

THE EDGE



Fundamentals of Actuarial Practice (FAP) Study Package

VOLUME 1 OF 3

BY

**Ryan Rowland, FSA, EA
Kevin Zagortz, FSA
Thomas McNab, FSA**

5th EDITION

**WRITTEN FROM AN EXAM TAKER'S POINT OF VIEW FOR EXAM
TAKERS**

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With additional authoring by Thomas McNab
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About the Study Package Important, Please Read

Copyright protection

MANY HOURS and DOLLARS went into the development of this study package. We respectfully ask that you respect its copyright protection.

The Objective

The Edge / ACTEX FAP Study Guide is the only study guide for students wishing to have an accompanying study aid for the entire FAP course. It is a perfect fit for students who want to **SIGNIFICANTLY** cut down the amount of note-taking / exam preparation time, while also focusing on enhanced comprehension (i.e. we've tackled the heavy lifting a student would normally endure while preparing for this course).

The biggest obstacle we hear that students find with the FAP course is moving through the material in a timely manner. Time and time again, we hear that what could feasibly be a six-month process often finds itself elongated into a two- or three-year headache! One of our primary goals as authors and prior FAP students is to relieve this headache and provide a tool that gives both the means and the motivation to sharpen your focus on completing this piece of the accreditation process as quickly and efficiently as possible, and move on towards to ultimate completion of your Associateships and Fellowship. You owe it to yourself to see this great manual we've put together with your success in mind!

The Tool

A good tool is designed to enable the user to complete the task at hand effectively and efficiently. For example, you can bang a nail into a piece of wood using the handle of a screw driver. However, doing so will most likely require the exertion of more energy, more time being exhausted and the end result of the process may be that the nail bended on the way in, and the process has to be redone. Redoing the project requires even more time and energy.

A good study guide is analogous to a good tool. Without the use of a good study guide you can get the job done but it will most likely require more energy, more time and may result in the higher likelihood of the test having to be retaken. A good study guide is designed to cut down both the time and energy needed to pass a test, and to also increase the student's likelihood of passing the test on the first attempt. *The Edge / ACTEX FAP Study Package* was designed with this mindset.

Further, the Interim and Final Assessments involve the submission of written responses. However, unlike the written Fellowship exams, these assessments are open-book. Therefore, the testing format is somewhat of a transition from the multiple choice exams to the written Fellowship exams. *The Edge / ACTEX FAP Study Package* reflects the techniques the authors learned and used to pass the written exams with high marks. Exam strategy makes a difference!

The Package

Students receive both a hardcopy version and read-only electronic version of the study package

Provisions and features regarding Electronic Access to the joint publication of *The Edge and ACTEX Learning FAP Study Package*:

- Electronic access of the study guide is available on two electronic devices.

Students can now access an electronic copy of the study guide on their smart phone or tablet. This is perfect for students who want the ease of accessibility while traveling / commuting and do not want to bring the hardcopy with them.

- Access will be provided for one year commencing with the date of purchase.
- Students will be able to navigate the electronic version of the study guide and search key words.

This feature will be helpful as you prepare your Interim and Final Assessment responses. Having online access to the study guide (i.e., to the Detailed Summary and Compressed Summary sections) will enable the student to locate reference points in the study guide much more efficiently than having to go through hundreds and hundreds of pages manually.

Comments regarding the 5th Edition of this study package

As instructors, we do not have access to the same website as our students that are actively working within the FAP environment. We access the SOA's continuing education version of the course, which we understand to be a mirror image of the original course, but we have no means of certifying that fact. However, there are two instances of differences of which you should be aware when using our materials:

- We do not have access to the End-of-Module Assignments nor the Interim / Final Assessments
- We do not have access to the End-of-Module Tests

The following textbook editions are a part of the SOA's current version of the FAP course:

- *Understanding Actuarial Practice* (Klugman, 2012)
- *Understanding Actuarial Management: The Actuarial Control Cycle* (Bellis et al, 2nd edition, 2010)
- *Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance* (Brown and Lennox, 4th edition, 2015)
- *Corporate Value of Enterprise Risk Management: The Next Step in Business Management* (Segal, 2011)

The 5th Edition of *The Edge / ACTEX FAP Study Package* will reflect all of the text editions listed above plus any other changes made by the SOA to the FAP course through December 31, 2016.

The unique design of our study package

The structure of *The Edge / ACTEX FAP Study Package* is delivered in the sections as described below:

Detailed Summaries

The syllabus encompasses a tremendous amount of material consisting of module screens, online readings, and textbook readings. Therefore, we designed this section of the study guide using Fellowship exam strategy techniques to pare down what we believe to be key information into something much more manageable while still retaining key informational content.

The Detailed Summary sections summarize key material from the module screens, online readings and textbook readings. They were designed to SIGNIFICANTLY cut down the amount of note-taking / exam preparation time while still retaining the necessary comprehension component of the Interim and Final Assessments' objectives. However, even our Detailed Summary sections are still enormous. Compiling a comparable set of condensed, information-rich notes to be available as a reference guide while completing the Interim and Final Assessments would take the student a considerable amount of time to develop. This section of the study package will save the student a tremendous amount of time and energy while still retaining key syllabus content.

Compressed Summaries

These are uniquely organized, high-level summaries of information from the Detailed Summary sections consisting of the following sections:

- Learning objectives
- Definitions
- Key concepts

We recommend reading these sections and rereading them until you are familiar with the material prior to downloading the Interim and Final Assessments. These sections further compress the syllabus into an even more manageable size so that the student can read the material and reread the material prior to downloading the Interim and Final Assessments without over-burdening themselves.

We anticipate that this is the section the student will most often refer to when completing the Interim and Final Assessments. However, as you read the Compressed Summaries, we suggest you go back to the Detailed Summary sections when you come across an underlying concept that you do not understand. Like the Detailed Summary sections, the Compressed Summary sections will significantly cut down the amount of time and energy the student would spend drafting and organizing a comparable set of reference notes to be referenced while completing the Interim and Final Assessments. It has also been structured to help the student pass the Interim and Final Assessments on the first attempt.

Sample Interim Assessment

The study package includes a sample Interim Assessment. Our sample assessment questions were designed to draw out a deeper understanding of the material, cover a broad cross-section of the syllabus, and also show a step-by-step process that we would use for developing responses in the Interim Assessment.

Module slides

We strongly recommend that you go through the slides and use the guide at the same time. It would be in your best interest to read the slides and not skip them.

Disclaimer

This study package contains comments regarding what we feel is likely to be tested or not to be tested. Alternatively, the Detailed Summary sections may only include material we believe is likely to be tested. Any explicit comments or implicit suggestions are solely our opinions. It is the student's responsibility to decide whether or not to study material that we believe is not likely to be tested. Further, although care has been taken to ensure all problems and their underlying methodologies provided in this study guide are correct, and the authors are not aware of any errors or omissions within this study guide, it is the student's responsibility to ensure they are aware of the proper treatment of any math or non-math related topic.

About the authors

Ryan is also the author of The Edge study guides for the following Fellowship exams:

- Retirement Design and Accounting (D&A) exam
- Retirement Investment and Risk Management (IRM) exam, and
- Funding and Regulation (FR) exam

Ryan has been developing study materials to help students pass actuarial exams since 2002. The Edge study materials have received *extremely* positive feedback from students since its inception.

In addition to developing study materials, Ryan is a pension consulting actuary with over 20 years of experience helping medium to large organizations solve funding (both in-distress / bankruptcy and non-distress situations), pension accounting, stock-option pricing / modeling and accounting, asset liability management / risk management, mergers and acquisitions, plan design, and HR-related issues.

Unlike Kevin and Tom, who attained their FSAs in their mid-20s, Ryan did not begin his actuarial career until 25. After narrowing down an effective exam strategy, Ryan passed virtually every exam on his first attempt and completed both his FSA and EA within six years of entering the actuarial field.

Kevin teamed up with Ryan years ago when he developed an innovative method to help students memorize material while preparing for the large written retirement fellowship exams. In addition, Kevin gave exam preparation seminars for the retirement fellowship exams for several years, worked as a pension consulting actuary for nearly seven years, and has now been working as a portfolio manager for seven years.

In addition to traditional pension funding, design, and accounting experience, he also has significant experience consulting to plan sponsors on risk management and managing pension investments in a liability-driven framework. Kevin attained both the FSA and EA credentials at the age of 25 and attributes his success in large part to developing time-saving study strategies while studying for each exam.

Tom is the latest partner to Kevin and Ryan in the development of *The Edge / ACTEX FAP Study Package*. He assisted with the development of the study material for Modules 6, 7, and 8, making the study package a fully comprehensive study guide for the entire FAP course.

Tom has spent a number of years in the traditional pension consulting industry, working with industry-leading Fortune 100 clients in developing innovative solutions to their ever-evolving retirement program

challenges. He now works with a London-based financial technology company providing defined benefit pension risk analytic software to users specializing in actuarial consulting, investment consulting, and asset management. He manages and consults on the technology relationships established with large and complex firms in North America.

Contact information

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*This study guide assumes the candidates’ knowledge of MLC/3L concepts. Students should review this reading, as well as the subsequent exercises, if necessary.

Module Slides

Module Slides

Module 1 learning objectives¹

- Explain what actuaries are.
- Describe what actuaries do.
- Explain how actuaries practice.
- Explain how actuaries work in the real world.
- Explain how the Control Cycle facilitates actuarial work.

¹Quoted from the SOA FAP e-Learning course on January 1, 2017

Actuarial Control Cycle

- Problem solving framework
 - Framework is useful regardless of practice area
 - Control Cycle steps
 - Define the problem
 - Design a solution
 - Monitor the results
- Go through the cycle steps again based on what is discovered / feedback from step 3
- External forces affect the work of actuaries
 - They are outside of the actuary's control
 - However, they need to be considered within the Control Cycle context
- Professionalism must be complied with as the actuary goes through the Control Cycle steps

Risk

- There are many definitions of risk
 - Possibility of the occurrence of an undesirable event
 - Potential of adverse consequences
 - Cost of uncertain events arising in the future
 - Financial exposure to loss
 - Potential to lose economic security
- Risk requires two key components – uncertainty and exposure to loss or cost
- Ultimately, risk can only be defined in context of a specific situation
- Entity risk represents the risk of the organizations that manage the risks of others
 - E.g., a life insurance company not collecting enough premiums to pay operational expenses and claims coming due
 - Individuals participating in the financial security system to manage their own risk incur entity risk through inherent participation
- Actuaries identify, measure (model), and manage economic risk and entity risk
 - Managing risk involves:
 - Evaluating the probability of future events
 - Designing risk management products for individuals and institutions so they can protect themselves from adverse outcomes

Textbook Readings

Understanding Actuarial Management – Chapter 3

Introduction

- Actuarial profession has a good reputation
- People will trust your opinion
 - You will be given freedom to use your best judgment on how to carry out work
 - You will need to conduct yourself in a way that justifies that trust

What is a profession?

- Defining a profession is not a simple task
- Professional elements fall into three categories:
 - Knowledge-related: Specialized knowledge and long training
 - Value-related: Ethical behavior and a commitment to provide services for the public good
 - Organizational elements: Members belong to an organization that supports knowledge-related and value-related elements

The theory about why professions exist

- Advantages of a profession
 - Members gain status
 - Legislation may require services that can only be provided by professionals
 - Governments may listen to the opinions of professionals
 - Mutual support between members
- To be recognized as a profession, an occupation must:
 - Provide solutions that society deems important
 - Provide a quality of the service that cannot be easily assessed
 - Provide services that cannot be delivered by applying a standard set of rules
- There is a need for an expert that society trusts
 - Professions have evolved to answer this problem
 - Profession shares a joint reputation
 - Professional body will enforce disciplinary powers

How the concept of a profession is changing over time

- Society is less trusting of professions than it used to be
- Professions must demonstrate they are not abusing their monopoly of services
- Practitioners have to justify their advice
 - Can no longer say “Trust me; I’m the expert.”

How the concept of a profession varies from country to country

In our opinion, this material is more informative than testable. Please add it to your notes if you feel otherwise.

The role of the professional body

- The actuarial profession is more international than many other professions

- The International Actuarial Association (IAA) serves as a forum to enable the actuarial profession to deal with issues at the international level
 - It is an umbrella association of professional actuarial bodies around the world
 - For full membership in the IAA, a professional actuarial body must have:
 - An acceptable code of conduct
 - An acceptable disciplinary procedure
 - A procedure for drafting and enforcing standards of practice, if these are issued
 - Fully qualified members that meet the minimum education guidelines set out by the IAA
 - The IAA has no power over the individual national bodies, but it is influential
- The European Actuarial Consultative Group represents actuarial organizations in the EU
- The US has several bodies
 - The American Academy of Actuaries was established to provide a single voice for the whole US profession in dealing with the government and making statements on matters of public interest
- Code of conduct and other professional standards
 - The professional actuarial body will have a code of conduct
 - Actuaries should only take on tasks which they are competent to perform
 - The body may also issue standards of practice
 - Advantages of having a standard:
 - Provides a useful checklist of what should be done
 - Protects clients since it ensures the work is complete and thorough using appropriate methods
 - Protects the actuary who might otherwise be pressured into omitting an essential part of a task or using unacceptable methods
 - Provides the professional body with a solid case if it needs to discipline a member
 - Protects an actuary from allegations of unsatisfactory performance
 - Satisfies regulators that actuaries will perform a task to a given standard
 - Disadvantage
 - Challenging to specify methods which apply in every situation
- An individual has to ensure they are complying with the standards
 - However, as a professional they must also take steps if they see other actuaries failing to meet the standards

The regulatory role of the actuary

- Different countries will have different roles for actuaries set out in legislation
 - For example, sign certain tax schedules for pension plans
- Broad functions which actuaries provide
 - Prudential supervision (*here, the actuary is a regulator*)
 - Regulator aims to reduce the risk that individuals will suffer losses from the collapse of the institution
 - Regulatory roles
 - Actuary may be required to certify certain documents
 - Disclosure
 - In providing information about the soundness of financial institutions, the actuary's role is to provide information that interested parties cannot obtain otherwise

Professional issues to consider while you work on any task

- Ethical behavior
 - Everyone should behave ethically
 - As a professional, one must meet a higher standard
- Conflicts of interest
 - Professionals have a duty to put their clients' interest first
 - The only exception is that the actuary has a higher responsibility to the public interest
- Consideration of other stakeholders
 - Should have awareness that advice may be relied upon by third parties
- Materiality
 - Refers to how much difference it will make to the final outcome
 - The materiality of the work is always an issue the actuary should keep
 - Involves professional judgment as to which parts of the task will require the most attention in the context of the particular job
- Reliance on other experts
 - An actuary may have to start with work done by others
 - Reliance should be disclosed
 - Should consider the following when using models designed by others:
 - The actuary's effort to understand and evaluate the model should be consistent with the materiality
 - A view of the experts who designed the model
 - An idea of how the model work and if it has been tested, validated, and calibrated
 - Whether the model is appropriate for your purpose
 - Reasonableness of model results
- How to do a professional job
 - Be conscience of professionalism
 - Consider all professional standards and guidance
 - The penalties for unprofessional work can be severe
 - Consider the following:
 - Should only take on actuarial work you are competent to perform
 - Define the task
 - Understand what is required
 - Understand what the client needs
 - What the client is asking for may be different from what they need
 - Collect the required information
 - Actuaries may be pressured to present results based on inadequate data
 - Review the data for reasonableness
 - Check results for reasonableness / accuracy
 - Especially if you produced the work
 - Be careful in communicating the results
 - Actuarial work often deals with uncertain cash flows
 - Results may be reduced to a single number or range of numbers
 - Communicate the variability around any answer
 - Disclose information used to develop the results (data, assumptions, and methodology)
 - Communicate results in an appropriate format

Practical implications for actuaries

- Some aspects of behaving as a professional are obvious
 - E.g., complying with the standards of practice
- Some are more subtle
 - E.g., sensitivity to conflicts of interest
 - As a result, actuarial bodies run courses on professionalism

Understanding Actuarial Practice – Section 2.1.1

Early actuarial applications

- John Graunt was the first to bring an actuarial treatment to probability and statistics
 - Parish clerks in London developed weekly mortality reports in the 1530s
 - Recorded those who died in total and those who died due to the plague
 - Used to provide an early warning of the next outbreak
 - Graunt was the first to publish results using the data
 - Observed the ratio of male and female birth stability over time and location
 - He also constructed a mortality table
- Next advancement occurred in 1669
 - Huygens used Graunt’s table to develop life expectancies at specific ages in the table
 - Gaps in table (i.e. gaps in data / ages) filled in with uniform distributions
 - Uniform distribution practice still used today
- Shortly thereafter, annuities developed
- Lorenzo Tonti developed a variant of the life annuity called the tontine
 - A group of people of approximately the same age deposit an amount with the state
 - The state provides interest on deposited amount
 - The interest payment is divided amongst those from group alive at the end of the year
 - In year two, the interest paid on the initial deposit is divided among those alive at the end of year two
 - The process continues until everyone has died
 - The state then keeps the original deposit
- In 1694, Edmond Halley published the first reliable table on births and deaths
 - The table could be used to develop single and two-life annuities
- Abraham de Moivre believed in mathematical laws over empirical tables
 - Developed what was to be known as de Moivre’s law to price annuities

$$a_x = \frac{1}{i} - \frac{(1+i) * a_{\overline{86-x}|}}{i * (86-x)}, 10 \leq x < 86$$

Assumes that $l_x = 86 - x, 10 \leq x < 86$

- This approximation was crude
 - However, using Halley’s table was laborious
 - As a compromise, he proposed using a piecewise linear function
- Today, most actuarial work is done using experienced-based tables
- By the 1700s, all actuarial formulas for annuities and premiums had been developed

Understanding Actuarial Practice – Sections 2.2 – 2.3

What actuaries do and what sets them apart

- An actuary:
 - Uses math, probability, statistics, finance, and economics to measure and manage risk
 - Usually in the context of a financial security system
- Various definitions of actuary listed by actuarial organizations:
 - The SOA
 - Business professional who analyzes the financial consequences of risk
 - Use math, statistics, and financial theory to study uncertain future events
 - Design ways to reduce likelihood and impact of adverse events
 - Work requires (1) strong analytical skills, (2) business knowledge, and (3) understanding of human behavior
 - Actuarial Profession in the UK
 - Apply financial and statistical theories to solve real business problems
 - Create theoretical models of the world around them
 - An actuary's work might be thought of as risk management
 - Institute of Actuaries of Australia
 - Apply math expertise, statistical knowledge, economic, and financial analyses and problem solving skills to a wide range of business problems
 - Help organizations understand the long-term financial implications of their decisions
 - Actuaries apply their skills in:
 - Measuring and managing risk
 - Designing financial contracts
 - Advising on investments
 - Measuring demographic influences on financial arrangements
 - Advising on financial and statistical problems
 - The Casualty Actuarial Society
 - Evaluate the financial impact of current economic, legal, and social trends on future events
 - Financial implications occur over long periods of time
 - Therefore, an actuary is a researcher, a planner, and a decision maker

An actuary is a professional

- The profession has a specialized body of knowledge and skills to perform specific work
- The profession provides value to society
 - Must consist of high standards and ethical behavior
- The profession serves the public
 - Must have a code of conduct and discipline process
- The profession has continuing education requirements and standards of practice

An actuary has a broad knowledge of financial services

- An actuary is expected to be familiar with all the areas of a financial security system

An actuary has deep knowledge of at least one area of practice

- An actuary (specifically a member at the highest level an actuarial association offers) must have extensive knowledge of at least one subject area and be familiar with the others

An actuary is a creative problem solver

- An actuary must find reasonable solutions to unstructured problems with limited resources and information
- Key points of actuarial thinking are:
 - One's results are often not the only possible solution
 - The acceptable solution is rarely found in the back of a book
 - Information or data you wish you had is rarely available
 - Time and resources required to build a best model are often limited
 - Results will affect decision makers
 - The future will be unlike the past

What is a financial security system?

- A system that minimizes financial insecurity
 - An entity that provides financial security products to reduce or eliminate financial insecurity related to an economic loss or losses
- Encompasses many areas from insurance to retirement plans
- Examples of contingencies that can cause economic loss:
 - Death of wage earner, disability, personal illness or injury, outliving retirement savings, auto accident, and property damage

Examples of financial security systems

- Social insurance
 - Base level of protection against financial insecurity
 - Established by the government
- Group insurance and retirement plans
 - Employer-provided benefits make up the second layer of coverage
 - Group benefits typically provided to active employees, includes:
 - Life insurance, medical, dental, and disability
 - Many employers also provide pension and retirement plans
- Individual insurance
 - Provides final level of protection
 - Provided to the individual instead of a group
 - Includes coverage for the following:
 - Life, disability, health, automobile, and homeowners
 - Personal savings and individual annuities provide a form of retirement income insurance

Financial security system model

- A financial security system is an arrangement for risk financing in which one person or institution assumes an obligation to provide benefits to offset undesirable economic consequences that may be experienced by a second entity
 - This is done in return for a payment, by or on behalf of a second person
- Model can be described by answering the following questions:
 - Who is responsible for providing the benefit?
 - What is the benefit provided?
 - Who receives the benefit?
 - Who pays for the coverage?
 - How much is paid?
 - Is the system mandatory or voluntary?
- Social insurance
 - Mandatory financial security system

Who is responsible for providing the benefit?	Government
What is the benefit provided?	Death, disability, rehabilitation, medical expense, retirement benefits
Who receives the benefit?	Plan participants or dependents
Who pays for the coverage?	Employers and/or employees, retirees and perhaps other taxpayers
How much is paid?	The government sets the rates

- Group insurance
 - Relationship exists between group policyholder (e.g., employer) and insurer
 - Individuals are third party beneficiaries

Who is responsible for providing the benefit?	Provider
What is the benefit provided?	Death, disability, medical and other health care expense
Who receives the benefit?	Employees or member of a group association, dependents
Who pays for the coverage?	Employer, employee, union or a combination thereof
How much is paid?	Set by employer but sometimes in negotiation with employees

- Retirement plans

Who is responsible for providing the benefit?	Employer
What is the benefit provided?	Income stream or lump sum, disability income, or death benefit
Who receives the benefit?	Employees or dependents
Who pays for the coverage?	Employer and/or employee
How much is paid?	Set by employer but sometimes in negotiation with employees

- Individual insurance
 - Direct relationship between policy owner and insurance company

Who is responsible for providing the benefit?	Insurance company
What is the benefit provided?	Death, disability, annuity income payments, medical expenses, automobile, homeowners, tenant, or renters
Who receives the benefit?	Policyholder and beneficiaries
Who pays for the coverage?	Policy owner
How much is paid?	Premium as specified in the contract

- Manufacturer’s warranty

Who is responsible for providing the benefit?	Manufacturer
What is the benefit provided?	Repair or replacement of equipment
Who receives the benefit?	Consumer
Who pays for the coverage?	Consumer
How much is paid?	Fee set in contract

Providers of financial security systems

- Provider
 - The institution assuming the obligation to provide benefits
- Different coverages and providers
 - Individual insurance
 - Provider is the insurance company
 - Insurance company bears risk
 - The contract is between the insurance company and the individual policyholder
 - Group insurance
 - Employer sponsors coverage
 - A number of providers exist in the marketplace
 - Insurance companies
 - Insurance company bears risk
 - Healthcare service corporations
 - Write medical and dental coverages
 - Not-for-profit identity
 - Retains risk
 - HMOs
 - Offer service benefits
 - Have direct contact with health care providers
 - Some directly employ physicians and own hospitals
 - Managed care
 - Most offer out-of-plan option
 - Have co-payments vs. coinsurance and deductibles
 - HMOs bear risk
 - PPOs
 - Enter contract with service providers
 - Perform utilization reviews
 - Insurance risk stays with insurance company or employer

- Can design comprehensive coverage with coinsurance and deductibles to in-network benefits with co-payments
- Self-insured employers
 - Reasons to self-insure
 - Save money
 - Avoid having to provide mandated benefits
 - Employer assumes the investment risk
- Retirement plans
 - Employer sponsors the plan
 - Two types of plans
 - Defined benefit plan
 - How the benefit will be determined is specified up front
 - Employer and sometimes employees contribute to fund
 - Employer assumes the investment risk
 - Amount of benefit is determined as specified regardless of investment performance
 - Defined contribution plan
 - A savings vehicle
 - Amount or formula to determine amount set aside by employer is specified up-front
 - Investment risk borne by the participant
 - Certain level of benefit is not guaranteed
- Social insurance
 - Government is the sponsor
 - Financed through taxes
 - Types of benefits include
 - Medical
 - Workers compensation
 - Retirement benefits

Distributors of financial security systems

- Distributors of individual life insurance:
 - Captive agents or career agents (primarily sell one company's products)
 - Independent agents or brokers
 - Banks
 - Direct marketing (selling directly to customers without the use of agents)
 - Fee-for-service (financial advisors including attorneys and accountants)
 - Debit agents (sell to low-income markets to cover funeral expenses)
 - Employer-sponsored (work directly with employers where the premium is deducted from payroll)
- P&C insurers use distribution channels similar to life insurers
 - Captive agents or career agents
 - Independent agents or brokers
 - Direct marketing
- Group insurance can be categorized into the following groups:
 - Small groups (2 to 50 employees)
 - Pooled groups (51 to 200 employees)
 - Experienced-rated groups (201 to 1,000 employees)
 - Large groups (over 1,000 employees)

- Methods used to market to:
 - Small groups
 - Group sales representatives selling business directly to clients or through agents and brokers
 - Directly by agents and brokers
 - Exclusive broker arrangements
 - Direct mass-marketing or telemarketing
 - Pooled groups
 - Generally made through group sales representatives working with life insurance agents
 - Experience-rated groups
 - Generally marketed through group sales representatives
 - Large groups
 - Generally marketed through group insurance representatives working with employee benefit consultants
 - Retirement plans
 - Small plans typically work with a financial planner
 - Large plans would design their plans with the assistance of an employee benefit consultant

Understanding Actuarial Practice – Section 2.5

This reading covers the risks being managed, the financial security programs, and the actuary's contributions to each actuarial area of practice.

Traditional areas of actuarial practice

- Health
- Life insurance and annuities
- Retirement
- Property and casualty
- Investments
 - Actuaries are becoming more involved in Enterprise Risk Management (ERM)

Investments

- Risks
 - Manage financial risks associated with the investment function
 - Returns on investments
 - Defaults
 - Asset-liability management
- Financial security programs
 - A wide variety of financial security programs involve the investment of premiums or contributions in order to accumulate benefits to be paid later
- The actuary's contributions
 - Understanding the investment needs of the relevant financial security program
 - Managing risks associated with financing new investments
 - Understanding how financial markets operate, as well as available instruments and embedded options
 - Solving problems related to asset-liability mismatch risk, credit risk, liquidity risk, equity risk, and market risks in general

Life insurance and annuities

- Different types of annuities:
 - Immediate annuities
 - Purchased at or subsequent to retirement
 - Fixed immediate annuity
 - Insurance company invests the money from the policyholder and pays a fixed amount each month
 - Variable immediate annuity
 - Annuity amount varies depending on investment performance
 - Deferred annuities
 - Investment products with the option to convert accumulated funds to an annuity
- Risks
 - Uncertainty of the age of death of an individual
 - Dying prematurely and outliving their assets in retirement
 - Annuities and long-term care used to manage longevity risk
 - An aging population has reduced the demand for life insurance and increased the demand for annuities

- Life actuary takes into consideration not only the risks of premature death or outliving resources, but also the interrelationships of:
 - Insurance product benefits and guarantees
 - Target customers and risk pools
 - Anti-selection
 - Interest rates and the economic environment
 - Strategies and third-party contracts to manage risks
 - Tax and regulatory requirements
 - Legal restrictions
 - Various product distribution channels
 - Competitors
- Financial security programs
 - Life insurance provides protection against premature death
 - Annuities provide protection against longevity risk
- The actuary's contributions
 - Modeling and managing life and annuity insurance risks
 - Involvement with:
 - Life product development
 - Annuity product development
 - Regulatory filing
 - Mortality and other experience studies
 - Reinsurance
 - Products sold by captive agents, independent agents / brokers, banks, direct marketing, fee-for service, debit agents, and employer-sponsored sales
 - Involvement with the design, pricing, valuation, and risk management associated with life insurance and annuities
 - Balancing the designing a competitive product and keeping the system solvent
 - Key considerations for valuations include methods of calculation, conservatism, and standards of practice

Retirement

- Risks
 - The retirement actuary manages the risks that an individual (1) has insufficient income when employment ends, (2) outlives retirement income, (3) loses retirement income, and (4) that benefits are insufficiently funded
 - Post-retirement risks faced by an individual include:
 - Longevity
 - Healthcare needs
 - Long-term care
 - Inflation
 - Investments
 - Risks facing the plan sponsor:
 - Ability to attract and retain employees
 - Investment performance
 - Plan changes
 - Interest rate movement
 - Demographic changes
- Financial security programs
 - Include private and public pensions

- Designed to address risks while balancing plan participant and plan sponsor needs
- The actuary's contributions
 - Offering expertise in designing, funding, and regulatory aspects of public and private pensions
 - Working with the plan sponsor to understand objectives such as cost savings, employee retention, visibility of program, cash flow management, and cost volatility
 - Helping clients understand the tradeoffs involved with certain decisions, including
 - Cost savings vs. benefit reductions
 - Lowering long-term costs over time vs. adding cost volatility
 - Facilitating retirement while encouraging employee responsibility
 - Designing objectives vs. manageable administration
 - Designing the plans, valuing the plans, and determining benefit entitlements
 - Assessing and monitoring the defined benefit plan risks
 - Determining the appropriate contributions for the plan and their timing

Health Insurance

- Risks
 - Individual has inadequate healthcare due to cost or inaccessibility
 - Individual has inadequate income due to a health problem
 - Adequate healthcare depends on the healthcare system and how it is financed
 - A healthcare system is a collection of public or private providers that determine how the services of the providers are delivered to the individuals
 - The health actuary takes the following interdependent impacts into consideration, in addition to expected or average health care costs:
 - Risk pools associated with differing customers
 - Selection by participants
 - Negotiated payment methods with providers
 - Relationship of benefit levels to:
 - The cost of the insured event to the participant
 - The normal income of the participant
 - Health industry cost management practices
 - Availability of similar benefits from other sources
 - Tax and regulatory requirements
 - Legal restrictions
 - Various forms of marketing and potential markets
- Financial security programs
 - Include government plans, contracts with provider organizations, and private health insurance and managed care policies
- The actuary's contributions
 - Involvement in a range of issues, benefit types, and customer groups:
 - Employers, insurance companies, managed care organizations, and health care providers
 - Individual and group purchasers of health care services
 - Fully insured versus self-insured
 - Small group versus large group purchases
 - Active versus retiree insureds
 - Long-term and short-term products
 - Medical and non-medical plans
 - Direct insurance providers and reinsurance companies

- Special populations (e.g., Medicaid risk)
- Government-provided benefits
- Designing healthcare and health-related benefit packages
 - Members typically desire low premiums, choice of providers and comprehensive coverage
 - Health insurers need to remain viable
- Involvement with a variety of different products including dental and disability income, long-term care, and employee benefit planning
- Contributing to:
 - Pricing
 - Valuation
 - Cost / benefit analyses
 - Other types of financial analyses
- Measuring claim cost trends and forecasting future trends
- Performing health care calculations (e.g., post-retirement medical plans) is often the remit of the retirement actuary together with the healthcare actuary

Casualty (Also known as P&C or Property and Casualty)

- Risks
 - Financial loss as a result of accident or injury, damage to property as a result of causing damage to another's property, or injury to another
- Financial security programs
 - Include property, auto, liability and workers' compensation (also malpractice and errors and omissions)
- The actuary's contributions
 - Pricing and reserving, akin to life actuaries
 - Performing risk classification
 - Reserving
 - In some lines of business, it can take years for claims to be filed and paid ("incurred but not reported" claims)
 - Need to set aside funds to account for this (a key component of casualty reserving)
 - Loss distributions by size also differ in the P&C area of practice vs. life
 - Reflecting short-term policies vs. life insurance, which is either long-term or where life insurance renewability is guaranteed
 - Most have a one-year term
 - Areas that differ from life insurance include
 - Claims expense are much higher in P&C, particularly when lawyers and experts are required
 - More susceptible to concentration risk (*where when event can generate a lot of claims such as insuring lots of hurricane policies in Florida*)

Understanding Actuarial Practice – Sections 2.6.1 – 2.6.2

Key competencies for actuaries

- Defined as skills, knowledge, abilities, or behavioral characteristics associated with a specific profession
- Actuaries apply technical and enabling competencies

Technical and enabling skills

- Key technical skills for actuaries
 - Applied actuarial analysis
 - Competency in actuarial science is the foundation of the actuarial profession
 - In a changing world, one’s knowledge must be continuously expanded to meet increasingly complex problems
 - General business skills
 - Actuaries have a broad knowledge of business, such as:
 - Accounting
 - Business law
 - Economics
 - Corporate finance
 - Quantitative skills
 - Actuaries have mathematical, analytical, and financial modeling skills
 - An actuary’s quantitative skill set includes:
 - Calculus, linear algebra, and probability
 - Mathematical and applied statistics
 - Financial statistics
 - Contingency, frequency, severity, aggregate loss, and credibility models
 - Parametric and nonparametric models
 - Computer applications, languages, and programming
 - Specialized skills
 - Specialization comes from education, exams, and experience
- Enabling skills
 - Enabling skills are general knowledge, skills, and abilities relevant to all professionals
 - They are nontechnical
 - They are central to an actuary’s success
 - Enabling skills include:
 - Change enablement
 - Actuaries change initiatives and overcome barriers to changes
 - Communication
 - Both oral and written skills
 - Ability to communicate complex issues clearly and accurately
 - Knowledge management and self-development
 - Pursuing opportunities, acquiring knowledge, and sharing knowledge
 - Staying current helps an actuary design effective solutions
 - Leadership
 - Project management
 - Defining and managing assignments and projects consistent with scope

- Central to delivering quality work while managing risks and meeting goals
- Relationship management
 - Effective business relationships cultivate respect and trust
- Teamwork

Blending technical and enabling skills

- It is important for an actuary to stay current
- A combination of technical and enabling skills is often referred to as “business savvy” or “business acumen”
- Continuing education
 - Achieving an actuarial designation is important
 - However, continued training and experience is what qualifies an actuary to practice

The SOA Competency Framework

- The SOA Competency Framework for Actuaries is a tool to help actuaries make decisions related to their professional development
- The tool also includes a self-assessment to identify strengths and opportunities for additional skill development
- There are 8 competencies that make up the framework
 - Competencies shown below were the result of a survey asking actuaries what competencies actuaries will need to develop in the future
 - The eight are provided in no particular order of importance
 - Communication
 - Professional values
 - Adhering to standards of practice and the Code of Conduct
 - External forces and industry knowledge
 - Identifying and incorporating economic, social, and business changes into the design of actuarial solutions
 - Leadership
 - Relationship management and interpersonal collaboration
 - Technical skills and analytical problem solving
 - Strategic insight and integration
 - Anticipating trends and aligning actuarial practice with broader organizational goals
 - Results-oriented solutions
 - Providing effective problem solving

Understanding Actuarial Practice – Sections 3.1, 3.2.1 – 3.2.3

Introduction

- The Control Cycle process is not new
 - Actuaries use it on a regular basis
- Essence of the Control Cycle approach
 - Understand the problem
 - Make a decision
 - Monitor the results
 - Make changes as appropriate
- The goal of the Actuarial Control Cycle is to provide a foundation for doing quality work

Versions and evolution of the Actuarial Control Cycle

- The Actuarial Control Cycle was originated by Jeremy Goford in 1985
 - Goford applied the process in his paper to life insurance profit testing
- The Institute of Actuaries of Australia adopted the Control Cycle concept in their curriculum in the mid-1990s
 - Used to focus on techniques relevant for all practice areas
 - Advantages of this approach:
 - Furnishes an actuarial framework for later subjects
 - Concentrates on principles, approaches, and problem-solving without focusing on legislation and other details that are covered later
 - Builds on the math skills taught in earlier subjects
 - Applicable to a wide range of problems
 - Supplies a broad / flexible syllabus that can be easily updated
 - Creates improved job opportunities
 - The Control Cycle provides students with a generalized approach for addressing a range of problems
 - The Institute defined the Control Cycle as three steps
 - Understand, identify, and specify the problem
 - Develop and implement a solution
 - Monitor response and go back to step one as experience dictates
- In 2001, the SOA began to redesign the exam process
 - An introduction to actuarial practice was not addressed in the curriculum at that time
 - Material was taught in the UK and Australia
 - However, they have a well-developed means to teach the material through the university system
 - Given the US does not, it was decided the Control Cycle would be taught through online education
- As presented in the FAP course, the Control Cycle is defined as:
 - Define the Problem
 - Design the Solution
 - Monitor the Results
 - Like the Australian version, it is surrounded by professionalism and the awareness of external forces
 - However, unlike the Australian version, movement in the US version can go in any direction

- Learning the Control Cycle material will increase the student’s understanding regarding:
 - The role of the actuary
 - Actuarial work
 - Competencies needed to be an actuary
 - Effect of actuarial forces on actuarial work
 - Concepts applicable to common actuarial problems
 - Traditional and nontraditional work
 - Models common to each practice area
 - Selecting assumptions
 - Relationships between each cycle component
- What makes the Actuarial Control Cycle actuarial?
 - The nature of the work at each stage
 - Defining the problem typically involves future cash flows
 - Defining the solution typically involves modeling

Understanding Actuarial Practice – Sections 3.3 – 3.5

An expanded discussion of the Control Cycle

Define the Problem

- One must effectively communicate and document the problem
 - If the problem was already identified, is it right?
 - If faced with identifying the problem oneself, should confirm that it is right
- The communication and documentation must identify both the nature and potential effect of the risks involved
- Before moving on to the next stage, it is imperative that all parties understand the problem and agree that it has been defined appropriately

Design the Solution

- In this stage, it is necessary to constantly consider whether the right problem is being solved
 - Was the problem defined properly?
 - Have all material risks been identified and been made provision for?
 - Are the risks identified material?
- During the design-the-solution stage one must:
 - Communicate the problem with all relevant parties
 - Document one's work
 - Have one's work peer reviewed by other actuaries
- It may be necessary to develop a model upon which tests can be run
 - The model must facilitate the ability to test each of the critical risks
- Model assumptions must be selected carefully
 - Must also be consistent with the material risks identified in the definition of the problem

Monitor the Results

- Monitoring the results distinguishes an actuarial solution from other solutions
 - Actuarial solutions typically extend over long periods of time and have to be continually monitored (*e.g., adequate reserves*)
 - Often beyond the career and/or lifetime of the original problem solver or solution designer
 - This is why excellent documentation and communication is required
 - The monitoring process will often lead to a new problem to be defined

Control Cycle examples

Several examples are provided demonstrating how the Control Cycle works which we recommend you read. Per the instructions in the reading, as you review the problems, think about what might be involved in each stage of the Control Cycle. How would you define the problem? Further, consider the other points raised above.

Some conclusions about actuarial work and the Control Cycle

- Three elements that make actuarial work unique
 - Temporal Congruence
 - A common misconception about actuaries is that they focus almost totally on prospective events

- Solution must be based both on the present to the future (i.e., prospectively) and from the past to the present (i.e., retrospectively)
- Should be able to reconcile the past to the future with the solution
 - If not, it is time to step back and re-evaluate
- A retrospective review is almost always necessary when monitoring the results
- Additivity
 - The pieces to a solution must add up
 - For any given contingency, the probability of it not happening plus the probability of it happening must equal one
- Solubility
 - There is typically no single, correct solution in most actuarial problems
 - There is often an optimal solution
 - A “correct answer” implies an exact result
 - This cannot be done with contingent events
 - An optimal solution implies the result is within a range of acceptability
 - The Control Cycle facilitates the development of an optimal solution

Revisiting professionalism

- Professionalism surrounds the three stages of the control cycle

Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance – Chapter 1 – Why Insurance?

The evolution of insurance

- Insurance facilitates economic growth
 - For example, in ancient times, traders insured goods subject to risk while caravanning
 - Without insurance, many traders may not have been able to afford to put their goods at risk
 - Marine insurance helped develop ancient Greece
 - The World Bank identified casualty insurance as a critical element in emerging economies
- Economic security is the opposite of economic risk (*which the author refers to as just risk*)
- Risk derives from variation from the expected, not from probability
 - E.g., if there is a risk of rain, then what is better meant is that there is a high probability of rain
- Examples of insurance can be seen from long ago
 - E.g., farmers might informally agree to rebuild the barn of the community member if it was destroyed
- The need for a more formal system arose at the time of the industrial revolution
 - Communal expectations changed with urbanization, where one was less likely to know many people in the community
- The pooling concept was then formalized
 - Under insurance, it was no longer necessary to have a connection with any other policyholder

How insurance works

- The insurer of n individuals, through careful underwriting and selection, will end up with an average risk that is relatively smaller compared to the original risk to individual policyholders
 - This result is explained by the law of large numbers, which says:
 - As the number of observations increases, the difference between the observed relative frequency of an event and the true underlying probability tends to zero
 - The difference between observed average severity of an event and the expected severity tends to zero as the number of observations increases
- Accurate prediction of outcomes is much easier with many separate (independent) risks than with only one or two
- The larger the sample size, the smaller the variance of the average claim and the smaller the risk
- Through the insurance mechanism, individuals can transfer their risks to an insurer without having the insurer taking on an unmanageable level of risk in total

Example

- Assume an insurer has n independent policyholders, each with an expected loss of μ and variance of loss of σ^2
- Show that expected value of the insurer's loss per policy is μ and the variance of the average loss per policy is σ^2/n

$$\text{Let } S_n = X_1 + X_x + \cdots + X_n$$

$$\text{Let } \bar{X} = \frac{\sum X_i}{n}$$

$$E(\bar{X}) = \frac{n * \mu}{n} = \mu$$

$$\text{Var}(\bar{X}) = \frac{n * \sigma^2}{n^2} = \frac{\sigma^2}{n}$$

Thus, the risk per policy of the insurer is only $1/n$ the risk of the policyholder.

Notice how the expected average loss is μ . Pooling does not change the average loss. However, pooling does reduce the likelihood of the pool producing an average loss that deviates from what is expected. As n increases, the deviation is expected to decrease. Pooling allows the insurer to better predict what the average loss will be.

Insurance and utility

- Merely entering an insurance contract does not change the individual's expected loss
- Why then would one pay a gross premium?
 - It is because of the principle of decreasing marginal utility of money
 - As extra units of wealth or income are added, the utility derived from such units decreases
 - This applies to anyone who is risk averse

Example

- Member has 100 units of wealth but can suffer a random loss of Y units
- Y has a uniform distribution of 36: $f(y) = \frac{1}{36}$
- The member's utility function is $U(x) = \sqrt{x}$

Notice how the first derivative of the utility function is greater than zero and the second derivative is not. This indicates the member is risk averse: although their utility from money increases as their wealth increases, it does so at a decreasing rate.

Their expected loss is

$$E(y) = \int_0^{36} y * f(y) dy = \int_0^{36} \frac{y}{36} dy = \frac{y^2}{72} \Big|_0^{36} = 18$$

Thus, the insurer must charge more than 18 to cover sales commissions and administrative costs. The member will pay more than 18 because they are risk averse.

They will at most pay a premium such that their expected utility when insured equals their expected utility if not insured.

$$\text{Expected utility if insured} = \sqrt{100 - P}$$

Expected utility if not insured

$$E(U) = \int_0^{36} \sqrt{100 - Y} * \frac{1}{36} dy = \frac{1}{36} * \left[-\frac{2}{3} (100 - Y)^{3/2} \right]_0^{36} = \frac{244}{27} \sim 18.33$$

Therefore, the most the policyholder will pay is $\sqrt{100 - P} = \frac{244}{27}$ or $P = 18.33$. Therefore, the insurer must sell the policy for no more than 18.33 (i.e., if the insurer can earn enough profit after factoring in expenses, or 0.33 load needs to cover both profit and expenses, then insurance will be sold and the individual will purchase the insurance).

Example

You are provided the following table regarding the expected investment returns:

	Probability	Profit Company A	Profit Company B
Economy advances	40%	4,000	2,800
Economy stagnates	60%	200	400

You want to decide in company A or B.

The investor’s utility function is $u(P) = \sqrt{P - 100}$ for $P > 100$

P represents profit. The investor’s expected wealth and utility are provided below:

Expected wealth

$$E(A) = 40\% \times 4,000 + 60\% \times 200 = 1,720$$

$$E(B) = 40\% \times 2,800 + 60\% \times 400 = 1,360$$

Expected utility

$$E(u(a)) = 40\% \times (4,000-100)^{1/2} + 60\% \times (200-100)^{1/2} = 30.98$$

$$E(u(b)) = 40\% \times (2,800-100)^{1/2} + 60\% \times (400-100)^{1/2} = 31.18$$

Even though the expected payoff of company A is larger than that of company B, the investor should invest in company B because it provides a higher expected utility.

Example

An individual faces the following losses:

Loss Size	Probability
\$1,000	0.1%
100	10.0%
0	89.9%

The utility function of the insured is $u(x) = x^{0.6}$

- a) Show that the person is risk averse
- b) Calculate the maximum premium this person will pay if their initial wealth is \$2,000

a) First calculate the first derivative: $u'(x) = 0.6x^{-0.4}$

The first derivative is positive for positive values of x . Therefore, this person receives higher utility from higher wealth.

The second derivative is $u''(x) = -0.24x^{-1.4}$. The second derivative is negative for positive values of x . Therefore, the member's utility increases with wealth but at a decreasing rate.

A positive first derivative combined with a negative second derivative indicates this person is risk averse.

- b) The most this person will pay occurs when the expected utility of purchasing insurance equals the expected utility if insurance is not purchased.

The expected utility if insurance not purchased:

$$E(u) = 0.001(2000 - 1000)^{0.6} + 0.1(2000 - 100)^{0.6} + 0.899(2000)^{0.6} \\ = 95.3128663$$

The expected utility if insurance purchased is $E(u) = (2000 - G)^{0.6}$

Set the two equal and solve for G .

$$(2000 - G)^{0.6} = 95.3128663 \\ G = 2000 - 95.3128663^{1.6667} = 11.19$$

Note, the expected loss = $(.001 * 1,000) + (.1 * 100) = 11$

- The premium is greater than the expected loss
 - This is because the person is risk averse

A risk averse person is willing to pay more than they are expected to lose. If there were no risk averse persons then there would be no viable insurance system. To remain solvent, insurance premiums must cover at least the pool's expected claims. However, insurance companies incur operating expenses, so the premium must contain a load to cover this item as well. Further, the company needs to include an additional load to provide an expected profit to the investors. Investors are not going to risk their capital without being compensated with an expected reward.

Therefore, the insurance company must charge a premium that is greater than the expected claims. Thus, by definition, risk averse persons are needed since the premiums will be greater than their expected loss.

What makes a risk insurable?

- It should be economically feasible
 - It should not cost so much as to be undesirable
- The economic value of the insurance should be calculable
- The loss must be definite
 - This criterion is meant to guard against policyholder manipulation and moral hazard
- The loss must be random in nature
- The exposures in any rate class must be homogeneous
 - The loss expectation for any unit in a class must be the same as for any other unit in the class
 - This criterion might not be satisfied through anti-selection
- Exposure units should be spatially and temporally independent

- The desire is to avoid catastrophic exposure to risk
- The fact that one insured has a claim should not affect whether another insured has a claim

The risk is definitely insurable if these criteria are satisfied.

What insurance is and is not

- The insurance mechanism is used to transfer risk from the individual policyholder to the pooled group of policyholders
- Insurance is not speculation
 - Speculation: An individual can transfer an unwanted risk to a speculator
 - From a policyholder’s perspective, insurance is only available for pure risks
 - Outcome is either a loss or no loss
 - The individual transferring the risk is seeking to lock in a profit
 - For example, consider a futures contract
 - A farmer wants the security of selling a commodity at a certain price at a specified date in the future (*i.e.*, *locking in a profit*)
 - Without the contract, the market rate may be higher or lower than the “would be” contract price
 - The farmer’s profit might be less than or greater than the profit they are locking in
 - The speculator’s motive is the chance to make a profit (*like an insurer*)
 - However, the speculator is still at risk of not making a profit
 - In the example, the market price at delivery might be below the contract price
 - The insurance company is at risk too but that risk is reduced because of pooling
- Key differences between speculation and insurance:
 - There is no profit motive on the part of the policyholder
 - The insurance process significantly reduces total risk through the Law of Large Numbers

Risk, peril, and hazard

- Risk is a measure of possible variation of economic outcomes
- Peril is used as an identifier of a cause of risk (e.g., fire, collision, theft, etc.)
- Hazards are various contributing factors to the peril

Other reasons for the purchase of insurance

- Legal requirements
- Lender requirements
- Commercial requirements
 - In the course of business, one will often obligate oneself to perform a service
 - It is common to purchase insurance to protect from loss if the service is not performed
- Special expertise
 - The insurance company may provide service on a more cost-effective basis than the insured can do on his or her own
- Taxation
 - There may be tax incentives for purchasing insurance