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Identification and prioritization of factors influencing the purchase of insurance portfolios with AHP approach

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Abstract The main objective of this research is to identify and prioritize the factors influencing the purchase of insurance portfolios using the AHP approach. The research is applied and descriptive in nature, and the data were collected in Excel tables and are quantitative. The data used in this study were obtained from the Cooperative Insurance Company, related to the purchases of 33,671 customers. The nature of this research is data-driven, and the main basis of the research is to discover knowledge from the database of the Cooperative Insurance Company. In this study, transactions related to Cooperative Insurance customers were examined. After identifying the factors influencing the purchase of insurance portfolios, these factors were validated by 15 experts using the Delphi technique and then prioritized using Expert Choice software. The findings indicated that delay, frequency, monetary value, and customer relationship length are effective in examining the behavior of policyholders. It was determined that the criterion of monetary value, with a score of (0.473), holds the highest importance according to experts in weighting, ranking first, followed by frequency with a score of (0.216), delay with a score of (0.169), and customer relationship length with a score of (0.142) in fourth place.

Keyword: Purchase Model, Policyholders, Insurance Portfolios, Cooperative Insurance.

1 Introduction

Insurance companies annually seek to enhance their financial credibility and provide better services to the public and policyholders through deposits [1]. Insurance plays a crucial role in managing companies, intermediary institutions, debt management, and vulnerability due to stock price changes. By committing to pay damages, insurance stabilizes the financial position of the policyholder, thereby indirectly enhancing their credibility with their trading partners. Thus, insurance facilitates investment by providing assurance and reducing the risks threatening investments [2]. Most studies in the field of portfolio optimization, including

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optimal portfolios, focus on maximizing returns or performance. The main weakness of these methods is their lack of attention to cash flow requirements in modeling. In the insurance industry, the primary philosophy of investment focuses not only on returns but also on cash flows, which conventional models cannot adequately address. Conventional portfolio optimization methods primarily consider a single investment period, which is not practically compatible with real-world decisions. This approach is suitable for investments in companies and investment funds whose main goal is long-term wealth increase; however, it is ineffective in other financial activities, including insurance, as investments in insurance are debt-based [3].

The insurance business consists of two essential components: Pricing, selling, and collecting premiums, as well as managing and investing premiums. However, unlike manufacturing and banking businesses, the cost of services sold in the insurance industry is uncertain. This means that insurance companies price their products based on actuarial estimates, and the actual price can only be assessed after sales and the occurrence of incidents. In this context, life insurance, which has a duration of 5 to 30 years, faces higher uncertainty in investments, and the impact of investment factors in actuarial calculations in this group of insurances is significantly greater than in property and liability insurance [4]. Based on the aforementioned points, one of the fundamental issues in investing in the insurance industry is achieving an appropriate return compared to guaranteed returns. Additionally, the primary goal of insurance company management is to achieve suitable returns for shareholders [5]. One of the main objectives in defining the objective function in insurance companies is to have the necessary liquidity to fulfill commitments. This issue also affects customer satisfaction and marketing in insurance companies. However, investing in highly liquid assets reduces the expected return while eliminating the risk of delays or failures in fulfilling commitments [6]. Therefore, to optimize the investment portfolio of insurance companies, an asset-liability management framework should be utilized [7].

A fundamental problem in insurance is the investment of policyholders based on their available income. The investment strategies of insurance consumers are chosen based solely on past information about risky assets without utilizing information from the processes of insurance agents [8, 9]. The goal of predicting and providing relevant insurance products and services to customers is to offer equal returns and investments for individuals in their portfolios. This can be done for both primary and potential customers. Customers are continuously changing their methods of selecting insurance purchases, and it cannot be assumed that they will always communicate with insurance representatives and experts for this purpose. The varying levels of knowledge among insurance agents regarding different products can affect the customer experience in selection. Information related to the current insurance portfolio of customers can be used to predict new, more complete products and services or better selections for customers. For new customers, reliance can be placed on external data and recently collected data to predict a new set of products and services for customer portfolios [10]. The diversity of various products and services in the insurance industry presents policyholders with numerous challenges and issues in selecting the optimal type of investment. Another issue in Iran is that many policyholders perceive insurance payments as costs rather than viewing them as desirable investments. Therefore, providing an optimal model of the investment portfolio and presenting it to policyholders and insurance industry managers may resolve many of the issues raised in this regard. Thus, the main issue of the present research is to design an optimal purchasing model for policyholders in the insurance industry using artificial intelligence, and the main question is posed as follows: How is the purchasing model of insurance portfolios based on data mining using association

rules? Consequently, this article is structured in several main sections, with the introduction presented in the first section, followed by a review of the theoretical literature of the research. The research methodology will then be examined. In the findings section, the stages and steps of the analysis will be described. Finally, the discussion and conclusion will be presented.

2 Literature Review

Investments are assets held to earn profit and involve a two-dimensional process of risk and return. Investors maintain various types of assets with different risks and returns to reduce risk and increase return. The appropriate combination of stocks or other assets chosen by an investor is referred to as an investment portfolio. The goal of selecting a portfolio is to diversify investments and have various assets in one investment portfolio, such that the return or value of the portfolio is maximized while its risk is minimized [8, 9]. Insurance also plays an important role as a significant source of financing and investment in the economy of a country. Thus, investing from capital and technical reserves is one of the important responsibilities of insurance companies. Investment enables insurance companies to cover potential losses and earn significant profits. Beyond its primary function of providing and compensating for damages, the insurance industry can serve as a source of financing and investment, playing a crucial role in the economy. In these institutions, the selection of investment plans is of great importance, as investment decision-making is subject to complex factors [8, 9].

In today's dynamic and competitive environment, the success of any organization in increasing and maintaining market share and improving competitive status depends on identifying the factors that create competitive advantage. Achieving competitive capabilities has become one of the main challenges for various industries today [11]. Over the past few years, the insurance industry (globally) has undergone a series of changes due to financial reforms, advancements in information and communication technology, globalization of financial services, and economic development. These changes have had a significant impact on efficiency, productivity changes, market structure, and the performance of the insurance industry. It is expected that the implementation of liberalization policies, privatization, and the increase in the number of insurance companies will enhance efficiency, increase the competitive power of economic enterprises, and ultimately lead to economic well-being for the general public through increased economic efficiency and sustainable economic growth. In such circumstances, competition among insurance companies to provide services to customers has intensified, and these companies need to reduce their costs and improve the quality of their services to retain and attract customers. The insurance industry is among those that have not remained indifferent to this matter. Insurance companies are increasingly expanding their agencies to gain a larger share of the target market. Therefore, the capability level of agencies is very decisive in profitability. Insurance management has paid special attention to investing in various resources to enhance this industry [12]. Due to the potential ability of the insurance industry to create suitable conditions for investments, it is of great importance in protecting the rights of policyholders and achieving economic growth and development in the country. Currently, insurance companies are in a competitive and complex situation due to market globalization, customer orientation, the introduction of new technologies, and so on [13]. On the other hand, the pressures arising from globalization, the communication revolution, and information technology, the rising level of customer expectations, and changes in their behavioral patterns when facing insurance companies, as

well as the increase in the number of competitors today, have made the concept of competitiveness and the pursuit of competitive advantage a necessary and vital issue for insurance companies. Therefore, insurance companies must find ways to adopt distinct strategies compared to others for providing services and investments to customers and gaining competitive advantage. The following discusses the background of research conducted in this area and the techniques used in related studies.

3 Research Methodology

This research is categorized as applied research based on its objectives and as descriptive research based on the data collection method. The data for this study are presented in Excel tables and are quantitative. The data used in this research were obtained from the Cooperative Insurance Company, related to the purchases of 33,671 customers. The research method employed is applied in terms of purpose, field-based in terms of data collection method, and descriptive-survey in terms of the level of control over variables. Additionally, due to the provision of a model, it is exploratory research. In this study, the purchased insurance assets by policyholders in the insurance industry will first be identified through a review of previous studies. In the second step, using the Delphi method and the opinions of experts in the field, the determination and weighting of insurance assets in the portfolios of policyholders will be conducted. The Delphi method aims to achieve a general consensus among specialists. When applied to multidimensional, multi-objective topics and complex decision-making issues, the repeated time-consuming process of questioning and answering to reach a relative consensus is considered a significant challenge. The Delphi method was developed in the 1980s by Kaufman and Gupta to overcome existing deficiencies. This method's feature is providing a flexible framework that addresses many obstacles related to the lack of precision and clarity. Subsequently, based on the available documentation and collected information, an appropriate model for purchasing insurance portfolios in the insurance industry will be designed using artificial neural networks.

4 Findings

The importance coefficient and prioritization of these indicators are not the same across different industries and companies. Some indicators have greater or lesser precedence over others. In this regard, various methods such as the entropy method, eigenvector method, SMART method, and Analytic Hierarchy Process (AHP) are available to determine the weights of indicators. The most common method for calculating the weights of the LRFM model criteria is the AHP technique. The AHP method is a powerful technique and a flexible multi-criteria tool for decision-making in complex issues, considering both qualitative and quantitative concepts. At this stage, the problem is analyzed and broken down into several simpler parts. After identifying the options and indicators, pairwise comparisons are conducted among the indicators. In the next step, pairwise comparisons are made between the options for each indicator. We then follow the algorithm below:

Normalize the pairwise comparison matrix.

Obtain the arithmetic mean of each row of the normalized pairwise comparison matrix (referred to as relative weights.

Multiply the relative weights of the indicators by the arithmetic mean of the options.

Rank the options.

After this stage, we proceed to "measure the consistency ratio." To do this, the following steps are taken:

1. Calculate the Weighted Sum Vector (WSV): Multiply the pairwise comparison matrix (D) by the vector of relative weights. The resulting vector is referred to as the "Weighted Sum Vector".

WSV=D×W

2. Calculate the Consistency Vector (CV): Divide the elements of the Weighted Sum Vector by the relative weights vector. The resulting vector is referred to as the "Consistency Vector".

3. Calculate the maximum eigenvalue of the pairwise comparison matrix: The average of the elements of the Consistency Vector is calculated to determine the maximum eigenvalue.

4. Calculate the Inconsistency Index (II): The inconsistency index is calculated as follows

$$II = \frac{\lambda_{max} - n}{n - 1}$$

5. Calculate the Inconsistency Ratio (IR): This is done as follows:

$$IR = \frac{II}{IRI}$$

Here, IRI (Random Inconsistency Index) is a value extracted from the corresponding table. The random inconsistency index table is derived from simulations and is presented as follows:

Table 1 Random inconsistency index table

n	1	2	3	4	5	6	7	8	9	10
IRI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

If the inconsistency ratio is less than or equal to 0.1 ($IR \leq 0.1$), there is consistency in the pairwise comparisons, and the work can continue. Otherwise, the decision-maker must reconsider the pairwise comparisons. It is worth noting that a scale from 1 to 9 is used to fill in the pairwise comparisons to specify the relative importance of each element concerning other elements regarding that characteristic. The following table shows the scale for conducting pairwise comparisons.

Considering that in this research, the opinions of 15 experts were used for judgment, before calculating the geometric mean for the judgments of all experts and aggregating opinions, one of the questionnaires was randomly selected, and all analyses were conducted individually for the respective expert. The purpose of this analysis is to examine the validity of the opinions provided by the respective expert. Initially, the judgments related to one of the experts are presented individually. This is done by first determining the degree of importance of the four indicators of the LRFM model, namely delay, frequency, monetary value, and customer relationship length, for examining policyholder behavior. These indicators are entered into the software, and then the relative importance of each of these indicators is determined.

Fig. 1 Pairwise comparison matrix for the four indicators of the model according to one expert's opinion

Fig. 2 Relative importance of the four indicators of the model according to one expert's opinion

As shown in Figure 1, the monetary value criterion, with a score of (0.428), holds the highest importance according to one expert's weighting, ranking first. Following this, frequency ranks second with a score of (0.233), delay ranks third with a score of (0.175), and customer relationship length ranks fourth with a score of (0.164). Furthermore, to verify the accuracy of the expert's judgment, the inconsistency ratio is calculated; this ratio must be less than 0.1 for the pairwise comparisons of the criteria. Since the obtained inconsistency ratio is (0.03), it indicates the correctness of the expert's judgments. In Figure 3, the final output of the Expert Choice software for prioritizing the main criteria of the model is presented, with all weights displayed on the tree structure.

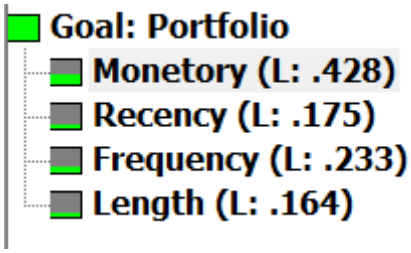

Fig. 3 Results of the relative importance of the four indicators of the model according to one expert's opinion

To evaluate the judgments of all experts, the geometric mean was calculated from the responses provided in the questionnaire. Therefore, all judgments were combined using Excel software to obtain a unified response regarding the overall weights of all criteria and sub-criteria. The software calculated the geometric mean of all judgments, and the overall results are presented below. Initially, as shown in Figure 4, the aggregation of expert judgments regarding the determination of the importance degree of the four indicators of the LRFM model—namely delay, frequency, monetary value, and customer relationship length—was entered into the software to analyze the behavior of the insurer.

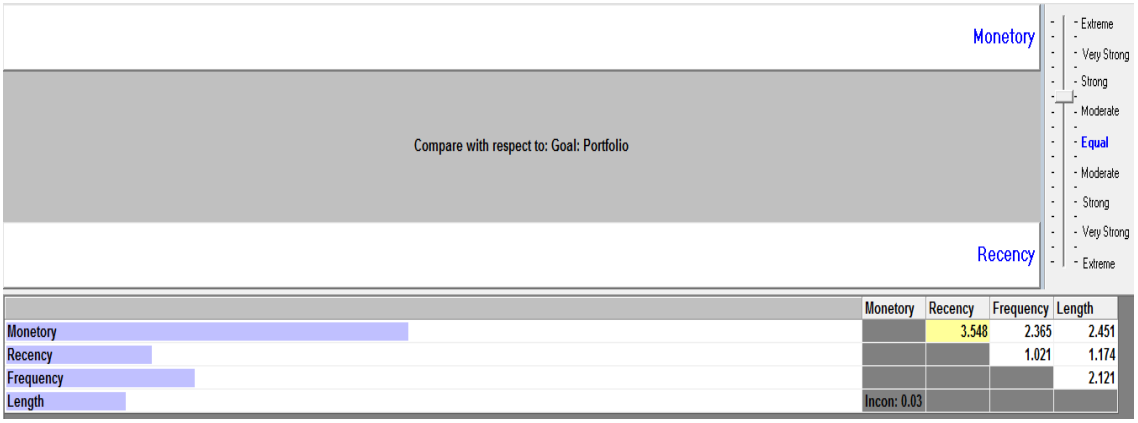

Fig. 4 Pairwise comparison matrix for the four indicators of the model according to the aggregated judgments of experts

Fig. 5 Relative importance of the four indicators of the model according to the aggregated judgments of experts

5 Discussion and Conclusion

Insurance plays a vital role in reducing risk and providing financial and mental security in today's civilized world. The insurance industry is a key sector in the financial institutions domain, and its penetration rate is one of the indicators of economic development in any society. Insurance is a useful tool for risk management, ensuring peace and comfort for individuals in society. The insurance sector holds a unique position as a factor for development in any country. The financial resources collected have specific goals and can be preserved for a defined period to achieve their real objectives. Given that these resources are collected from the impact of regular cash flow, insurance is among the most important tools designed to prepare for threats. Undoubtedly, insurance is one of the greatest achievements of developed human life that has proven its effectiveness in many ways. The insurance industry, as one of the most important providers of long-term financial resources and due to its risk distribution role, can play a significant role in developing the business environment of any country. Every business faces risks that may impose significant costs on it. The insurance industry can help stabilize businesses through risk coverage. Insurance companies are among the most important service companies in any country and play a significant role in the economy. Therefore, increasing market share by insurance companies is vital for the country's economy. However, weaknesses in providing insurance services in recent years have led to a recurring decrease in customer satisfaction and loyalty, as well as an increase in customer complaints. Customers facing service weaknesses have resulted in losing clients who have exceeded the average dissatisfaction threshold, which has harmed the performance of insurance companies in the market.

In recent years, with the increase in the number of private insurance companies, competition within the insurance industry has significantly intensified. Despite the advertising expenses incurred for growing market share by insurance companies, many of them have been unsuccessful in this regard. Weaknesses in providing insurance services in recent years have led to a recurring decrease in customer satisfaction and loyalty, as well as an increase in customer complaints. Customers facing service weaknesses have resulted in losing clients who have exceeded the average dissatisfaction threshold, which has harmed the performance of insurance companies in the market. High premium collection, lack of public awareness regarding the functions of insurance, insufficient coverage provided by insurance companies, imposing one-sided conditions, and offering traditional insurance to the public, as well as cumbersome regulations requiring adherence to fixed rates and avoiding discounts based on the decisions of the Supreme Insurance Council, are among the challenges that have led to a decrease in insurance sales. Although the insurance industry in Iran has experienced considerable growth over the past decade, it has not yet adequately addressed the primary needs of its customers.

The insurance industry, with its extensive human resources and a wide network of branches, agencies, and other insurance entities, can play a significant role in the economic development of the country. This industry is one of the sub-sectors of the financial market that has extensive side effects in other markets and must ensure the health and survival of economic movements. Services are among the rapidly growing sectors in developing countries; however, less attention is paid to service-related issues in these countries. In fact, due to the dominance of seller market conditions in the developing economy, studies related to the service sector have been neglected. Although the insurance industry in Iran has experienced considerable growth over the past decade, it has not adequately addressed the primary needs of its customers, and with the increase in the number of insurance companies,

competition among them has significantly intensified, leading to consequences such as decreased sales and market share.

Therefore, two roles can be considered for the insurance industry in developing the business environment. The insurance industry plays a very important role in creating the secure environment needed; however, fulfilling this role appropriately requires further development of the insurance industry and an increasing number of policyholders. On the other hand, one of the main factors influencing the decision to purchase insurance policies is their price (premium). Therefore, determining an appropriate premium that attracts a significant number of customers is the most important issue in insurance markets while justifying the economic activity of the insurance company. In a situation where there is perfect competition among existing insurance companies in the market, demanding premiums above the equilibrium level leads to the loss of customers for a particular insurance company. Conversely, if the insurance company sets its premiums below the equilibrium level, it will incur losses in the early stages of operation and exit the market. Therefore, efforts to calculate an appropriate premium should be at the forefront of the objectives of insurance company officials. One of the key issues related to determining an appropriate premium is how the selection theory operates in insurance markets. If adverse selection exists in the insurance market, the insurance company must set its premiums at a level higher than the average expected loss of the community because, in this case, only high-risk individuals are inclined to purchase insurance services, and the expected loss facing the company will be higher than the average expected loss of the community. However, if advantageous selection prevails in the market, a lower premium should be set compared to the previous situation because, in this case, low-risk individuals are also interested in purchasing insurance services. Thus, understanding the type of selection theory in the insurance market plays a vital role in determining premiums. Cluster three has the highest customer lifetime value and received rank one. This group of policyholders has the highest values of delay, frequency, customer relationship length, and monetary volume of insurance policy purchases or renewals, making them the most valuable policyholders for the company in terms of customer lifetime value. Since the frequency, customer relationship length, and monetary volume of insurance policy purchases or renewals are very favorable for these policyholders, their delay is higher than the two other clusters, resulting in a greater risk of disengagement or higher risk due to the significant gap since their last renewal or purchase of an insurance policy.

Policyholders in cluster two, who ranked second, have higher values of delay, frequency, customer relationship length, and monetary volume than cluster one but lower than cluster three. Cluster one has the lowest customer lifetime value and, consequently, received rank three. This group of policyholders has the lowest values of delay, frequency, customer relationship length, and monetary volume.

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