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THE ROLE OF THE ACTUARY IN RISK MANAGEMENT: HOW ACTUARIAL SCIENCE CONTRIBUTES TO THE PRECISE ASSESSMENT OF RISKS AND INSURANCE PREMIUMS

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ABSTRACT

In today's business environment, risk management is becoming increasingly important due to the increased complexity and uncertainty in global financial markets. Actuaries, as experts in mathematics, statistics and finance, have a key role in this process. This paper explores the role of actuaries in the identification, assessment and management of different types of risk. Special emphasis is placed on quantitative methods and techniques that actuaries use to predict future events and their financial consequences. Concrete examples from practice, including insurance companies, pension funds and banks, are analyzed in order to show how actuaries contribute to the stability and security of these institutions. The paper also looks at ways in which actuaries design and implement financial products and insurance policies that reduce risk and increase the resilience of organizations to unforeseen events. Through a detailed analysis, this paper highlights the importance of the actuarial profession in modern risk management, pointing out the necessity of their contribution for the long-term stability and sustainability of financial systems. Research results suggest that actuaries are an indispensable part of the risk management team in all major financial institutions.

KEYWORDS

risk management, actuaries, quantitative methods, financial system

INTRODUCTION

In today's world, risk management is becoming increasingly important due to the increasing complexity of business environments and uncertainty in economic and financial markets. In this context, actuary stands out as a key profession that contributes to the identification, assessment and management of risks. Actuaries, as experts in mathematics, statistics and finance, play a vital role in insurance companies, pension funds, banks, as well as in many other industries that deal with different types of risk.

The actuary's main task is to provide quantitative analyses and models that enable accurate prediction of future events and their possible financial consequences. Through these analyses, actuaries enable

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insurance companies to make informed decisions and develop risk mitigation strategies. In addition, actuaries are often involved in the design and implementation of insurance policies and other financial products that provide risk protection .

Actuaries, with their professional knowledge and quantitative skills, enable insurance companies to correctly assess risks and set insurance premiums that are fair and sustainable. Their role is crucial in ensuring that companies can cover their obligations to policyholders while remaining profitable and competitive in the market.

SWOT ANALYSIS OF THE INFLUENCE OF AQUARIUM IN THE RISK MANAGEMENT PROCESS

A SWOT analysis of the impact of actuaries in the risk management process provides insight into the key strengths, weaknesses, opportunities and threats relevant to the insurance sector.

STRENGTHS:

- Expertise and knowledge - actuaries have a deep knowledge of mathematics, statistics and finance, which enables them to make accurate risk assessments. A high level of education and certification guarantees expertise and professionalism.
- Quantitative methods - use sophisticated quantitative methods and models for forecasting and risk assessment. Ability to analyze large amounts of data and identify trends.
- Objectivity - actuaries provide independent and objective risk assessments, thus minimizing subjectivity in decision-making.
- Flexibility - the ability to adapt models and methods to different industries and types of risk. Quick response to changes in market conditions and regulations.

WEAKNESSES:

- Complexity of methods - complex methods and models can be difficult for management and other stakeholders to understand. They require significant resources for data collection and analysis.
- Dependence on historical data - risk assessments often rely on historical data, which can be problematic in case of changes in market conditions or emergence of new risks.
- High costs - hiring and training actuaries can be expensive for smaller organizations. Implementing complex actuarial models can increase operating costs.

OPPORTUNITIES:

- Technological advances - the development of new technologies, such as machine learning and artificial intelligence, can improve risk analysis processes. Automation and digitization can improve the efficiency and accuracy of assessments.
- Growing Needs for Risk Management - Increased regulation and complexity of financial markets increase the need for risk management professionals. New markets and products provide opportunities to expand the actuary's role.



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- Globalization - increased global connectivity and international business creates a need for comprehensive risk assessments.

THREATS:

- Regulatory challenges - changes in regulatory frameworks can make actuaries' work more difficult or limited. Increased requirements for transparency and reporting.
- Competition - increased competition from other risk management professionals such as financial analysts and consultants. Technology companies developing risk analysis tools can reduce the need for traditional actuarial skills.
- External shocks - unexpected events, such as financial crises or natural disasters, can significantly change risk profiles and make accurate assessments difficult.

Actuaries play a key role in the risk management process, using their professional skills and quantitative methods to make accurate assessments. Although they face challenges such as the complexity of the methods and the dependence on historical data, the opportunities provided by technological progress and the growing need for risk management open new opportunities for their development and improvement. However, threats such as regulatory challenges and competition require continuous adaptation and innovation for actuaries to remain relevant and effective in their work.

ACTUARIAL SCIENCE AND ITS PRINCIPLES

Actuarial science is a multidisciplinary field that combines mathematics, statistics, economics and finance to analyze and manage risks in various industries, most commonly in insurance and pension funds. Actuaries use their skills to develop models to estimate the likelihood and financial consequences of future events, enabling informed decision-making and risk management strategies.

Main principles of actuarial science (McNeil, Frey, Embrechts, 2005):

- Principle of data collection and analysis - actuaries collect large amounts of data from various sources, including historical data on losses, claims, demographic data and economic indicators. Using statistical methods and software tools, actuaries analyze collected data to identify patterns, trends and key risk factors.
- The principle of risk quantification - risk modeling includes the development of mathematical and statistical models for estimating the probability of occurrence of certain events and their financial consequences. Probability and severity assessment includes risk quantification by determining the probability and expected costs of potential events, which enables accurate determination of insurance premiums and provisions.
- The principle of actuarial value - discounting of future obligations includes the use of discount rates to calculate the present value of future obligations, taking into account the time value of money. Actuaries determine the required reserves that an insurance company should have in order to meet future obligations to policyholders.
- Principle of proportionality and adequacy - fair distribution of premiums actuaries ensure that the premiums charged to policyholders are proportional to the risk that each policyholder represents. Premiums must be sufficient to cover expected losses, administrative costs and ensure the profitability of the insurance company.



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- Principle of uncertainty and conservatism - actuaries take uncertainty into account in their estimates and models, using conservative assumptions to ensure the stability and safety of financial institutions. Using stress tests and scenario analysis to assess the resilience of insurance companies to extreme events and adverse conditions.
- Principle of continuous monitoring and adjustment - actuaries continuously monitor business results and deviations from planned values, adjusting models and strategies as needed. Constant improvement of methods and tools, as well as adaptation to new regulations, market conditions and technological innovations.

Actuarial science also relies on a number of mathematical and statistical tools that enable risk assessment and premium formation. The basic principles include:

- Probability theory - used to estimate the probability of various events, such as death, illness, accidents and other insured events.
- Statistical Models - Actuaries use models such as regression analysis, time series, and stochastic processes to analyze data and predict future events. For example, regression analysis can help understand how various factors (eg age, health, lifestyle) affect the probability of a certain insured event occurring. (Klugman, Panjer, Willmott, 2008)
- Financial mathematics - used to estimate the value of future liabilities and income, including discounting cash flows and estimating reserves for claims payments. (Promislow, 2010)

Actuarial science is based on rigorous quantitative methods and principles that enable accurate risk assessment and management. The application of these principles ensures the stability and security of financial institutions, enabling them to effectively manage risks and fulfill their obligations to policyholders and clients. Actuaries, as key professionals in this process, use their skills and knowledge to contribute to the long-term sustainability and profitability of the organizations in which they work.

RISK ASSESSMENT IS THE KEY TASK OF THE ACTUARY

Risk assessment is a fundamental task of actuaries and a key component in the insurance industry, financial institutions and many other sectors that face uncertainty. Stages of risk assessment (Wang, Venter, Bovbjerg, 2007):

- Risk identification - Actuaries collect and analyze relevant data, including historical losses, demographics, economic indicators and specific client or portfolio information. Identification of external factors that may affect risk, such as economic conditions, regulatory changes and market trends.
- Risk quantification - the development of mathematical and statistical models for estimating the probability of the occurrence of certain events and their financial consequences is used for process modeling. These models may include regression analyses, Monte Carlo simulations, and actuarial tables. Actuaries determine the probability and expected costs of potential events, taking into account different scenarios and possible outcomes.
- Risk evaluation - actuaries analyze model results to understand the overall risk of a portfolio or specific products. This includes assessing how different factors affect risk and identifying key risk drivers. Examining the portfolio's resistance to extreme events and adverse conditions through stress tests and analysis of different scenarios.



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- Development of risk management strategies - based on risk assessment, actuaries provide recommendations to reduce or control risk, which may include changes in premiums, insurance terms, reinsurance or other strategies. Adjusting the portfolio structure to optimize the balance between risk and return.
- Continuous monitoring and adjustment - continuous monitoring of actual results against estimates and adjustment of models and strategies as needed. Regular review and updating of actuarial models to remain relevant in light of new data and changes in the environment.

Risk assessment is a central actuary task that enables organizations to effectively manage uncertainty and minimize potential losses. Through the systematic identification, quantification and evaluation of risks, actuaries provide key insights and strategies that ensure the stability and profitability of financial institutions. Their role is indispensable in creating sustainable and more resilient systems, which can successfully respond to the challenges of the modern business environment.

PRECISE ESTIMATION OF PREMIUMS

Premium setting is the process in which actuaries use their risk assessments to determine adequate insurance premiums. This includes:

- Use of actuarial tables - actuaries use mortality, morbidity and other actuarial tables that provide statistical data on the probability of various events. For example, mortality tables show the probability of death for different age groups, which is a key piece of information for setting life insurance premiums.
- Formation of premiums - actuaries use mathematical models to calculate premiums that will cover the expected costs of paying claims and administrative costs, while ensuring a profit for the insurance company. For example, using an expected value model, actuaries can calculate the required premium to cover a risk taking into account the probability and severity of potential claims (Bowers, Gerber, Hickman, Jones, Nesbitt, 1997).
- Balancing risk and profitability - insurance companies must balance between the need for risk coverage and profit making. Actuaries play a key role in this process, ensuring that premiums are high enough to cover risks but also competitive in the market (Cairns, 2000).

Premium formation is a complex process that requires a deep understanding of risk and the ability to quantify the likelihood and severity of future claims. Actuaries play a key role in this process. This process ensures the financial stability and sustainability of insurance companies, enabling them to effectively manage risks and fulfill their obligations to policyholders.

THE ROLE OF THE ACTUARY IN REINSURANCE

Reinsurance is a key risk management tool in insurance companies, and actuaries play an important role in assessing the need for reinsurance. Reinsurance allows insurers to transfer part of their risks to reinsurers, thereby reducing their exposure to large claims. The actuary's role includes (Solvency II Directive, 2019):



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- Assessing the need for reinsurance - actuaries analyze the portfolios of insurance companies to identify risks that may be too large for a single company. For example, in the case of natural disasters, such as earthquakes or hurricanes, reinsurance may be necessary to reduce financial risk.
- Selection of reinsurance partners - actuaries use their professional analysis to help insurance companies in the selection of reinsurance partners. This includes an analysis of the financial stability of reinsurers, their conditions and reinsurance prices.
- Negotiation and formation of reinsurance contracts - actuaries play a key role in the negotiation and formation of reinsurance contracts, ensuring that the terms are favorable for the insurance company. This includes defining coverage limits, premiums and other contract terms.

Actuaries play an essential role in the reinsurance process, using their professional skills to assess risk, determine the structure of reinsurance, negotiate terms, monitor performance and manage capital. Their contribution enables insurance companies to effectively manage risks, improve financial stability and ensure long-term business viability. The actuary's role in reinsurance is essential for making informed decisions that optimize risk protection and support the business goals of insurance companies.

APPLICATION OF TECHNOLOGY IN THE ACTUARY

Technology is playing an increasingly important role in actuarial practice, enabling faster and more accurate data analysis. Actuaries use sophisticated software tools and platforms to analyze large amounts of data and model risk. Some of the key technologies include:

- Software tools and platforms - actuaries use software tools such as R, Python, and specialized actuarial software for data analysis and risk modeling. These tools allow actuaries to process large amounts of data faster and more accurately (Biffis, Millosovich, 2006).
- Analysis of big data (Big Data) - the use of big data allows actuaries to use huge amounts of data for more accurate risk assessments. For example, analyzing data from social networks, mobile devices and other sources can provide new insights into policyholder behavior and potential risks (Elling, Schmeiser, 2010).
- Artificial intelligence and machine learning - the application of artificial intelligence and machine learning enables advanced methods for data analysis and risk modelling. These technologies can improve forecasting accuracy and enable actuaries to identify new patterns and trends in data.
- Blockchain - enables secure and transparent exchange of data between different stakeholders, reducing the risk of fraud and increasing trust. Using smart contracts on the blockchain to automate insurance and reinsurance processes, including automatic fulfilment of contractual obligations when certain conditions are met.
- Cloud computing - cloud platforms enable the scalability of actuarial analyses, enabling access to large resources for data collection and processing without the need for significant investments in infrastructure. They enable collaboration between actuarial teams in different locations through real-time sharing of data and models (IFRS 17, 2017).



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- Internet of Things (IoT) - real-time data collection. IoT devices enable real-time data collection, which allows actuaries to better understand current risks and adjust their models accordingly. Using data collected through IoT devices to develop preventive measures that can reduce the likelihood and severity of damages.

Applying technologies in actuarial practice brings significant benefits, including greater precision in risk assessment, more efficient data processing and automation of routine tasks. Actuaries using these technologies can make better informed decisions, develop more advanced models and improve the overall efficiency of the risk management process. Technological innovations continue to transform actuarial practice, providing new tools and opportunities to advance this vital profession.

CHALLENGES AND FUTURE OF THE ACTUARIAL PROFESSION

The actuarial profession faces numerous challenges, including changes in the regulatory environment and the evolution of risk. Some of the key challenges include:

- Changes in the regulatory environment - new laws and regulations can significantly affect the way actuaries assess risks and form premiums. For example, the Solvency II directive in the European Union sets new requirements for risk and capital management in insurance companies (Elling, Schmeiser, 2010).
- Development of skills and education - the future of the actuarial profession depends on the development of new skills and educational programs that will enable actuaries to remain relevant in an increasingly complex world of risk. This includes constant training in new technologies, regulation and risk management.
- Quantitative risks and uncertainty - the emergence of new risks, such as climate change, pandemics and cyber attacks, is challenging traditional risk assessment models. Actuaries must develop new approaches to quantifying and managing these risks. Complex financial products and markets require advanced models and analyses, which can be challenging and require constant improvement of techniques and tools (Anderson, Brown, 2005).
- Global perspective and collaboration - globalization and international regulation will require actuaries to develop a global perspective and collaborate with colleagues around the world to share knowledge and best practices. Actuaries will expand their roles beyond the traditional insurance and pension sectors, entering areas such as health economics, the energy sector and risk management in government institutions.

EXAMPLES OF APPLICATION OF ACTUARIAL PRACTICE IN INSURANCE COMPANIES IN SERBIA

Actuarial practice in insurance companies in Serbia includes a wide range of activities that are key to risk assessment, premium formation, reserve management, and reinsurance. Here are some concrete examples of the application of actuarial practice in Serbia:



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Formation of premiums in life insurance - insurance companies in Serbia, such as Dunav osiguranje and Generali osiguranje, use actuarial methods for formation of premiums in life insurance. Actuaries analyze mortality and morbidity data, using domestic and international mortality tables, to accurately determine risk-appropriate premiums. For example, to determine premiums for life insurance with a savings component, actuaries take into account factors such as age, gender, health and length of insurance period.

Risk assessment in property insurance - insurance companies such as Wiener Städtische and Triglav osiguranje use actuarial analyzes to assess risk in property insurance. This includes analyzing historical data on damages caused by natural disasters, such as floods and earthquakes. Actuaries develop models that predict the frequency and severity of these events, allowing companies to set premiums that cover potential losses. For example, after the floods that hit Serbia in 2014, actuaries had to reevaluate risks and adjust premiums for flood insurance.

Management of reserves for claims - all insurance companies in Serbia must maintain adequate reserves for the payment of future claims. Actuaries play a key role in this process, estimating the amount to be set aside for reserves. For example, Uniqa Insurance uses actuarial models to estimate claims reserves based on historical data on reported claims, average claims processing time and trends in claims payouts.

Reinsurance is an important tool for risk management, and actuaries help insurance companies in Serbia decide when and how to use reinsurance. For example, Dunav osiguranje uses reinsurance to cover large risks such as industrial facilities and infrastructure projects. Actuaries assess potential losses and negotiate reinsurance terms with international reinsurers.

Risk assessment in health insurance - in insurance companies such as Sava Insurance, actuaries assess risks in health insurance. By analyzing data on the frequency and cost of medical treatments, actuaries form premiums for various health policies. For example, when forming premiums for supplementary health insurance, actuaries take into account factors such as the insured's age, existing health problems and expected treatment costs.

Risk assessment in motor vehicle insurance - insurance companies such as DDOR Novi Sad and Generali use actuarial methods to assess risk and form premiums in motor vehicle insurance. Actuaries analyze data on the frequency and severity of traffic accidents, as well as driver characteristics (e.g. age, experience, claims history) to determine premiums that adequately cover the risks. For example, young drivers with less experience often pay higher premiums due to their higher risk of accidents.

Analysis of market trends and competition - actuaries in insurance companies in Serbia often analyze market trends and competition in order to adjust their products and premiums. For example, after the introduction of new legal regulations or changes in the economic environment, actuaries assess how these changes affect the insurance market and adjust the strategies of insurance companies accordingly.

These examples show how actuarial practice plays a key role in insurance companies in Serbia, enabling precise risk management and formation of premiums that are in line with real risks and market needs.

CONCLUSION

The actuary's role in the risk management process is essential for the stability and sustainability of financial institutions and insurance companies. Actuaries, with their deep knowledge of mathematics, statistics and finance, provide key quantitative analyzes that enable the precise identification, assessment and management of different types of risk. Through processes such as premium formation, reinsurance



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and continuous performance monitoring, actuaries enable insurance companies to optimize their risk reduction strategies, improve resource allocation and ensure long-term profitability. Their analyses and recommendations based on rigorous methods and models provide the foundation for making informed decisions that minimize uncertainty and maximize certainty.

Although they face challenges such as technological change, regulatory changes and the emergence of new risks, actuaries demonstrate a remarkable ability to adapt and innovate. The integration of advanced technologies, such as artificial intelligence and machine learning, allows actuaries to improve their methods and models, improving the accuracy and efficiency of their valuations. In the future, the role of the actuary is expected to become even more important as the world faces increasingly complex and dynamic risks. Their ability to provide quantitative insights and develop risk management strategies will be essential for financial stability and security. Through continuing education and professional development, actuaries will continue to play a key role in protecting policyholders' interests and strengthening trust in financial institutions.

In conclusion, the actuarial profession is a pillar of the modern economy, enabling organizations to effectively manage risks and achieve sustainable growth. Their contribution is not only technical but also strategic, providing invaluable value in the decision-making process and creating more resilient financial systems.

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