to provide basic and adequate knowledge for our students to sit in the early professional examinations. Emphasis is given such that our graduates could also significantly contribute towards other financial sectors and not limited to insurance.

How can I become an Actuary?

To become an “Actuary”, you must become an Associate, and ultimately a Fellow, of one of the professional societies by passing a series of examinations administered by them. The largest of the professional groups is the Society of Actuaries (SOA), the organization for actuaries working in life and health insurance, employee benefits, and pensions. The Casualty Actuarial Society (CAS) is the organization for actuaries working in automobile, fire, and liability insurance and workers’ compensation. The American Society of Pension Actuaries is the organization for actuaries working in the pension field; in particular, those actuaries who certify to the federal and state governments that pension plans are sound.

Entry into the profession is very competitive and success in the field demands commitment and hard work during college and the few years after graduation when the actuarial exams are being taken. Potential employers suggest the minimum requirements for hiring are an upper second class Honors degree or higher and at least one actuarial exam. The qualities sought in applicants are high technical ability, good communications skills, and a broad background including courses in mathematics, statistics, business, and the liberal arts.

The actuarial exams, administered by the SOA and the CAS, cover a variety of subjects of importance in the insurance industry. Exams cover probability, interest theory, risk management, life contingencies, as well as topics that are more specific to insurance. For more information on exams, *see the Be An Actuary exams page*.

The interdisciplinary Actuarial Science major, administered jointly by the Departments of Mathematics and Statistics & Actuarial Science, is a good first step! The purpose of the program is to provide the broad quantitative background in mathematics, probability, economics, business, and related areas that is necessary for success in the actuarial profession and to provide the academic background needed to pass the first four actuarial exams.

Actuarial Science students take a substantial number of mathematics and statistics courses as well as courses that cover actuarial topics and some courses in the School of Computer Science and Information Technology. In addition to the courses required

for graduation, students should carefully consider electives that will coordinate with an actuarial career. In particular, additional courses from the School of Computer Science and Information Technology, courses in economics, computer science, or courses in writing and communication are very helpful for an actuarial career. The goals of the program include that students be well prepared for the exams they take, that they be knowledgeable about the career and in technical areas, and that they have a well-rounded education.

Traits Which All Actuaries Should Possess

There are many beneficial traits which an actuary should possess. First and foremost, an actuary needs to possess wonderful mathematical skills. Since they will be dealing a great deal with statistical equations and data, having such mathematical skills will help them to excel in their job responsibilities.

Good analytical skills are another important trait which an actuary should possess as it will help them in their job role. As they will need to analyze a variety of documents, having analytical skills which are more than adequate will greatly benefit them in the long run.

An actuary is an individual who should possess good public speaking skills as well. In their daily job duties, not only will they need to analyze documents and data but they will also have to report such data results to company officials and members of the public. Therefore, in order to best get their opinions and conclusions across in a straightforward, easy to understand manner, good public speaking skills should be a prerequisite to taking on the role of actuary.

Creativity is something which actuaries should possess. From time to time, they will need to aid company officials in the drafting of company policy and make changes to the policy. With a little bit of creativity, an actuary will be able to take the documentation and put such a spin on it that it is formed into a proper and valid policy.

One who is an actuary should also have wonderful research skills. Since many of the documents that they need to analyze will not just pop into their laps, it is important that actuaries can do good research and find out what they need to know with regard to statistics and pertinent documents in an efficient and expedient manner.

An actuary should also have good working computer skills. Since much of their work will involve computers, it is important that the actuary not only be familiar with computers but know how to maneuver around with them as well.

An actuary is an individual who has many duties and responsibilities concomitant to their position. If one in this job role has excellent analytical, comprehension, mathematical and public speaking skills, they will most likely be individuals who excel at their job and produce the highest quality work product possible. If one has all of these

aforementioned skills, the position of actuary may be the perfect one to fill.

LECTURE TWO

HISTORY OF ACTUARIAL SCIENCE

Pre-formalization

In the ancient world there was no room for the sick, suffering, disabled, aged, or the poor—it was not part of the cultural consciousness of societies (Perkins 1995). Early methods of protection involved charity; religious organizations or neighbors would collect for the destitute and needy. By the middle of the third century, 1,500 suffering people were being supported by charitable operations in Rome (Perkins 1995). Charitable protection is still an active form of support to this very day (Tong 2006). However, receiving charity is uncertain and is often accompanied by social stigma. Elementary mutual aid agreements and pensions did arise in antiquity (Thucydides c. 431BCE). Early in the Roman empire, associations were formed to meet the expenses of burial, cremation, and monuments—precursors to burial insurance and friendly societies. A small sum was paid into a communal fund on a weekly basis, and upon the death of a member, the fund would cover the expenses of rites and burial. These societies sometimes sold shares in the building of columbaria, or burial vaults, owned by the fund—the precursor to mutual insurance companies (Johnston 1903, \$475-\$476). Other early examples of mutual surety and assurance pacts can be traced back to various forms of fellowship within the Saxon clans of England and their Germanic forbears, and to Celtic society (Loan 1992). However, many of these earlier forms of surety and aid would often fail due to lack of understanding and knowledge (Faculty and Institute of Actuaries 2004).

Initial development

The seventeenth century was a period of extraordinary advances in mathematics in Germany, France and England. At the same time there was a rapidly growing desire and need to place the valuation of personal risk on a more scientific basis. Independently from each other, compound interest was studied and probability theory emerged as a well understood mathematical discipline. Another important advance came in 1662 from a London draper named John Graunt, who showed that there were predictable patterns of longevity and death in a defined group, or cohort, of people, despite the uncertainty about the future longevity or mortality of any one individual person. This study became the basis for the original life table. It was now possible to set up an insurance scheme to provide life insurance or pensions for a group of people, and to calculate with some degree of accuracy, how much each person in the group should contribute to a common fund assumed to earn a fixed rate of interest. The first person to demonstrate publicly how this could be done was Edmond Halley (of Halley's comet fame). In addition to constructing his own life table, Halley demonstrated a method of using his life table to calculate the premium or amount of money someone of a given age should pay to purchase a life-annuity (Halley 1693).

Early actuaries

James Dodson's pioneering work on the level premium system led to the formation of the Society for Equitable Assurances on Lives and Survivorship (now commonly known as Equitable Life) in London in 1762. The company still exists, though it has encountered difficulties recently. This was the first life insurance company to use premium rates which were calculated scientifically for long-term life policies. Many other life insurance companies and pension funds were created over the following 200 years. It was the Society for Equitable Assurances which first used the term 'actuary' for its chief executive officer in 1762. Previously, the use of the term had been restricted to an official who recorded the decisions, or 'acts', of ecclesiastical courts (Faculty and Institute of Actuaries 2004). Other companies which did not originally use such mathematical and scientific methods, most often failed, or were forced to adopt the methods pioneered by Equitable (Bhlmann 1997 p. 166).

Effects of technology

In the 18th century and nineteenth centuries, computational complexity was limited to manual calculations. The actual calculations required to compute fair insurance premiums are rather complex. The actuaries of that time developed methods to construct easily-used tables, using sophisticated approximations called commutation functions, to facilitate timely, accurate, manual calculations of premiums (Slud 2006). Over time, actuarial organizations were founded to support and further both actuaries and actuarial science, and to protect the public interest by ensuring competency and ethical standards (Hickman 2004 p. 4). However, calculations remained cumbersome, and actuarial shortcuts were commonplace. Non-life actuaries followed in the footsteps of their life compatriots in the early twentieth century. The 1920 revision to workers compensation rates took over two months of around-the-clock work by day and night teams of actuaries (Michelbacher 1920 p. 224, 230). In the 1930s and 1940s, however, the rigorous mathematical foundations for stochastic processes were developed (Bhlmann 1997 p. 168). Actuaries could now begin to forecast losses using models of random events, instead of the deterministic methods they had been constrained to in the past. The introduction and development of the computer industry further revolutionized the actuarial profession. From pencil-and-paper to punchcards to current high-speed devices, the modeling and forecasting ability of the actuary has grown exponentially, and actuaries needed to adjust to this new world (MacGinnitie 1980 p.50-51).

Actuarial science and modern financial economics

Some aspects of traditional actuarial science are not aligned with modern financial economics. Pension actuaries have been challenged by financial economists regarding funding and investment strategies. There are two reasons for the divergence of actuarial and financial economic practices. The first deals with the sheer complexity of calculations, and the second with the heavy burden of regulations resulting from the Armstrong investigation of 1905, the Glass-Steagall Act of 1932, the adoption of the Mandatory Security Valuation Reserve by the National Association of Insurance Commissioners; the latter

law cushioned market fluctuations. Finally pensions valuations and funding must comply with the Financial Accounting Standards Board, (FASB) in the USA and Canada. The regulatory burden led to a separation of powers regarding the management and valuation of assets and liabilities.

Historically, much of the foundation of actuarial theory predated modern financial theory. In the early twentieth century, actuaries were developing many techniques that can be found in modern financial theory, but for various historical reasons, these developments did not achieve much recognition (Whelan 2002). As a result, actuarial science developed along a different path, becoming more reliant on assumptions, as opposed to the arbitrage-free risk-neutral valuation concepts used in modern finance. The divergence is not related to the use of historical data and statistical projections of liability cash flows, but is instead caused by the manner in which traditional actuarial methods apply market data with those numbers. For example, one traditional actuarial method suggests that changing the asset allocation mix of investments can change the value of liabilities and assets (by changing the discount rate assumption). This concept is inconsistent with financial economics. The potential of modern financial economics theory to complement existing actuarial science was recognized by actuaries in the mid-twentieth century (Buhlmann 1997 p. 169-171). In the late 1980s and early 1990s, there was a distinct effort for actuaries to combine financial theory and stochastic methods into their established models. (D'arcy 1989). Ideas from financial economics became increasingly influential in actuarial thinking, and actuarial science has started to embrace more sophisticated mathematical modeling of finance (The Economist 2006). Today, the profession, both in practice and in the educational syllabi of many actuarial organizations, is cognizant of the need to reflect the combined approach of tables, loss models, stochastic methods, and financial theory (Feldblum 2001 p. 8-9). However, assumption-dependent concepts are still widely used (such as the setting of the discount rate assumption as mentioned earlier), particularly in North America. Product design adds another dimension to the debate. Financial economists argue that pension benefits are bond-like and should not be funded with equity investments without reflecting the risks of not achieving expected returns. But some pension products do reflect the risks of unexpected returns. In some cases, the pension beneficiary assumes the risk, or the employer assumes the risk. The current debate now seems to be focusing on four principles. 1. financial models should be free of arbitrage; 2. assets and liabilities with identical cash flows should have the same price. This, of course, is at odds with FASB. 3. The value of an asset is independent of its financing. 4. the final issue deals with how pension assets should be invested. Essentially, financial economics state that pension assets should not be invested in equities for a variety of theoretical and practical reasons. (Moriarty 2006).

Actuaries outside insurance

There is an increasing trend to recognise that actuarial skills can be applied to a range of applications outside the insurance industry. One notable example is the use in some US states of actuarial models to set criminal sentencing guidelines. These models at-

tempt to predict the chance of re-offending according to rating factors which include the type of crime, age, educational background and ethnicity of the offender (Silver and Chow-Martin 2002). However, these models have been open to criticism as providing justification by law enforcement personnel on specific ethnic groups. Whether or not this is statistically correct or a self-fulfilling correlation remains under debate (Harcourt 2003). Another example is the use of actuarial models to assess the risk of sex offense recidivism. Actuarial models and associated tables, such as the MnSOST-R, Static-99, and SORAG, have been used since the late 1990s to determine the likelihood that a sex offender will recidivate and thus whether he or she should be institutionalized or set free (Nieto and Jung 2006 pp. 28-33).

Notable Actuaries

James Dodson

Head of the Royal Mathematical School, and Stone's School, Dodson built on the statistical mortality tables developed by Edmund Halley in 1693 (Faculty and Institute of Actuaries 2004).

Edmond Halley

While Halley actually predated much of what is now considered the start of the actuarial profession, he was the first to mathematically and statistically rigorously calculate premiums for a life insurance policy (Halley 1693).

James C. Hickman

Notable actuarial educator, researcher, and author (Chaptman 2006).

Edward Rowe Mores

First person to use the title 'actuary' with respect to a business position (Ogborn 1956).

William Morgan

Morgan was the appointed Actuary of the Society for Equitable Assurances in 1775. He expanded on Mores's and Dodson's work, and may be rightly considered the father of the actuarial profession in that his title became applied to the field as a whole.(Faculty and Institute of Actuaries 1973).

Maurice Princet

French actuary and close associate of artist Pablo Picasso. Princet is considered "Le Mathématicien du Cubisme" ("The Mathematician of Cubism") for his "critical influence on Picasso's development as an artist at the birth of cubism" (Boyle 2002).

Frank Redington

Developed the Redington Immunization Theory

Isaac M. Rubinow

Founder and first president of the Casualty Actuarial Society (CAS 2008).

Elizur Wright

American actuary and abolitionist, professor of mathematics at Western Reserve College (Ohio). He campaigned for laws that required life insurance companies to hold sufficient reserves to guarantee that policies would be paid (Stearns 1905).

Fictional Actuaries

Due to the low public-profile of the job, some of the most recognizable actuaries to the general public happen to be characters in movies. Many actuaries were unhappy with the stereotypical portrayals of these actuaries as unhappy, math-obsessed and socially inept people; others have claimed that the portrayals are close to home, if a bit exaggerated. (Coleman 2003).

LECTURE THREE

ROLES/FUNCTIONS AND TYPES OF ACTUARIES

General Responsibilities of an Actuary

One who accepts the role of actuary is responsible for a multitude of items. They will review statistical information relating to rates dealing with mortality, sickness, accidents, disability and retirement. They will take the information that they obtain from reviewing statistical data and relay the information to individuals who need such items to successfully pursue insurance-related interests. The general role of the actuary is to compile the data which they collect in such a manner that it helps companies deal with payment and coverage issues.

Specific Duties of an Actuary

There are a variety of specific duties which an actuary must carry out on a daily basis. The first duty which an actuary must undertake in their job role is to review a variety of documents. These documents relate to statistical information, insurance plans, annuity plans, pension plans, contracts and company policies. The overall goal in reviewing these various document is to construct guidelines for which the companies can follow with their customers and employees.

Once the actuary has reviewed all of the pertinent documents, the individual must then construct concise tables evidencing the results of the intense document review. The tables will diagram the statistical evidence as well as highlight the recommended route to pursue with regard to disbursements, premiums and retirement funds.

An additional specific duty of an actuary is to determine company policy and explain such policy and its aspects to those who will benefit from it. The actuary may also work on the policy so that it adequately works to benefit those affected by the policy.

An actuary may also do consulting work and help various companies with their statistical needs and company policy construction. One who is an actuary may work for a specific corporation or many different companies and corporations.

Actuaries may also be asked to testify as expert witnesses in various forms of litigation. Their testimony most often relates to the lifetime earnings an individual would have seen based on a variety of factors.

One who fulfills the role of an actuary may also have to testify before public agencies with regard to new or revised legislation affecting the companies and corporations which it works for. This frequently occurs when a new law is about to be passed or the company wishes a particular piece of legislation to become law.

The actuary is also the go to individual for any questions relating to their job respon-

sibilities asked by the customers of the company. If the questions are best answered by the actuary, then he/she will do so in order to present straightforward information to the public.

An actuary must also develop mathematical ideas and formulas so that the proper data can be assessed. The actuary must use his/her mathematical abilities to format equations which will aid in the resolution of an issue.

Roles of Actuaries in Insurance Industry

Most insurance companies hire actuaries. An insurance actuary is a business professional who deals with the financial risk of insuring clients. There are two broad roles for actuaries in Life Insurance:

(i). Product Development/pricing (Rating)

Actuaries design insurance products and assess in the appropriate premium rates and charges to be applied. In the designing of the products, actuaries develop the underwriting process guidelines that are used to determine if a person should be accepted for coverage and at what rate, the premiums to pay and so on.

(ii). Financial Management

Actuaries help businesses to assess the risk of certain types occurring and formulate policies that minimize the cost of that risk. Their job is to evaluate the likelihood of loss by assembling and analyzing data. They study the overall likelihood that different events will occur, and they evaluate the potential risks each event poses. Their goal is to try and assess the costs associated with the events should it occur. Medical premiums are based on risk evaluation.

Actuaries ensure the company's solvency by calculating the estimated value of outstanding liabilities allowing for example for future claims, premiums, maturities and cancelations. Actuaries also produce life tables which determine the likelihood that a potential future event will generate a claim. From these tables, they estimate the amount a company can expect to pay in claims. Actuaries ensure that the price, or premium, charged for such insurance will enable the company to cover claims and other expenses. This premium must be profitable, yet competitive with other insurance companies.

Roles of Actuaries in Pensions and Benefits

Using their broad knowledge of statistics, finance, and business, actuaries help design pension plans, retirement schemes, and other financial strategies in a manner which will help ensure that the plans are maintained on a sound financial basis.

Actuaries also address financial questions including those involving the level of pension contributions required to produce a certain retirement income level and the way in which a company should invest resources to maximize return on investments in light of potential risk.

Actuaries working in government help manage social programs such as National Social Security Fund (NSSF), Retirement Benefit Authority (RBA) etc.

Roles of Actuaries in Financial and Investment Services

Actuaries in other financial services industries manage credit and help price corporate security offerings. They also devise new instrument tools to help their firm compete with other financial services companies.

Actuaries may help determine company policy and may need to explain complex technical matters to company executives, government officials, shareholders, policyholders, or the public in general. They may testify before public agencies on proposed legislation affecting their businesses or explain changes in contract provisions to customers. They also may help companies develop plans to enter new lines of business or new geographic markets with existing lines of business by forecasting demand in competitive settings.

Roles of Actuaries in Consultancy

Both staff actuaries employed by businesses and consulting actuaries provide to clients on a contract basis. The duties of most consulting actuaries are similar to those of other actuaries. For example, some may evaluate company pension plans by calculating the future value employee and employer contributions and determining whether the amounts are sufficient to meet the future needs of retirees. Others help companies reduce their insurance costs by lowering the level of risk the companies take on. For instance, they may provide advice on how to lessen the risk on the job, which will lower worker's compensation costs. Consulting actuaries sometimes testify in court regarding the value of the potential lifetime earnings of a person who is who is disabled or killed in an accident, the current value of future pension benefits (in divorce cases), or other values arrived at by complex calculations. Many consulting actuaries work in reinsurance, a field in which one insurance company arranges to share a large prospective liability policy with another insurance company in exchange for a percentage of the premium.

Roles of Actuaries in General Insurance Business

Life insurance, pensions and healthcare

Actuarial science became a formal mathematical discipline in the late 17th century with the increased demand for long-term insurance coverages such as Burial, Life insurance, and Annuities. These long term coverages required that money be set aside to pay future benefits, such as annuity and death benefits many years into the future. This requires estimating future contingent events, such as the rates of mortality by age, as well as the development of mathematical techniques for discounting the value of funds set aside and invested. This led to the development of an important actuarial concept, referred to as the Present value of a future sum. Pensions and healthcare emerged in the early 20th century as a result of collective bargaining. Certain aspects of the actuarial methods for discounting pension funds have come under criticism from modern financial economics.

- In traditional life insurance, actuarial science focuses on the analysis of mortality, the production of life tables, and the application of compound interest to produce life insurance, annuities and endowment policies. Contemporary life insurance programs have been extended to include credit and mortgage insurance, key man insurance for small businesses, long term care insurance and health savings accounts (Hsiao 2001).
- In health insurance, including insurance provided directly by employers, and social insurance, actuarial science focuses on the analyses of rates of disability, morbidity, mortality, fertility and other contingencies. The effects of consumer choice and the geographical distribution of the utilization of medical services and procedures, and the utilization of drugs and therapies, is also of great importance. These factors underlay the development of the Resource-Base Relative Value Scale (RBRVS) at Harvard in a multi-disciplined study. (Hsiao 1988) Actuarial science also aids in the design of benefit structures, reimbursement standards, and the effects of proposed government standards on the cost of healthcare (cf. CHBRP 2004).
- In the pension industry, actuarial methods are used to measure the costs of alternative strategies with regard to the design, maintenance or redesign of pension plans. The strategies are greatly influenced by collective bargaining; the employer's old, new and foreign competitors; the changing demographics of the workforce; changes in the internal revenue code; changes in the attitude of the internal revenue service regarding the calculation of surpluses; and equally importantly, both the short and long term financial and economic trends. It is common with mergers and acquisitions that several pension plans have to be combined or at least administered on an equitable basis. When benefit changes occur, old and new benefit plans have to be blended, satisfying new social demands and various government discrimination test calculations, and providing employees and retirees with understandable choices and transition paths. Benefit plans liabilities have to be properly valued, reflecting both earned benefits for past service, and the benefits for future service. Finally, funding schemes have to be developed that are manageable and satisfy the Financial Accounting Standards Board (FASB).

- In social welfare programs, the Office of the Chief Actuary (OCACT), Social Security Administration plans and directs a program of actuarial estimates and analyses relating to SSA-administered retirement, survivors and disability insurance programs and to proposed changes in those programs. It evaluates operations of the Federal Old-Age and Survivors Insurance Trust Fund and the Federal Disability Insurance Trust Fund, conducts studies of program financing, performs actuarial and demographic research on social insurance and related program issues involving mortality, morbidity, utilization, retirement, disability, survivorship, marriage, unemployment, poverty, old age, families with children, etc., and projects future workloads. In addition, the Office is charged with conducting cost analyses relating to the Supplemental Security Income (SSI) program, a general-revenue financed, means-tested program for low-income aged, blind and disabled people. The Office provides technical and consultative services to the Commissioner, to the Board of Trustees of the Social Security Trust Funds, and its staff appears before Congressional Committees to provide expert testimony on the actuarial aspects of Social Security issues.

Actuarial Science applied to other forms of Insurance

Actuarial Science is also applied to short-term forms of insurance, referred to as Property & Casualty or Liability insurance, or General insurance. In these forms of insurance, coverage is generally provided on a renewable annual period, (such as a yearly contract to provide homeowners insurance policy covering damage to a house and its contents for one year). Coverage can be canceled at the end of the period by either party.

- In the property and casualty insurance fields, companies tend to specialize because of the complexity and diversity of risks. A convenient division is to organize around personal and commercial lines of insurance. Personal lines of insurance are for individuals and include the familiar fire, auto, homeowners, theft and umbrella coverages. Commercial lines address the insurance needs of businesses and include property, business continuation, product liability, fleet/commercial vehicle, workers compensation, fidelity & surety, D&O insurance and a great variety of other coverages a business might need. Beyond these, the industry needs to provide insurance for unique exposures such as catastrophe, weather-related risks, earthquakes, patent infringement and other forms of corporate espionage, terrorism and all its implications, and finally coverage for the most unusual risks which are sometimes "one-of-a-kind" like a satellite launch (Lloyds of London handles many of these hard to gauge risks). In all of these ventures, actuarial science has to bring data collection, measurement, estimating, forecasting, and valuation tools to provide financial and underwriting data for management to assess marketing opportunities and the degree of risk taking that is required. Actuarial science needs to operate at two levels: (i) at the product level to facilitate politically correct equitable pricing and reserving; and (ii) at the corporate level to assess the overall risk to the enterprise from catastrophic events in relation to its underwriting capacity or surplus. Actuaries, usually working in a multidisciplinary team must

help answer management issues: (i) is the risk insurable; (ii) does the company have effective claims administration to determine damages; (iii) does the company have sufficient claims handling to cover catastrophic events; (iv) and the vulnerability of the enterprise to uncontrollable risks such as inflation, adverse political outcomes; unfavorable legal outcomes such as excess punitive damage awards, and international turmoil.

- In the reinsurance fields, actuarial science is used to design and price reinsurance and retro-reinsurance schemes, and to establish reserve funds for known claims and future claims and catastrophes. Retro-reinsurance, also known as retrocession occurs when a reinsurance company reinsures risks with yet another reinsurance company. Reinsurance can be used to spread the risk, to smooth earnings and cash flow, to reduce reserve requirements and improve the quality of surplus, Reinsurance creates arbitrage situations, and retro-reinsurance arbitrage can create Spirals which can lead to financial instability and bankruptcies. A spiral occurs (as an example) when a reinsurer accepts a retrocession which unknowingly contains risks that were previously reinsured. Some reported cases of arbitrage and spirals have been found to be illegal. The Equity Funding scam was built on the abusive use of financial reinsurance to transfer capital funds from the reinsurance carrier to Equity Funding. In the broadest sense of the word, reinsurance takes many forms: (i) declining a risk; (ii) requiring the insured to self insure part of the contingent or investment risk; (iii) limiting the coverage through deductibles, coinsurance or exclusionary policy language; (iv) placing a policy in a risk pool with a cohort of competitors to achieve a social objective; (v) ceding or transferring a percentage of each policy to another insurance company (i.e. the reinsurer); (vi) ceding or transferring excess amounts or excess coverages to the reinsurer; (vii) ceding or transferring asset based policies to the reinsurer in exchange for capital; (viii) purchasing stop loss insurance; (ix) purchasing umbrella coverages for a basket of risks; (x) purchasing catastrophe insurance for specific contingent events. Reinsurance is complex. Company management and their actuaries need to deal with all the known insurable contingent events, as well as underwrite the quality of their cedant companies, and maintain the information tools and auditing practices to identify arbitrage and spirals.

Disciplines

Actuaries' insurance disciplines may be classified as life; health; ~~pensions, annuities, and~~ asset management; social welfare programs; property; casualty; general insurance; and reinsurance. Life, health, and pension actuaries deal with mortality risk, morbidity, and consumer choice regarding the ongoing utilization of drugs and medical services risk, and investment risk. Products prominent in their work include life insurance, annuities, pensions, mortgage and credit insurance, short and long term disability, and medical, dental, health savings accounts and long term care insurance. In addition to these risks, social insurance programs are greatly influenced by public opinion, politics, budget constraints, changing demographics and other factors such as medical technology, inflation

and cost of living considerations (Bureau of Labor Statistics 2008).

Casualty actuaries, also known as non-life or general insurance actuaries, deal with catastrophic, unnatural risks that can occur to people or property. Products prominent in their work include auto insurance, homeowners insurance, commercial property insurance, workers' compensation, title insurance, malpractice insurance, products liability insurance, directors and officers liability insurance, environmental and marine insurance, terrorism insurance and other types of liability insurance. Reinsurance products have to accommodate all of the previously mentioned products, and in addition have to reflect properly the increasing long term risks associated with climate change, cultural litigiousness, acts of war, terrorism and politics (Bureau of Labor Statistics 2008).

LECTURE FOUR
ELEMENTARY CONCEPTS OF THE ACTUARIAL CONTROL CYCLE

LECTURE FIVE

LECTURE SIX HISTORY OF INSURANCE

“The number of different types of life insurance contracts on the market is large The effect of this proliferation is confusion and frustration for the buyer.”

Joseph M. Belth
Life Insurance: A customer’s handbook.

Introduction

Insurance began as a way of reducing the risk of traders, as early as 5000 BC in China and 4500 BC in Babylon. Life insurance dates only to ancient Rome; “burial clubs” covered the cost of members’ funeral expenses and helped survivors monetarily. Modern life insurance started in late 17th century in England, originally as insurance for traders: merchants, ship owners and underwriters met to discuss deals at Lloyd’s Coffee House, predecessor to the famous Lloyd’s of London.

The first insurance company in the United States was formed in Charleston, South Carolina in 1732, but it provided only fire insurance. The sale of life insurance in the U.S. began in the late 1760s. The Presbyterian Synods in Philadelphia and New York created the Corporation for Relief of Poor and Distressed Widows and Children of Presbyterian Ministers in 1759; Episcopalian priests organized a similar fund in 1769. Between 1787 and 1837 more than two dozen life insurance companies were started, but fewer than half a dozen survived.

Prior to the American Civil War, many insurance companies in the United States insured the lives of slaves for their owners. In response to bills passed in California in 2001 and in Illinois in 2003, the companies have been required to search their records for such policies. New York Life for example reported that Nautilus sold 485 slaveholders life insurance policies during a two-year period in the 1840s; they added that their trustees voted to end the sale of such policies 15 years before the Emancipation Proclamation.

Insurance, in law and economics, is a form of risk management primarily used to hedge against the risk of a contingent loss. Insurance is defined *as the equitable transfer of the risk of a loss, from one entity to another, in exchange for a premium, and can be thought of as a guaranteed small loss to prevent a large, possibly devastating loss.* An insurer is a company selling the insurance; an insured or policyholder is the person or entity buying the insurance. The insurance rate is a factor used to determine the amount to be charged for a certain amount of insurance coverage, called the premium. Risk management, the practice of appraising and controlling risk, has evolved as a discrete field of study and practice.

0.1 Principles of Insurance

Commercially insurable risks typically share seven common characteristics.

1. **A large number of homogeneous exposure units.** The vast majority of insurance policies are provided for individual members of very large classes. Automobile insurance, for example, covered about 175 million automobiles in the United States in 2004. The existence of a large number of homogeneous exposure units allows insurers to benefit from the so-called “law of large numbers,” which in effect states that as the number of exposure units increases, the actual results are increasingly likely to become close to expected results. There are exceptions to this criterion. Lloyd’s of London is famous for insuring the life or health of actors, actresses and sports figures. Satellite Launch insurance covers events that are infrequent. Large commercial property policies may insure exceptional properties for which there are no ‘homogeneous’ exposure units. Despite failing on this criterion, many exposures like these are generally considered to be insurable.
2. **Definite Loss.** The event that gives rise to the loss that is subject to the insured, at least in principle, take place at a known time, in a known place, and from a known cause. The classic example is death of an insured person on a life insurance policy. Fire, automobile accidents, and worker injuries may all easily meet this criterion. Other types of losses may only be definite in theory. Occupational disease, for instance, may involve prolonged exposure to injurious conditions where no specific time, place or cause is identifiable. Ideally, the time, place and cause of a loss should be clear enough that a reasonable person, with sufficient information, could objectively verify all three elements.
3. **Accidental Loss.** The event that constitutes the trigger of a claim should be fortuitous, or at least outside the control of the beneficiary of the insurance. The loss should be ‘pure,’ in the sense that it results from an event for which there is only the opportunity for cost. Events that contain speculative elements, such as ordinary business risks, are generally not considered insurable.
4. **Large Loss.** The size of the loss must be meaningful from the perspective of the insured. Insurance premiums need to cover both the expected cost of losses, plus the cost of issuing and administering the policy, adjusting losses, and supplying the capital needed to reasonably assure that the insurer will be able to pay claims. For small losses these latter costs may be several times the size of the expected cost of losses. There is little point in paying such costs unless the protection offered has real value to a buyer.
5. **Affordable Premium.** If the likelihood of an insured event is so high, or the cost of the event so large, that the resulting premium is large relative to the amount of protection offered, it is not likely that anyone will buy insurance, even if on offer. Further, as the accounting profession formally recognizes in financial accounting standards, the premium cannot be so large that there is not a reasonable chance of a significant loss to the insurer. If there is no such chance of loss, the transaction

may have the form of insurance, but not the substance. (See the U.S. Financial Accounting Standards Board standard number 113)

6. **Calculable Loss.** There are two elements that must be at least estimable, if not formally calculable: the probability of loss, and the attendant cost. Probability of loss is generally an empirical exercise, while cost has more to do with the ability of a reasonable person in possession of a copy of the insurance policy and a proof of loss associated with a claim presented under that policy to make a reasonably definite and objective evaluation of the amount of the loss recoverable as a result of the claim.
7. **Limited risk of catastrophically large losses.** The essential risk is often aggregation. If the same event can cause losses to numerous policyholders of the same insurer, the ability of that insurer to issue policies becomes constrained, not by factors surrounding the individual characteristics of a given policyholder, but by the factors surrounding the sum of all policyholders so exposed. Typically, insurers prefer to limit their exposure to a loss from a single event to some small portion of their capital base, on the order of 5 percent. Where the loss can be aggregated, or an individual policy could produce exceptionally large claims, the capital constraint will restrict an insurer's appetite for additional policyholders. The classic example is earthquake insurance, where the ability of an underwriter to issue a new policy depends on the number and size of the policies that it has already underwritten. Wind insurance in hurricane zones, particularly along coast lines, is another example of this phenomenon. In extreme cases, the aggregation can affect the entire industry, since the combined capital of insurers and reinsurers can be small compared to the needs of potential policyholders in areas exposed to aggregation risk. In commercial fire insurance it is possible to find single properties whose total exposed value is well in excess of any individual insurer's capital constraint. Such properties are generally shared among several insurers, or are insured by a single insurer who syndicates the risk into the reinsurance market.

0.2 Classes of Insurance

The two main classes of insurance are general and life insurance.

0.2.1 General insurance

General insurance or non-life insurance policies, including automobile and homeowners policies, provide payments depending on the loss from a particular financial event. General insurance typically comprises any insurance that is not determined to be life insurance. It is called property and casualty insurance in the U.S. and Non-Life Insurance in Continental Europe.

0.2.2 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* upon the occurrence of the insured individual's or individuals' death or other event, such as terminal illness or critical illness. In return, the policy owner agrees to pay a stipulated amount called a *premium* at regular intervals or in *lump sums*. There may be designs in some countries where bills and death expenses plus catering for after funeral expenses should be included in Policy Premium. In the Kenya, the predominant form simply specifies a lump sum to be paid on the insured's demise.

As with most insurance policies, life insurance is a contract between the insurer and the *policy owner* whereby a benefit is paid to the designated beneficiaries if an *insured event* occurs which is covered by the policy.

The value for the policyholder is derived, not from an actual claim event, rather it is the value derived from the 'peace of mind' experienced by the policyholder, due to the negating of adverse financial consequences caused by the death of the Life Assured.

To be a life policy the *insured event* must be based upon the lives of the people named in the policy. Insured events that may be covered include: death, serious illness.

Life policies are legal contracts and the terms of the contract describe the limitations of the insured events. Specific exclusions are often written into the contract to limit the liability of the insurer; for example claims relating to suicide, fraud, war, riot and civil commotion.

Life-based contracts tend to fall into two major categories:

- **Protection policies**-designed to provide a benefit in the event of specified event, typically a lump sum payment. A common form of this design is *term assurance*.
- **Investment policies**-where the main objective is to facilitate the growth of capital by regular or single premiums. Common forms are whole life, universal life and variable life policies.

Parties to Contract

There is a difference between the *insured* and the *policy owner (policy holder)*, although the owner and the insured are often the same person. For example, if Joe buys a policy on his own life, he is both the owner and the insured. But if Jane, his wife, buys a policy on Joe's life, she is the owner and he is the insured. The policy owner is the guarantee and he or she will be the person who will pay for the policy. The insured is a participant in the contract, but not necessarily a party to it.

The beneficiary receives policy proceeds upon the insured's death. The owner designates the beneficiary, but the beneficiary is not a party to the policy. The owner can

change the beneficiary unless the policy has an irrevocable beneficiary designation. With an irrevocable beneficiary, that beneficiary must agree to any beneficiary changes, policy assignments, or cash value borrowing.

Contract terms

Attached list.

The *face amount* on the policy is the initial amount that the policy will pay at the death of the insured or when the policy matures, although the actual death benefit can provide for greater or lesser than the face amount. The policy matures when the insured dies or reaches a specified age (such as 100 years old).

Costs, insurability, and underwriting

The insurer (the life insurance company) calculates the policy prices with intent to fund claims to be paid and administrative costs, and to make a profit. The cost of insurance is determined using mortality tables calculated by actuaries.

The insurance company receives the premiums from the policy owner and invest them to create a pool of money from which it can pay claims and finance the insurance company's operations. Contrary to popular belief, the majority of the money that insurance companies makes comes directly from premiums paid, as money gained through investment of premiums can never, in even the most ideal market conditions, vest enough money per year to pay out claims. rates charged for life insurance increase with the insurer's age because, statistically, people are more likely to die as they get older.

Given that adverse selection can have a negative impact on the insurer's financial situation, the insurers investigate each proposed insured individual unless the policy is below a company-established minimum amount, beginning with the application process. Group insurance policies are an exception. This investigation and resulting evaluation of the risk is termed *underwriting*.

Underwriters will determine the purpose of insurance. The most common is to protect the owner's family or financial interests in the event of the insurer's demise. Other purposes include estate planning or, in the case of cash-value contracts, investment for retirement planning. Bank loans or buy-sell provisions of business agreements are another acceptable purpose.

Insurance companies alone determine insurability, and some people, for their own health or lifestyle reasons, are deemed uninsurable. The policy can be declined (turned down) or rated up. Rating up increases the premiums to provide for additional risks relative to the particular insured.

Death proceeds

Upon the insured's death, the insurer requires acceptable proof of death before it pays the claim. The normal minimum proof required is a death certificate and the insurer's claim form completed and signed (and typically notarized). If the insured's death is suspicious and the policy is large, the insurer may investigate the circumstances surrounding the death before deciding whether it has an obligation to pay the claim. Proceeds from the policy may be paid as a lump sum or as an annuity, which is paid over time in regular recurring payments for either a specified period or for a beneficiary's lifetime.

Insurance vs Assurance

The specific uses of the terms "insurance" and "assurance" are sometimes confused. In general, in these jurisdictions "insurance" refers to providing cover for an event that might happen (fire, theft, flood, etc.), while "assurance" is the provision of cover for an event that is certain to happen. "Insurance" is the generally accepted term; however, people using this description are liable to be corrected. In the United States both forms of coverage are called "insurance", principally due to many companies offering both types of policy, and rather than refer to themselves using both insurance and assurance titles, they instead use just one.

Types of Life Insurance

Life insurance may be divided into two basic classes—Temporary and permanent or following subclasses— term, universal, whole life and endowment life insurance.

Life insurance policies can also be classified as either **Temporary term insurance** or **cash-value life insurance**. Term insurance provides temporary protection, while cash-value life insurance has a saving component and builds cash values. Numerous variations and combinations of these two types of life insurance are available today.

Temporary Term Insurance

Term assurance provides for life insurance coverage for a specified term of years for a specified premium. Term is generally considered "pure" insurance, where the premium buys protection in the event of death and nothing else.

There are three key factors to be considered in term insurance:

1. Face amount (protection or death benefit),
2. Premium to be paid (cost to the insured), and
3. Length of coverage (term).

Various insurance companies sell term insurance with many different combinations of these parameters. The face amount can remain constant or decline. The term can be for one or more years. The premium can remain level or increase. A common type of term is called **annual renewable** term. It is a one year policy but the insurance company guarantees it will issue a policy of equal or lesser amount without regard to the insurability of the insured and with a premium set for the insured's age at that time. Another common type of term insurance is mortgage insurance, which is usually a level premium, declining face value policy. The face amount is intended to equal the amount of the mortgage on the policy owner's residence so the mortgage will be paid if the insured dies.

A policy holder insures his life for a specified term. If he dies before that specified term is up, his estate or named beneficiary receives a payout. If he does not die before the term is up, he receives nothing.

Temporary Term insurance has several basic characteristics. First, **the period of protection is temporary**, such as 1, 5, 10 or 20 years. Unless the policy is renewed, the protection expires at the end of the period.

Most term insurance policies are **renewable**, which means that the policy can be renewed for additional periods without evidence of insurability. The premium is increased at each renewal and is based on the insured's attained age. The purpose of the renewal provision is to protect the insurability of the insured. However, the renewal provision results in adverse selection against the insurer. Because premiums increase with age, insured's in good health tend to drop their insurance, while those in poor health will continue to renew, regardless of the premium increase. To minimize adverse selection, many insurers have an age limitation beyond which renewal is not allowed, such as age 70 or 80. Some insurers, however, permit term policies to age 95 or 99.

Most term insurance policies are also **convertible**, which means the term policy can be exchanged for a cash-value policy without evidence of insurability. There are two methods for converting a term policy. Under the *attained-age method*, the premium charged is based on the insured's attained age at the time of conversion. Under the *original-age method*, the premium charged is based on the insured's original age when the term insurance was first purchased. Most insurers offering the original-age method require the conversion to take place within a certain time period, such as five years, from the issue date of the term policy. The policy owner must also pay the difference between the premiums paid on the term policy and those that would have been paid on the new policy, with interest on the difference at a specified rate. The purpose of the financial adjustment is to place the insurer in the same financial position it would have achieved if the policy had been issued at the original age. Because of the financial adjustments required, few term insurance policies are converted based on the original-age method.

Finally, term insurance policies have no cash value or saving element. Although some long-term policies develop a small reserve, it is used up by the contract expiration date.

Types of Term Insurance

A wide variety of term insurance products are sold today. They include the following

- Yearly renewable term
- 5-, 10-, or 20-year term
- Term to age 65
- Decreasing term
- Reentry term

Yearly renewable term insurance is issued for a one-year period, and the policy owner can renew for successive one-year periods to some stated age without evidence of insurability. Premiums increase with age at each renewal date. Most yearly renewable term policies also allow the policy owner to convert to a cash-value policy with no evidence of insurability.

Term insurance can also be issued for *5, 10, 15, or 20 years, or for longer periods*. The premiums paid during the term period are level, but increase when the policy is renewed.

A *term to age 65 policy* provides protection to age 65, at which time the policy expires. The policy can be converted to a permanent plan of insurance but the decision to convert must be exercised before age 65. For example, the insurer may require conversion to a permanent policy before age 60. Because premiums are level, the policy develops a small reserve that is used up by the end of the period.

Decreasing term insurance is a form of term insurance where the face amount declines each year. Although the face amount declines over time, the premium is level throughout the period. In some policies, the premiums are structured so that the policy is fully paid for a few years before the coverage expires. For example, a 20-year decreasing term policy may require premium payments for 17 years. This method avoids paying a relatively large premium for only a small amount of insurance near the end of the term period. Finally decreasing term insurance can be written as a separate policy, or it can be added as a rider to an existing contract.

Reentry term (also called *revertible term*) is another important term insurance product. Under a reentry term policy, renewal premiums are based on select (lower) mortality rates if the insured can periodically demonstrate acceptable evidence of insurability. Select mortality rates are based on the mortality experience of recently insured lives. However, to remain on the low-rate schedule, the insured must periodically show that he or she is in good health and is still insurable. The rates are substantially increased if the insured cannot provide satisfactory evidence of insurability.

Uses of Term Insurance

Term insurance is appropriate in three situations. *First, if the amount, of income that can be spent on life insurance is limited, term insurance can be effectively used.* Because of mortality improvements and keen price competition, term insurance rates have declined sharply in recent years. Substantial amounts of life insurance can be purchased for a relatively modest annual premium outlay.

Second term insurance is appropriate if the need for protection is temporary. For example, decreasing term insurance can be effectively used to pay off the mortgages if the family head dies prematurely.

Finally, term insurance can be used to guarantee future insurability. A person may desire large amounts of permanent insurance, but may be financially unable to purchase the needed protection today. Inexpensive term insurance can be purchased, which can be converted later into a permanent insurance policy without evidence of insurability.

Limitations of Term Insurance

Term insurance has two major limitations. *First, term insurance premiums increase with age at an increasing rate and eventually reach prohibitive levels.* Thus, term insurance is not suitable for individuals who need large amounts of life insurance beyond age 65 or 70. For example, based on the rates of one insurer, the premium for a \$500,000 annual renewable term policy for a male nonsmoker, age 25, is \$353. The premium increases to \$2914 at age 65 and \$9805 at age 75.

Second, term insurance is inappropriate if you wish to save money for a specific need. Term insurance policies do not accumulate cash values. Thus, if you wish to save money for a child's college education or accumulate a fund for retirement, term insurance is inappropriate unless it is supplemented with an investment plan.

Permanent Life Insurance

Permanent life insurance is life insurance that remains in force (in-line) until the policy matures (pays out), unless the owner fails to pay the premium when due (the policy expires OR policies lapse). The policy cannot be canceled by the insurer for any reason except fraud in the application, and that cancelation must occur within a period of time defined by law (usually two years).

Permanent insurable builds a cash value that reduces the amount at risk to the insurance company and thus the insurance expense over time. This means that a policy with a million face value can be relatively expensive to a 70 year old. The owner can access the money in the cash value by withdrawing money, borrowing the cash value, or surrendering the policy and receiving the surrender value.

The four basic types of permanent insurance are **whole life**, **universal life**, **limited pay** and **endowment**.

Whole Life Insurance

In contrast to term insurance, which provides short-term protection, **whole life insurance** is *a cash-value policy that provides lifetime protection*. From a historical or traditional perspective, the following two types of whole life insurance merit some discussion:

1. Ordinary life insurance
2. Limited-payment life insurance

Ordinary Life Insurance

Ordinary life insurance (also called straight life and continuous premium whole life) provides lifetime protection to age 100, and the death claim is a certainty. If the insured is still alive at age 100, the face amount of insurance is paid to the policy owner at that time.

In addition, premiums do not increase from year to year but remain level throughout the premium paying period. Under an ordinary life policy, the policy owner is overcharged for the insurance protection during the early years and undercharged during the later years when premiums are inadequate to pay death claims. The excess premiums are reflected in a liability item for insurers known as a possible to provide lifetime protection.

Ordinary life insurance also has an investment or saving element called a **cash surrender value**. the cash values are due to the overpayment of insurance premiums during the early years. As a result, the policyowner builds a cash equity in the policy. the policy may be surrendered for its cash value, or the cash value may be borrowed under a loan provision. the cash values are relatively small during the early years, but increase over time.

Finally, ordinary life insurance contains cash surrender or non forfeiture options, dividend options (if participating), and settlement options that can be used to meet a wide variety of financial needs and objectives.

Uses of Ordinary Life Insurance

Ordinary life insurance is appropriate in two general situations: (1) when lifetime protection is needed, and (2) when additional savings are desired.

An ordinary life policy is appropriate when life time protection is needed. This means that the need for life insurance will continue beyond age 65 or 70.

Ordinary life insurance can also be used to save money. some insureds wish to meet their protection and saving needs by an ordinary life policy. As stated earlier, ordinary life insurance builds cash values that can be obtained by surrendering the policy or by borrowing the cash value.

Limitations of Ordinary Life Insurance

The major limitation of ordinary life insurance is that some people are still underinsured after the policy is purchased. Because of the saving feature, some persons may voluntarily purchase or else be persuaded by a life insurance agent to purchase an ordinary life policy when the term insurance would be a better choice.

Limited-Payment Life Insurance

A **Limited-Payment policy** is another type of traditional whole life insurance. The insurance is permanent, and the insured has lifetime protection. The premiums are level, but they are paid only for a certain period. For example Shannon, age 25, may purchase a 20-year limited payment policy in the amount of \$25,000. After 20 years, the policy is completely paid up, and no additional premiums are required even though the coverage remains in force.

A paid-up policy should not be confused with one that matures. A policy **matures** when the face amount is paid as a death claim or as an endowment. A policy is **paid up** when no additional premium payments are required.

The most common limited-payment policies are for 10, 20, 25 or 30 years. A policy paid up at age 65 or 70 is another form of limited-payment insurance. An extreme form of limited-payment life insurance is **single-premium whole life insurance**, which provides lifetime protection with a single premium. Because the premiums under a limited-payment policy are higher than those paid under an ordinary life policy, the cash values are also higher.

Endowment Insurance

Endowment insurance is another traditional form of life insurance. An endowment policy pays the face amount of insurance if the insured dies within a specified period; if the insured survives to the end of the endowment period, the face amount is paid to the policyowner at that time. For example, if Stephanie age 35, purchased a 20-year endowment policy and died any time within the 20-year period, the face amount would be paid to her beneficiary. if she survives to the end of the period, the face amount is paid to her.

At the present time, endowment insurance is relatively unimportant in terms of total life insurance in force. Endowment insurance accounts for less than 1 percent of the life insurance in force.

Variations of Whole Life Insurance

Life insurers have experienced keen competition from mutual funds, commercial banks, and other financial institutions. To remain competitive and to overcome the criticisms of traditional, cash-value policies, insurers have developed a wide variety of whole life products that combine insurance protection with an investment component. Important variations of whole life insurance include the following:

1. Variable life insurance
2. Universal life insurance
3. Variable universal life insurance
4. Current assumption whole life insurance
5. Indeterminate-premium whole life insurance

Variable Life Insurance

Variable life insurance *can be defined as a fixed-premium policy in which the death benefit and cash values vary according to the investment experience of a separate account maintained by the insurer.* The death benefit and cash surrender values will increase or decrease with the investment experience of the separate account. Although there are different policy designs, variable life policies have certain common features. They are summarized as follows:

1. *A variable life policy is a permanent whole life contract with a fixed premium.* The premium is level and is guaranteed not to increase.
2. *The entire reserve is held in a separate account and is invested in common stocks or other investments.* The policyowner has the option of investing the cash value in a variety of investments, such as a common stock fund, bond fund, balanced fund, money market fund or international fund. If the investment experience is favourable, the face amount of insurance is increased. If the investment experience is poor, the amount of life insurance could be reduced, but it can never fall below the original face amount.
3. *Cash surrender values are not guaranteed, and there are no minimum guaranteed cash values.* The actual cash values depend on the investment experience. Thus, although the insurer bears off the risk of excessive mortality and expenses, the policyowner bears the risk of poor investment results.

Universal Life Insurance

Universal life insurance is another important variation of whole life insurance. **Universal life insurance** (also called flexible premium life insurance) *can be defined as a flexible premium policy that provides protection under a contract that unbundles the*

protection and savings components. Except for the first premium, the policyowner determines the amount and frequency of payments. The premiums, less explicit expense charges, are credited to a cash value account (also called an accumulation fund) from which monthly mortality charges are deducted and to which monthly interest is credited. In addition, universal life policies typically have a monthly deduction for administrative expenses.

Universal life insurance has certain characteristics, which include the following:

- Unbundling of component parts
- Two forms of universal life insurance
- Considerable flexibility
- Cash withdrawals permitted
- Favourable income-tax treatment

Variable Universal Life Insurance

Variable universal life insurance is an important variation of whole life insurance. It is a popular type of cash value insurance that has been widely sold in recent years. Most variable universal life policies are sold as investments or tax shelters.

Benefits of Insurance to Society

The major social and economic benefits of insurance include the following:

1. Indemnification for loss
2. Reduction of worry and fear
3. Source of investment funds
4. Loss prevention
5. Enhancement of credit

Indemnification for loss

Indemnification permits individuals and families to be restored to their former financial position after a loss occurs. As a result, they can maintain their financial security. Because insureds are restored either in part or in whole after a loss occurs, they are less likely to apply for public assistance or welfare benefits, or to seek financial assistance from relatives and friends.

Indemnification to business firms also permits firms to remain in business and employees

to keep their jobs. Suppliers continue to receive orders, and customers can still receive the goods and services they desire. The community also benefits because its tax base is not eroded. In short, the indemnification function contributes greatly to family and business stability and therefore is one of the most important social and economic benefits of insurance.

Reduction of Worry and Fear

A second benefit of insurance is that worry and fear are reduced. This is true both before and after a loss. For example, if family heads have adequate amounts of life insurance, they are less likely to worry about the financial security of their dependents in the event of premature death, persons insured for long-term disability do not have to worry about the loss of earnings if a serious illness or accident occurs; and property owners who are insured enjoy greater peace of mind because they know they are covered if a loss occurs. Worry and fear are also reduced after a loss occurs, because the insureds know that they have insurance that will pay for the loss.

Source of Investment Funds

The insurance industry is an important source of funds for capital investment and accumulation. premiums are collected in advance of the loss, and funds not needed to pay immediate losses and expenses can be loaned to business firms or invested.

The investments increase society's stock of capital goods, and promote economic growth and full employment.

Loss Prevention

Insurance companies are actively involved in numerous loss. Prevention programs and also employ a wide variety of loss prevention personnel, including safety engineers and specialists in fire prevention, occupational safety, and health, and products liability. Some important loss prevention activities that property and liability insurers strongly support include the following:

1. Highway safety and reduction of automobile deaths
2. Fire prevention
3. Reduction of work related disabilities
4. Prevention of auto theft
5. Prevention of detection of arson losses
6. Prevention of defective products that could injure the user
7. Prevention of boiler explosions

8. Educational programs on loss prevention

The loss prevention activities reduce both direct and indirect, or consequential losses. Society benefits, since both types of losses are reduced.

Enhancement of Credit

Insurance enhances a person's credit. Insurance makes a borrower a better credit risk because it guarantees the value of the borrower's collateral or gives greater assurance that the loan will be repaid. For example, when a house is purchased, the lending institution normally requires property insurance on the house before the mortgage loan is granted. The property insurance protects the lender's financial interest if the property is damaged or destroyed. If a new car is purchased and financed by a bank or other lending institution, physical damage insurance on the car may be required before the loan is made. Thus, insurance can enhance a person's credit.

Costs of Insurance to Society

Although the insurance industry provides enormous social and economic benefits to society, the social costs of insurance must also be recognized. The major social costs of insurance include the following:

1. Cost of doing business
2. Fraudulent claims
3. Inflated claims

Cost of Doing Business

One important cost is the cost of doing business. Insurers consume scarce economic resources - land, labor, capital and business enterprise - in providing insurance to society. In financial terms, an expense loading must be added to the pure premium to cover the expenses incurred by insurance companies in their daily operations.

An **expense loading** is the amount needed to pay all expense, including commissions, general administrative expenses, state premium taxes, acquisition expenses, and an allowance for contingencies and profits.

Fraudulent Claims

Examples of fraudulent claims include the following:

1. Auto accidents are faked or staged to collect benefits
2. Dishonest claimants fake slip-and-fall accidents
3. Phony burglaries, thefts, or acts of vandalism are reported to insurers

4. False health claims are submitted to collect benefits
5. Dishonest policy owners take out life insurance policies on insureds who are later reported as having died.

The payment of such fraudulent claims results in higher premiums to all insureds. The existence of insurance also prompts some insureds to deliberately cause a loss so as to profit from insurance. These social costs fall directly on society.

Inflated Claims

Another cost of insurance relates to the submission of inflated or “padded” claims. Although the loss is not intentionally caused by the insured, the dollar amount of the claim may exceed the actual financial loss. Examples of inflated claims include the following:

1. Attorneys for plaintiff sue for high-liability judgements that exceed the true economic loss of the victim.
2. Insureds inflate the amount of damage in auto mobile collision claims so that the insurance payments will cover the collision deductible.
3. Disabled persons often malingering to collect disability-income benefit for a longer duration.
4. Insureds exaggerate the amount and value of property stolen from a home or business.

Inflated claims must be recognized as an important social cost of insurance. Premiums must be increased to pay the additional losses. As a result, disposable income and the consumption of other goods and services are reduced.

Actuarial Control Cycle

The actuarial control cycle is a generic problem solving methodology used in risk management. While initially applied to the management of life insurance companies’ products, the methodology can be extended to other insurance companies and financial institutions.

The actuarial control cycle is a specific business activity which involves the application of actuarial science to real world business problems. Much like the accounting control cycle, the actuarial control cycle requires a professional within that field (ie an actuary) to specify a problem, develop a solution, monitor the consequences thereof, and repeat the process.

The cycle is as follows (Goford 1985):

1. **Initial Assumptions.** Here the initial assumptions for the product to be modeled are made.
2. **Profit Test.** The result from the profit test will determine whether the product is "profitable", i.e., it provides a positive contribution to the company's fixed costs.
3. **Model Office.** Here a full asset-liability model is run over the entire company to see whether the product is profitable to the company as a whole. A result of this model is the products and the company's appraisal values (how much they are worth).
4. **Analysis of Surplus.** After a certain time period, the actual experience is compared to the expected experience from the models.
5. **Monitoring.** Decide whether assumptions need to be updated, or whether other actions need to be taken (such as scrapping the product, adjusting reserves)
6. **Updating of Assumptions** that feeds back into 2.

You will notice that the control cycle is basically a feedback loop, that is common everywhere. It is called the *actuarial control cycle* simply because of its application.

LECTURE EIGHT

RISK

The future is uncertain. Some of the events that can happen are undesirable. "Risk" is the possibility that an undesirable event will occur. Actuaries are experts in:

- Evaluating the likelihood of future events
- Designing creative ways to reduce the likelihood of undesirable events
- Decreasing the impact of undesirable events that do occur.

The impact of undesirable events can be both emotional and financial. Reducing the likelihood of these events helps relieve emotional pain. But some events, such as death, cannot be totally avoided. So, reducing their financial impact is very important. Actuaries are the leading professionals in finding ways to manage risk. It takes a combination of strong analytical skills, business knowledge and understanding of human behavior to design and manage programs that control risk.

Actuaries love what they do. Their work is intellectually challenging and they are very well-paid. Actuaries are key players in the management team of the companies that employ them. In a fast-changing world, with new risks and the need for ever-more creative ways to tackle them, there are constant opportunities for personal and professional growth in an actuarial career, and the pleasure of life-long learning. Most actuaries work in a pleasant environment, alongside other professionals, and enjoy the respect of their peers. This is why the actuarial profession has consistently been rated as one of the top five jobs in the United States according to *Jobs Rated Almanac*.

Actuaries are the analytical backbone of our society's financial security programs. They are the brains behind the financial safeguards we have implemented in our personal lives, so we can go about our daily lives without worrying too much about what the future may hold for us. These are the safeguards that protect us from life's catastrophes. The insight into risk that actuaries have also helps to ensure that our savings are working hard for us, so that everything we love and cherish can grow and flourish. The work of actuaries benefits all of us.

What is risk and how do actuaries manage risk?

Explaining what an actuary does would not be complete without also explaining risk itself.

Risk comes in many forms. Every person and organization faces risk. As experts in measuring and managing risk, actuaries fill a significant need in our society. Their contribution to society's psychological, physical and economic well-being is immense. If the risk management programs actuaries develop didn't exist, our economy would not be able to grow as it does. Consider the following:

1. Would as many people be willing to own a home if fire insurance did not exist?
2. Would a company build a factory that could be destroyed in an earthquake if it were not protected by insurance?
3. Would people spend money today and still be confident about their future if there were no retirement programs or social security?
4. Would the cars people drive be safe if the parts were not rigorously tested to last for many years using mathematical techniques actuaries routinely use?
5. Would parents enjoy risky and adventurous recreational activities such as rock climbing or skiing if their children faced financial disaster in the event of an accident?
6. Would the banks (and the money deposited in them) be safe if their assets and liabilities were not carefully managed to control financial risk?
7. Would the returns on our investments be high if financial institutions such as mutual funds, banks, and insurance companies did not use sophisticated techniques to improve returns without increasing risk too much?

There are many ways to manage risk. While there are some well-established techniques, both academics and practicing actuaries, are constantly inventing new ways to maximize financial results for the participants in our economy, without exposing them to excessive risk. Some popular techniques include:

- Offsetting one risk with another. Under certain circumstances, two harmful events might possess the characteristic that when the likelihood of one goes up, the likelihood of the other goes down. Thus, if we know that when coffee prices go up, soda prices go down, we might want to invest in both coffee and soda stocks, to manage our risk.
- Risk is a matter of perspective. What might be harmful to one party, might be good for another. For example, when the value of the dollar goes down against the French Franc, that might be bad for an American business, but favorable for a French business. By trading off the consequences of an undesirable event with another party who is affected favorably, both parties are made better off.
- Focus on catastrophic risks. Mathematical theory shows that the greatest relief from risk (and consequently, the greatest increase in peace of mind) comes from eliminating the consequences of events that are very unlikely, but result in very big losses. Thus, families should think about what might happen if the breadwinner dies, their house burns down, or they lose all of their savings. They should then implement solutions that reduce the likelihood of these events, as well as manage their financial impact. This might involve purchasing a life insurance policy or investing the savings in many different stocks, to reduce the exposure to

any one company's fortunes. Generally, a few simple measures taken to address catastrophic risks have a great impact on our well-being.

- Diversify, diversify, diversify. It is better to take on many small risks than face one big risk. Many small risks generally average out, to give an outcome that is not too extreme in one direction or another. Results become more predictable. Thus, diversification is an important tool in managing risk.

Where do actuaries manage risk?

At this time, the majority of actuaries work in careers that are associated with the insurance industry, though growing numbers work in other fields. They are heavily involved in insurance because that is society's most powerful answer for managing risk. We reduce our risk of financial loss by transferring it to an insurance company that accepts the risk for a price (which is the insurance premium). Actuaries play a key role in designing insurance plans by determining the premium, monitoring the profitability of insurance companies, and recommending corrective action when appropriate. Actuaries working in insurance companies also ensure that insurance companies have set aside enough funds to pay claims and provide advice on how to invest the insurance company's assets.

Actuaries work in all sectors of the economy, though they are more heavily represented in the financial services sector, including insurance companies, commercial banks, investment banks, and retirement funds. They are employed by corporations as well as the state government. Many work for consulting firms. Some are self-employed, enjoying financially rewarding careers that also come with the great flexibility of being one's own boss.

In 2002 and 2009, a *Wall Street Journal* survey on the best jobs in the United States listed actuary as the second best job, while in previous editions of the list, actuaries had been the top rated job (Lee 2002), (Needleman 2009). The survey used six key criteria to rank jobs: environment, income, employment outlook, physical demands, security and stress. A similar survey by *U.S. News & World Report* in 2006 included actuaries among the 25 Best Professions that it expects will be in great demand in the future (Nemko 2006).

Economists, scientists, risk theorists, statisticians, and actuaries each have their own concept of risk. However, risk traditionally has been defined in terms of uncertainty. Based on this concept, risk is, *defined here as uncertainty concerning the occurrence of a loss. For example, the risk of being killed in auto accident is present because uncertainty is present.* The risk of lung cancer for smokers is present because uncertainty is present. Although risk is defined as uncertainty in this text, employees in the insurance industry often use the term risk to identify the property or life being insured. Thus, in the insurance industry, it is common to hear statements such as "that driver is a poor risk"

or “that building is an unacceptable risk.” Finally, when risk is defined as uncertainty, some authors make a careful distinction between objective risk and subjective risk.

Objective Risk

Objective risk (also called degree of risk) is defined as the relative variation of actual loss from expected loss. For example, assume that a property insurer has 10,000 houses insured over a long period and, on average, 1 percent, or 100 houses, burn each year. However, it would be rare for exactly 100 houses to burn each year. In some years, as few as 90 houses may burn; in other years, as many as 110 houses may burn. Thus, there is a variation of 10 houses from the expected number of 100, or a variation of 10 percent. This relative variation of actual loss from expected loss is known as objective risk. Objective risk declines as the number of exposures increase. More specifically, objective risk varies inversely with the square root of the number of cases under observation. Objective risk can be statistically calculated by some measure of dispersion, such as the standard deviation or the coefficient of variation.

Subjective Risk

Subjective risk is defined as uncertainty based on a person’s mental condition or state of mind. For example, a customer who was drinking heavily in a bar may foolishly attempt to drive home. The driver may be certain whether he will arrive home safely without being arrested by the police for drunk driving. This mental uncertainty is called subjective risk. The impact of subjective risk varies depending on the individual. Two persons in the same situation can have a different perception of risk, and their behavior may be altered accordingly. If an individual experiences great mental uncertainty concerning the occurrence of a loss, that person’s behavior may be affected. High subjective risk often results in conservative and prudent behavior, while low subjective risk may result in less conservative behavior.

Basic Categories of Risk

Risk can be classified into several distinct categories. The most important categories are the following:

- (i) Pure and Speculative risk
- (i) Fundamental risk and particular risk
- (i) Enterprise risk

Pure Risk and Speculative Risk

Pure risk is defined as a situation in which there is only the possibility of loss or no loss. The only possible outcomes are adverse (loss) and neutral (no loss). Examples of pure risks include premature death, job-related accidents, catastrophic medical expenses, and

damage to property from fire, lightning, flood, or earthquake. Speculative risk is defined as a situation in which either profit or loss is possible. For example, if you purchase 100 shares of common stock, you would profit if the price of the stock increases but would lose if the price declines. Other examples of speculative risks include betting on a horse race, investing in real estate, and going into business yourself. In these situations, both profit and loss are possible. It is important to distinguish between pure and speculative risks for three reasons.

- (i). Private insurers typically insure only pure risks. With certain exceptions, private insurers generally do not insure speculative risks, and other techniques for dealing with speculative risk must be used.
- (ii). The law of large numbers can be applied more easily to pure risks than to speculative risks. The law of large numbers is important because it enables insurers to predict future loss experience.
- (iii). Society may benefit from a speculative risk even though a loss occurs, but it is harmed if a pure risk is present and a loss occurs. For example, a firm may develop new technology for producing inexpensive computers. As a result, some competitors may be forced into bankruptcy.

Despite the bankruptcy, society benefits because the computers are produced at a lower cost. However, society normally does not benefit when a loss from a pure risk occurs, such as a flood or earthquake that devastates an area.

Fundamental Risk and Particular Risk

A fundamental risk is a risk that affects the entire economy or large number of persons or groups within the economy. Examples include rapid inflation, cyclical unemployment, and war because large numbers of individuals are affected. More recently, the risk of a terrorist attack is rapidly emerging as a fundamental risk and piracy. In contrast to a fundamental risk, a particular risk is a risk that affects only individuals and not the entire community. Examples include car thefts, bank robberies, and dwelling fires. Only individuals experiencing such losses are affected, not the entire economy. The distinction between a fundamental and a particular risk is important because government assistance may be necessary to insure a fundamental risk.

Enterprise Risk

Enterprise risk is a relatively new term that encompasses all major risks faced by a business firm. Such risks include pure risk, speculative risk, strategic risk, operational risk, and financial risk. Enterprise risk also includes financial risk, which is becoming more important in a commercial risk management program. Financial risk refers to the uncertainty of loss because of adverse changes in commodity prices, interest rates, foreign exchange rates, and the value of money.

Types of Pure Risk

Major types of pure risk that can create great financial insecurity include (1) personal risks, (2) property risks, and (3) liability risks. **Personal Risks** Personal risks are risks that directly affect an individual. They involve the possibility of the complete loss or reduction of earned income, extra expenses, and the depletion of financial assets. There are four major four major personal risks.

1. Risk of premature death
2. Risk of insufficient income during retirement
3. Risk of poor health
4. Risk of unemployment

Property Risk

Persons owning property are exposed to property risks -the risk of having property damaged or lost from numerous causes.

There are two major types of loss associated with the destruction or theft of property direct loss and indirect or consequential loss. **Direct loss** A direct loss is defined as a financial loss that result from the physical damage, destruction or theft of the property.

Indirect or Consequential Loss

An indirect loss is a financial loss that results indirectly from the occurrence of a direct physical damage in theft loss.

Liability Risks

Liability risks are another important types of pure risk that most persons face. Under our legal system, you can be held legally liable if you do something that results in bodily injury or property damage to some one else. A court of law may order you to pay substantial damages to the persons you have injured.

Burden of Risk on Society

The presence of risk in certain undesirable social and economic effects. Risk entails three major burdens on society:

1. The size of an emergency fund must be increased
2. Society is deprived of certain goods and services
3. Worry and fear are present

Larger Emergency Fund

it is prudent to set a side funds for an emergency. However, in the absence of insurance, individuals and business firms would have to increase the size of their emergency fund to pay for unexpected losses.

Loss of certain Goods and Services

Another burden of risk is that society is deprived of certain goods and services. For Example, because of the risk of a liability law suit, many corporations have discontinued manufacturing certain products. Firms have discontinued the manufacture of certain products, including asbestos products, football helmets, silicone-gel breast implants, and certain birth-control devices because of fear of legal liability.

Worry and Fear

A final burden of risk is that worry and fear are present. Numerous examples can illustrate the mental unrest and fear caused by risk. parents may be fearful if a teenage son or daughter departs for a night outing, because the risk of being attacked, arrested or attacked, car crashing etc. is present. Some passengers in a commercial jet may become extremely nervous and fearful if the jet encounters severe turbulence during the flight. A college student who needs a grade of *A* in a course to graduate may enter the final examination room with a feeling of apprehension and fear.

Methods of Handling Risk

Risk is a burden not only to the individual but to society as well. Thus, it is important to examine some techniques for meeting the problem of risk. There are five major methods of handling risk:

1. Avoidance
2. Loss control
3. Retention
4. Non-insurance transfers
5. Insurance

Avoidance

Avoidance is one method of handling risk. For example, you can avoid the risk of being mugged in a high-crime rate area by staying out of the area; you can avoid the risk of divorce by not marrying; and a business firm can avoid the risk of being sued for a defective product by not producing the product.

Not all risks should be avoided, however. For example, you can avoid the risk of death or disability in a plane crash by refusing to fly. But is this choice practical or desirable? The alternatives-driving or taking a bus or train-often are not appealing. although the risk of a plane crash is present, the safety record of commercial airlines is excellent, and flying is a reasonable risk to assume.

Loss Control

Loss control consists of certain activities that reduce both the frequency and severity of losses. Thus, loss control has two major objectives: loss prevention and loss reduction.

Loss prevention: Loss prevention aims at reducing the probability of loss so that the frequency of losses is reduced. several examples of personal loss prevention can be given. Auto accidents can be reduced if motorists take a safe-driving course and drive defensively. the number of heart attacks can be reduced if individuals control their weight, give up smoking, and eat healthy diets.

Loss prevention is also important for business firms. For example, strict security measures at airports and aboard commercial flights can be reduce hijacking by terrorists. Boiler explosions can be prevented by periodic inspections by safety engineers; occupational accident can be reduced by the elimination of unsafe working conditions and by strong enforcement of safety rules; and fire can be prevented by forbidding workers to smoke in a building where highly flammable material are used. In short, the goal of loss prevention is to prevent the loss from occurring.

Loss reduction Strict loss-prevention efforts can reduce the frequency of losses, yet some losses will inevitably occur. Thus the second objective of loss control is to reduce the severity of a loss after it occurs.

From the viewpoint of society, loss control is highly desirable for two reasons. First, the indirect costs of losses may be large, and in some instances can easily exceed the direct costs.

Second, the social costs of losses are reduced.

Retention

Retention means that an individual or a business firm retains all or part of a given risk. Risk retention can be either active or passive.

Active Retention Active retention means that an individual is consciously aware of the risk and deliberately plan to retain all or part of it. For example, a motorist may wish to retain the risk of a small collision loss by purchasing an auto insurance policy with a \$250 or higher deductible.

Passive Retention Risk can also be retained passively certain risks may be unknowingly retained because of ignorance, indifference, or laziness. Passive retention is very dangerous if the risk retained has the potential for destroying you financially. For example, many workers with earned incomes are not insured against the risk of total and permanent disability under either an individual or group disability income plan.

Non-insurance Transfers

In non-insurance transfers, the risk is transferred to a party other than an insurance company. A risk can be transferred by several methods, among which are the following:

1. Transfer of risk by contracts
2. Hedging price risks
3. Incorporation of a business firm

Transfer of Risk by Contracts Unwanted risks can be transferred by contracts. For example, the risk of a defective television, stereo or phone can be transferred to the retailer by purchasing a service contract, which makes the retailer responsible for all repairs after the warranty expires. the risk of a rent increase can be transferred to the landlord by a long-term lease. the risk of a price increase in construction costs can be transferred to the builder by having a fixed price in the contract.

Finally, a risk can be transferred by a **hold-harmless clause**. For example, if a manufacturer of scaffolds inserts a hold-harmless clause in a contract with a retailer, the retailer agrees to hold the manufacturer harmless in case a scaffold collapses and some one is injured.

Hedging Price Risks Hedging is a technique for transferring the risk of unfavorable price fluctuations to a speculator by purchasing and selling futures contracts on an organized exchange.

Incorporation of a Business Firm If a firm is a sole proprietorship, the owner's personal assets can be attached by creditors for satisfaction of debts. if a firm incorporates personal assets cannot be attached by creditors for payment of the firm's debts. In essence, by incorporation, the liability of the stockholders is limited, and the risk of the firm having insufficient assets to pay business debts is shifted to the creditors.

Insurance

For most people, insurance is the most practical method for handling a major risk. Although private insurance has several characteristics, three major characteristics should be emphasized. First, **risk transfer** is used because a pure risk is transferred to the insurer. Second, the **pooling technique** is used to spread the losses of the few over the entire group so that average loss is substituted for actual loss. Finally, the risk may be

reduced by application of the **law of large numbers** by which an insurer can predict future loss experience with greater accuracy.

Requirements of an Insurable Risk

Insurers usually insure only pure risks. However, not all pure risks are insurable. Certain requirements usually must be fulfilled before a pure risk can be privately insured. From the viewpoint of the insurer, there are ideally six requirements of an **insurable risk**

1. There must be a large number of exposure units
2. The loss must be accidental and unintentional
3. The loss must be determinable and measurable
4. The loss should not be catastrophic
5. The chance of loss must be calculable
6. the premium must be economically feasible.

Large Number of Exposure Units

The first requirement of an insurable risk is a large number of exposure units. Ideally, there should be a large group of roughly similar, but not necessarily identical, exposure units that are subject to the same peril or group of perils. For example, a large number of frame dwellings in a city can be grouped together for purposes of providing property insurance on the dwellings.

The purpose of this first requirement is to enable the insurer to predict loss based on the law of large numbers. Loss data can be compiled over time, and losses for the group as a whole can be predicted with some accuracy. The loss costs can then be spread over all insureds in the underwriting class.

Accidental and Unintentional Loss

A second requirement is that the loss should be accidental and unintentional; ideally, the loss should be fortuitous and outside the insured's control. Thus, if an individual deliberately causes a loss, he or she should not be indemnified for the loss

The requirement of an accidental and unintentional loss is necessary for two reasons:

1. If intentional losses were paid, moral hazard would be substantially increased and premiums would rise as a result. The substantial increase in premiums could result in relatively fewer persons purchasing the insurance, and the insurer might not have a sufficient number of exposures units to predict future losses.
2. The loss should be accidental because the law of large numbers is based on the random occurrence of events.

A deliberately caused loss is not a random event because the insured knows when the loss will occur. Thus, prediction of future experience may be highly inaccurate if a large number of intentional or non random losses occur.

Determinable and Measurable Loss

This means the loss should be definite as to cause, time, place, and amount. Life insurance in most cases meet this requirement easily. The cause and time of death can be readily determined in most cases, and if the person is insured, the face amount of the life insurance policy is the amount paid.

Some losses, however, are difficult to determine and measure. For example, under a disability-income policy, the insurer promises to pay a monthly benefit to the disabled person if the definition of disability stated in the policy is satisfied.

The basic purpose of this requirement is to enable an insurer to determine if the loss is covered under the policy, and if it is covered, how much should be paid.

No Catastrophic Loss

This means that a large proportion of exposure units should not incur losses at the same time. Pooling is the essence of insurance. If most or all of the exposure units in a certain class simultaneously incur a loss, then the pooling technique breaks down and becomes unworkable. Premiums must be increased to prohibitive levels, and the insurance technique is no longer a viable arrangement by which losses of the few are spread over the entire group.

Insurers ideally wish to avoid all catastrophic losses. Several approaches are available for meeting the problems of a catastrophic loss. First, reinsurance can be used by which insurance companies are indemnified by reinsurers for catastrophic losses.

Reinsurance is the shifting of part or all of the insurance originally written by one insured to another. The reinsurer is the responsible for the payment of its share of the loss.

Second, insurers can avoid the concentration of risk by dispersing their coverage over a large geographical area.

Calculable Chance of Loss

The insurer must be able to calculate both the average frequency and the average severity of future losses with some accuracy. This requirement is necessary so that a proper premium can be charged that is sufficient to pay all claims and expenses and yield a profit during the policy period.

Certain losses, however, are difficult to insure because the chance of loss cannot be accurately estimated, and the potential for a catastrophic loss is present.

Economically Feasible Premium

The insured must be able to pay the premium. In addition, for the insurance to be an attractive purchase, the premiums paid must be substantially less than the face value, or amount of the policy.

To have an economically feasible premium, the chance of loss must be relatively low.

0.3 Introduction

A company is started by sacrifice of funds from the owners known as shareholders. The shareholders sacrifice other opportunities to invest in the corporation. The objective of the corporation is therefore to create value for its shareholders. Value is mainly presented by the market price of the company's common stock, which is the most objective and observable perspective. the firm's most significant objective is to create value. This occurs when the management does something the owners cannot do themselves.

0.4 Decision Functions of Financial Management

Financial management is broadly concerned with the acquisition, financing and management of assets of a business firm with the goal of maximizing shareholders wealth. The three broad decision functions of financial management are:-

0.4.1 The Financing Decision - Management of the Firm's Financial Structure

The management of the financing side of the balance sheet involves:- (i). establishing the debt-equity ratio or financial leverage, (ii). determining the dividend policy (iii). choosing the specific instruments of financing, and (iv). negotiating and developing relationship with various suppliers of capital.

The functions involves deciding on the optimal capital structure (the Proportion of debt and share capital) to be employed by the firm. The long term sources of financing which form the capital structure of the firm comprise basically three components: debt capital, preference share capital, and ordinary share capital. These components each have different costs and it is the responsibility of the finance manager to ensure the firm's overall cost of financing is as low as possible.

the financing decision encompasses the dividend decision of the firm. The value of dividends paid to shareholders must be balanced against the opportunity cost of retained earnings lost as a means of equity financing.

0.4.2 The Investment Decision -Financial Analysis, Planning and Control

This is one of the most important decision contributing to value creation. Financial analysis, planning, and control are concerned with Management of their firm's asset structure. It involves, (i). the decision of the amount of assets to be held and the

composition of the assets (asset structure) (ii). assessing the financial performance and conditions of the firm, (iii). forecasting and planning the financial future of the firm, (iv). estimating the financing needs of the firm, and (v). instituting appropriate systems of control to ensure that the actions of managers are congruent with the goals of the firm. Comprehensive as they are, these functions have reference to the balance sheet, the profit and loss account, and other statements.

0.4.3 The Asset Management Decision - Management of the Firm's Asset Structure

The asset acquired must be managed effectively. The task requires an analysis of the risk and return of the various assets in order to ensure firm's assets are held in efficient combinations. Management of the firm's asset structure entails:- (i). the decision of the amount of assets to be held and the composition of the assets (asset structure). (ii). determining the capital budget, (iii). managing the liquid resources, (iv). establishing the credit policy, and (v). controlling the level of inventories.

0.5 Goals of Financial Management

Finance theory rests on the premise that managers should manage their firm's resources with the objective of enhancing the firm's market value. This goal has been eloquently defended by distinguished finance scholars, economists, and practitioners. Here is a sampling of their views.

In a market based economy which recognizes the rights of private property, the only social responsibility of business is to create value and do so legally and with integrity. It is a profound error to view increases in a company's value as a concern just for its shareholders. Enlightened managers and public officials recognize that increases in stock prices reflects improvement in competitiveness an issue which affects everyone who has a stake in the company or economy. "Should a firm maximize the welfare of employees, or customers, or creditors? These are bogus questions. The real question is: What should a firm do to maximize its contribution to the society? The contribution to the society is maximized by maximizing the value of the firm."

"The quest for value drives scarce resources to their most productive uses and their most efficient users. The more effectively resources are deployed, the more robust will be the economic growth and the rate of improvement in our standard of living. Adam Smith's 'invisible hand' is at work when investors' private gain is a public value."

You may ask why are we overlooking the interest of customers, employees, and suppliers. No company can succeed unless it offers value for money to its customers, provides satisfactory employment condition to its employees, and treats its suppliers fairly. Hence the question of neglecting the interests of these constituencies to promote the welfare

of shareholders simply does not arise. More value for shareholders does not imply less value for customers, employees, or suppliers.

Alternative Goals

Maximization of profits is not as inclusive a goal as maximization of shareholders wealth. It suffers several limitations:

- Profit in absolute terms is not a proper guide to decision making. it should be expressed either on a per share basis or in relation to investment.
e.g. Safaricom profits of about 18 billion an then dividend per share of 40 cents.
- It leaves considerations of timing and duration undefined. There is no guide for comparing profit now with profit in future or for comparing profit streams of different durations.
- it glosses over the factor of risk. It cannot for example, discriminate between an investment project which generates a ceratin profit of 50,000 and an investment project which has a variable profit outcome with an expected value of 50,000.

The general goals of maximization of earnings per share and maximization of return on equity do not suffer from the fast limitation mentioned above. However, they do suffer from the other limitations and hence are not suitable.

In view of the short comings of the alternatives discussed above, maximization of the wealth of equity share holders (as reflected in the market price of equity) appears to be the most appropriate goal for financial decision making. Though the strict validity of this goal rests on certain rigid assumptions, it can be reasonably defended as a guide for financial decision making under fairly plausible assumptions about capital markets.

0.6 Risk-Return Trade-Off

Financial decisions often involves alternative courses of action. Should the firm set up a plant which has a capacity of one million tons or two million tons? Should the debt-equity ratio of the firm be 2 : 1 or 1 : 1? Should the firm pursue a generous credit policy or a niggardly credit policy? Should the firm carry a large inventory or a small inventory?

The alternative course of action typically have different risk-return implications. A large plant may have a higher expected return and a higher risk exposure, whereas a small plant plant may have a lower expected return and a lower risk exposure. A higher debt-equity ratio, compared to a lower debt-equity ratio, may reduce the cost of capital but expose the firm to greater risk. A “hot” stock compared to a defensive stock, may offer a higher expected return but a greater possibility of loss.

In general, when you make a financial decision, you have to answer the following questions: What is the expected return? What is the risk exposure? Give the risk-return characteristics of the decision, how would it influence value?

0.7 Goal of the Firm

The preferable goal of the firm should be *maximization of shareholders wealth*, by which we mean maximization of the price of the existing common stock. Not only will this goal be in the best interest of the shareholders, but it will also provide the most productive use by businesses competing to create wealth.

0.8 Principles that form the Basis of Financial management

1. The Risk-Return Trade-Off - We won't take an additional risk unless we expect to be compensated with additional return.
2. The time value of money - A dollar received today is worth more than a dollar received in the future.
3. Cash-Not Profit-is King - In measuring wealth or value, we will use cash flows, not accounting profits, as our measurement tool.
4. Incremental Cash Flows - It's only what changes that counts. In making business decisions, we are concerned with the results of those decisions; i.e. *Alvaro* and *Novida* have pushed the cash flows for their respective companies due to increased demand for the product.
5. The Curse of Competitive markets - Why it's hard to find exceptionally profitable projects; eg Coca Cola company introduced *Novida* into the market to counter the popularity of the EABL's *Alvaro*.
6. Efficient Capital Markets - The markets are quick and the prices are right.
7. The Agency Problem - Managers won't work for owners unless it's in their best interest.
The agency problem results from the separation of management and the ownership of the firm. For example, a large firm may be run by professional managers who have little or no ownership in the firm. because of this separation of the decision makers and owners, managers may make decisions that are not in line with the goal of maximization of shareholders wealth. They may approach work less energetically and attempt to benefit themselves in terms of salary and perquisites at the expense of shareholders.
Agency Problem - problem resulting from conflicts of interest between the manger (the stockholder's agent) and the stockholders.
8. Taxes Bias Business decision - The cash flows we will consider will be after tax incremental cash flows to the firm as a whole.
9. All Risk is Not Equal - Some risk can be diversified away and some cannot.

10. Ethical behaviour is doing the right thing and ethical dilemmas are everywhere in finance.

0.9 Financial Management Environments

The environments that impact on the functions of a financial manager can be broadly viewed in terms of social, political, economic and legal contexts. Although all four environments affect a finance manager's functions and decisions, the political and social dynamics are driven by events on which the manager has little or no influence. Consequently, in this section we restrict the discussion only to aspects of the legal and economic environment, namely the various types of business organizations, the tax legislation and the financial system (market institutions and intermediaries).

LECTURE TWELVE

ETHICS AND PROFESSIONALISM

Ethics

Ethical behaviour mean “doing the right thing.” A difficulty arise, however, in attempting to define “doing the right thing.” the problem is that each of us has his or her own set of values, which forms the basis for our personal judgements about what is the right thing to do. however, every society adopts a set of rules or laws that prescribe what it believes to be “doing the right thing.” In a sense, we can think of laws as a set of rules that reflect the values of the society as a whole, as they have evolved.

Many students ask, “Is ethics really relevant?” First, although business errors can be forgiven, ethical errors tend to end careers and terminate future opportunities. Why? Because unethical behaviour eliminates trust, and without trust, businesses cannot interact. Second, the most damaging event a business can experience is a loss of the public’s confidence in its ethical standards; i.e. *TRACK IT Security company scandal was recently exposed and the company was forced to close shop.*

Business Ethics

Business ethics can be thought of as a company’s attitude and conduct towards its employees, customers, community and stockholders. High standards of ethical behaviour demand that a firm treat each party that it deals with in a fair and honest manner. A firm’s commitment to business ethics can be measured by the tendency of the firm and its employees to adhere to laws and regulations relating to such factors as product safety and quality, fair employment practices, fair marketing and selling practices, the use of confidential information for personal gain, community involvement, bribery, and illegal payments to obtain business (contracts).

Most firms today have in place strong codes of ethical behaviour, and they also conduct training programs designed to ensure that employees understand the correct behaviour in different business situations. However, it is imperative that top management be openly committed to ethical behaviour, and that they communicate this commitment through their own personal actions as well as through company policies, directives, and punishment/reward systems:

Examples: Dirty rivalry between beer companies, soda companies, DSTV and GTV etc.

When conflict arise between profits and ethics, sometimes the ethical considerations are so strong that they clearly dominate. However, in many cases the choice between ethics and profits is not clear cut.