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Multi-Attribute Decision-Making Methods in Optimizing the Reinsurance Structure for Life Insurance Financing Products: A Case Study of PT Asuransi Jiwa Syariah XYZ

Anindito Dwi Apriano*, Lenny Suardi
Universitas Indonesia, Indonesia
Email: anindito.dwi@ui.ac.id*, lennys@ui.ac.id

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ABSTRACT
Reinsurance structure plays a critical role in balancing risk exposure, financial stability, and profitability in life insurance companies, particularly for portfolios characterized by substantial claim variability and extreme losses. This study aims to determine the optimal combination of quota-share (QS) and excess-of-loss (XL) reinsurance parameters for financing life insurance products at PT Asuransi Jiwa Syariah XYZ. A quantitative case study approach was employed using historical company data, including policies, claims, reinsurance claims, premiums, and reinsurance premiums. Claim distributions were modeled to accommodate the characteristics of both body and tail losses. A total of 1,000 QS–XL alternatives were evaluated using four performance indicators: ruin probability, profit, variance of retained risk, and expected utility. The Complex Proportional Assessment (COPRAS) method was subsequently applied to rank the alternatives according to predetermined company preference weights. The results demonstrate a trade-off between risk retention and profitability, indicating that higher retention may increase profit while simultaneously increasing claim volatility and risk exposure. The COPRAS assessment identified the optimal structure at a quota-share retention proportion of 84.44% and an excess-of-loss retention limit of IDR 105,555,556. This study concludes that the COPRAS-based multi-attribute decision-making framework provides an objective and quantitative approach for selecting a reinsurance structure that balances profitability, utility, risk volatility, and ruin probability.

INTRODUCTION

Reinsurance is a mechanism for transferring part of the risk from the insurance company to the reinsurance company through a contractual agreement (Cremer et al., 2024; Eggleton, 2026; JUMA, 2026; Mahasneh, 2024; Pallaria, 2023). According to Vaughan (2014), Reinsurance has two main functions, namely risk spread and financial function. Through the reinsurance contract, the insurance company establishes a risk-sharing structure that includes the proportion of claims held by themselves (retention), the share of the risk transferred to the reinsurer, and the reinsurance premium payment mechanism (Wehrhahn, 2009). This structure determines how premiums and claims are allocated between insurers and reinsurers, thus directly affecting the risk profile, surplus volatility, and solvency of the insurance company.

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Reinsurance contracts regulate various main provisions that are the basis for risk sharing between the insurance company and the reinsurer. These provisions include the reinsurance structure used, the proportion of risks held by the insurance company, the limit of reinsurer liability, and the mechanism for determining and paying reinsurance premiums (Schwepcke & Vetter, 2022). Based on its structure, reinsurance contracts are divided into three, namely Obligatory, Facultative, and Semi-Obligatory, while based on class, they are divided into two, namely Proportional and Non-Proportional (Schwepcke & Vetter, 2022). Thus, the design of reinsurance contracts plays an important role in shaping the risk structure and overall financial performance of the insurance company.

In the design of a reinsurance contract, there are a number of key parameters that can be adjusted by the insurance company. In proportional contracts, such as Quota-Share (QS), the main parameter is the retention proportion, which determines the percentage of premiums and claims held by the company. Meanwhile, in non-proportional contracts, such as excess of loss (XL), an important parameter is in the form of a claim limit or limit that determines the level of protection against extreme losses (Schwepcke & Vetter, 2022). The combination of the two structures results in the QS–XL design, where the insurance company regulates two parameters at once, namely the proportion () and the limit (). These two values simultaneously affect the number of claims held, reinsurance costs, and surplus volatility, so that they become the main object in the process of optimizing the reinsurance structure as carried out by Hu et al., (2017) and Karageyik (2025). αM

The determination of the design of the reinsurance contract is not a simple decision because in the QS-XL structure, the parameters and are the main parameters that determine the sharing of risk between the insurance company and the reinsurer. If the value and the set value are too high, the portion of risk held by the company will increase. On the other hand, if both are set too low, then the portion of risk transferred to reinsurers becomes larger. The increase in the portion of risk transferred can have an impact on increasing reinsurance costs and lowering the company's net premium income. Therefore, the combination of parameters and needs to be determined optimally in order to be able to balance the risks retained, reinsurance costs, and the company's profitability. αMαMαM

In Karageyik's (2025) research, the optimization of the QS-XL reinsurance structure was carried out by evaluating several performance indicators, namely ruin probability, profit, variance of retained risk, and expected utility. The four indicators are used to represent the risk aspects to bankruptcy, financial performance, risk stability, and utility preferences of insurance companies. The four indicators have two conflicting goals, namely minimizing ruin probability and variance of retained risk and maximizing profit and expected utility. The difference in the direction of the goals in the performance indicators shows that the problem of optimizing the reinsurance structure does not depend only on one criterion, but involves several criteria that contradict each other in the decision-making process. Therefore, the problem of optimizing the reinsurance structure is relevant to be analyzed using the Multi-Attribute Decision Making (MADM) approach. MADM is a subcategory of Multi-Criteria Decision Making (MCDM) which is used to solve decision-making problems with a limited number of alternatives based on certain attributes or criteria (Karageyik, 2025). Within the framework of MADM, this study uses the Complex Proportional Assessment (COPRAS) method to evaluate and rank an alternative set of parameters and based on weights on each of the performance indicators that have been determined. The COPRAS method is used because it is able to consider beneficial αMand non-beneficial criteria separately, making it suitable for evaluating reinsurance alternatives that have different optimization goals.

On the other hand, in addition to methodological considerations, the determination of the reinsurance structure is also influenced by the applicable regulatory framework. In Indonesia, provisions regarding retention, reinsurance support, and reporting obligations are regulated in the Financial Services Authority Regulation (POJK) Number 14 of 2015 and its amendments, while capital adequacy and risk-based solvency levels are regulated in POJK Number 71 and POJK Number 72 of 2016 for conventional and sharia insurance companies. Thus, the regulatory framework directs insurers to establish retention and reinsurance support strategies that are aligned with the risk profile, capacity to meet liabilities, and the level of solvency of the company. In practice, regulations are often used as a minimum compliance limit. However, to produce a reinsurance structure that is in line with the characteristics of the company's portfolio, the determination of retention needs to be done based on data by considering the balance between risk and cost, both in terms of insurer and reinsurer.

This research was conducted on PT Asuransi Jiwa Syariah XYZ, a sharia life insurance company that has a business portfolio dominated by Life Insurance Financing products in the group business. This product appears as a consequence of a financing contract, in which the debtor's life risk is transferred to the insurance company during the financing tenor. The characteristics of the portfolio are characterized by a high level of risk concentration and the potential for claims with a large real value, so the establishment of the right reinsurance structure is an important aspect in maintaining the company's financial stability.

Based on this decision-making framework, this study operationalizes the optimization of the reinsurance structure by evaluating a number of contract design alternatives represented by parameter pairs and. The evaluation is carried out by utilizing the company's actual claims data as the basis for estimating the characteristics of the claim distribution, so that performance indicators can be calculated consistently with the empirical conditions of the portfolio being studied. Each pair of these parameters forms an alternative set that reflects the design choices of reinsurance contracts with different levels of protection and costs, which are then compared based on predetermined performance indicatorsα

METHOD

Research Design

This study applied a quantitative approach with a case study design, which is focused on the analysis of determining the optimal reinsurance structure for Life Insurance Financing products at PT Asuransi Jiwa Syariah XYZ. The quantitative approach was chosen because this research involves actuarial risk modeling, calculation of numerical indicators, and a decision-making process based on quantitative comparisons between alternative reinsurance structures. The case study design is used to enable an in-depth and contextual analysis of the risk characteristics of the portfolio researched based on the company's actual data.

This study used historical company data that includes policy information, claims, reinsurance claims, premiums, and reinsurance premiums during the period January 2014 to December 2025. The data is used to identify the characteristics and distribution of losses of the Financing Life Insurance portfolio, which subsequently becomes the basis for modeling the

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QS-XL reinsurance structure. The analysis is carried out from the perspective of the insurer, so that all measures of performance and risk calculated reflect the exposure and interests of the insurance company.

Research Data

Data Source

The data used in this study is internal secondary data of the company obtained from the database system of PT Asuransi Jiwa Syariah XYZ. The data was collected from several work units that are directly involved in risk and claims management, namely the Claims Department and the Actuarial Department.

The Claims Department provides data related to the realization of claims that have been paid by the company, especially death claims, which are the main types of claims in sharia life insurance products. Meanwhile, the Actuarial Department provides supporting data as well as other necessary technical information.

All data is obtained directly from the company's internal database system and is used on a limited basis for academic purposes. In order to maintain confidentiality and compliance with the ethical principles of research, the identity of insurance participants is not explicitly displayed and has gone through an anonymization process.

RESULT AND DISCUSSION

Descriptive Data

The data used in this study is claim data on PT Asuransi Jiwa Syariah XYZ's financing life insurance products during the period January 2014 to December 2025. The main variable analyzed was the value of claim compensation paid by the company to participants and expressed in Rupiah units.

Keterangan	Minimum	Maksimum	Mean	Variance	Std.Deviasi	Skewness	Kurtosis
Data Klaim Keseluruhan	3,500,000	555,441,988	75,718,968	4,823,150,517,395,280	69,448,906	3.3665	13.76

Table 4.1 Descriptive Statistics of Initial Claims Data

Based on the results of the initial data processing presented in Table 4.1, a total of 374 claims data were obtained. The minimum claim value was recorded at IDR 3,500,000, while the maximum claim value reached around IDR 555,441,988. This very wide range of claim values indicates that there is a high variation in the amount of claims that occur.

Statistically, the average value (mean) of claims is IDR 75,718,968, with a standard deviation of IDR 69,448,906. The relatively large variance value, which is 4.82×10^{15}, indicates a high level of claim volatility. In addition, a skewness value of 3.3665 indicates that the claim distribution is right-skewed, while a kurtosis value of 13.76 indicates the existence of a heavy-tailed distribution.

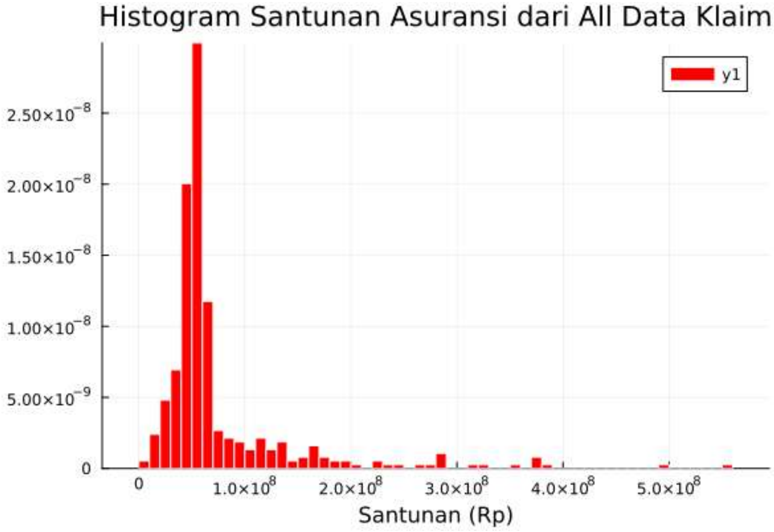

Figure 1 Initial Claims Data Histogram

A visualization of the distribution of claims data is shown through the histogram in Figure 1. Based on the histogram, it is evident that the distribution of claims is right-skewed, with most of the claims concentrated on relatively small values, while there are a small number of claims with very large or extreme values.

This distribution pattern shows the heavy-tailed characteristics commonly found in insurance claims data. The existence of these extreme claims has important implications for a company's risk management, as it can increase the volatility of losses and affect the company's solvency level.

Thus, the analysis of the claim distribution in this study is not only focused on the main distribution (body distribution), but also considers the behavior of the tail distribution separately in order to obtain a more representative model of the empirical data.

Estimated Claim Distribution

Estimating the distribution of claims is an important stage in risk modeling, especially in this case, the reinsurance strategy. In the initial stage, a test of the compatibility of several theoretical distributions to the overall claim data was carried out using EasyFit software.

Table 1 Goodness-of-Fit Test Results on Initial Claims Data Distribution

No.	Distribution	*p-value*
1	Wakeby	$8{,}5586 \times 10^{-4}$
2	Cauchy	$6{,}9642 \times 10^{-5}$
3	Gen. Logistic	$1{,}4911 \times 10^{-5}$
4	Gen. Extreme Value	$5{,}4606 \times 10^{-6}$
5	Log-Logistic (3P)	$2{,}0963 \times 10^{-7}$
6	Pearson 6	$7{,}0572 \times 10^{-9}$
7	Pearson 5	$6{,}6155 \times 10^{-9}$
8	Log-Pearson 3	$4{,}9055 \times 10^{-9}$
9	Gen. Pareto	$1{,}6228 \times 10^{-9}$
10	Frechet (3P)	$3{,}9641 \times 10^{-10}$

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Based on the results of the test presented in Table 4.2, no single distribution was found that was able to adequately represent the claim data. This is reinforced by the results of the Kolmogorov-Smirnov (KS) statistical test, in which the entire distribution of candidates has *a p-value* < significance of 5%. As such, there is no one-size-fits-all distribution model.

This phenomenon indicates that claims data have complex characteristics, especially the existence of extreme claims that cannot be captured well by a single distribution. Therefore, in this study, a *composite distribution approach is used*, namely modeling the distribution of claims by dividing the data into two parts, namely:

1. *Body distribution*, which represents small to medium-sized claims
2. *Tail distribution*, which represents extreme claims.

Body Distribution

The body distribution in this study represents claims with small to medium values, which is 70% of the total claim data that is below the threshold value. Based on the results of the estimation using EasyFit software, the most suitable distribution for modeling body parts is Generalized Logistic Distribution.

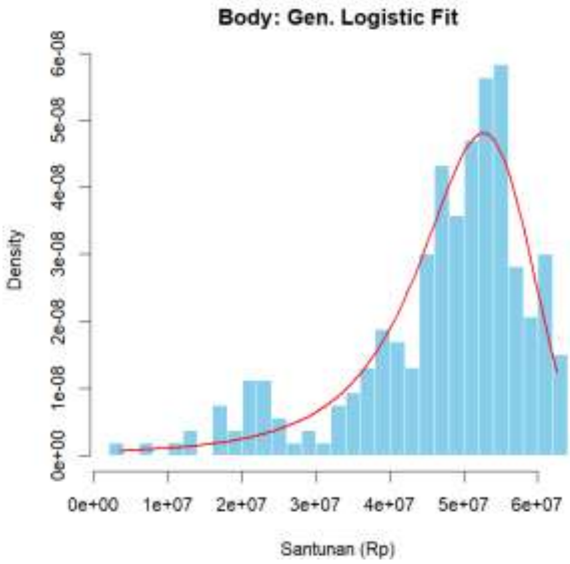

Figure 1 *Fitting* Distribution *Generalized Logistic* against Empirical Data Body

Visualization of the distribution match to empirical data is shown in Figure

The graph displays a histogram of body claims data compared to the *estimated Generalized Logistic* distribution curve.

Based on the figure, it can be seen that *the Generalized Logistic distribution curve* is able to follow the empirical data distribution pattern quite well, especially in the middle of the distribution. The peak distribution is around the claim value of IDR 50,000,000 and is consistent with the *Location Parameter* (μ) value obtained.

Overall, *the Generalized Logistic distribution* is considered quite representative in modeling the behavior of claims in the *body*, because it is able to capture the form of the distribution that is asymmetrical and flexible in representing the skewness of the data.

So that the function of opportunity concentration for *body distribution* in this study can be written as

$$f(x)=\frac{\left(1-0.2664\cdot\frac{x-4.9794\times10^{7}}{5.5845\times10^{6}}\right)^{-1+\frac{1}{0.2664}}}{5.5845\times10^{6}\left[1+\left(1-0.2664\cdot\frac{x-4.9794\times10^{7}}{5.5845\times10^{6}}\right)^{\frac{1}{0.2664}}\right]^{2}}$$

The equation shows that the *body* distribution has flexibility in capturing asymmetrical forms of distribution, especially with the presence of *a shape parameter* () that controls the degree of slope (skewness$k$) of the distribution.

Calculation of Performance Indicators on QS-XL Reinsurance Contracts

Determination of Basic Parameters of Calculation

Before calculating performance indicators for each alternative QS–XL reinsurance structure, several basic parameters used in the model are first determined. These parameters are necessary so that *the calculation of ruin probability*, *profit*, *variance of retained risk*, and *expected utility* can be performed consistently for all alternative parameter pairs α and M.

The frequency of claims in this study was determined based on the historical average of the number of claims during the observation period. Based on the claim data used, there were 374 claims observations during the seven years of observation, so that the annual claim frequency parameter was set at λ = 374 / 7 = 53.4286.

The value of λ represents the average number of claims that occur in one year and is used in the calculation of *aggregate claims* and all reinsurance performance indicators.

Furthermore, the *safety loading factor* on the insurance company's side is set at = 5%. In the context of sharia life insurance, the value in this study is not interpreted as the profit margin of the insurance company, but as a $\theta\theta$*contingency margin* or margin of caution against the potential deterioration of the claim experience in *the Tabarru'* fund. Thus, this parameter reflects the additional margin used in the formation of risk contribution based on *the principle of expected value premium*.

In addition to *the safety loading factor* on the insurance company side, this study also set the *loading* on the reinsurance side at = 5%. This value is used in the calculation of reinsurance costs, especially to determine the amount of reinsurance contributions or premiums paid on the portion of the risk transferred to the reinsurer.ξ

The initial surplus or initial funds used in the *baseline* calculation is set at IDR 3,060,255,815. This value represents the initial capacity of the available funds to absorb claim risk in the analysis period. The initial surplus parameter plays an important role in calculating *ruin probability* and *expected utility* because the larger the initial funds available, the stronger the company's ability to deal with claims fluctuations.

In the calculation of *expected utility*, the *risk aversion* parameter or utility constant is set as = 2×10^{-10}. Values are used in the exponential utility function to reflect a company's preference for risk. The greater the value, the higher the assumed level of risk aversion. In this study, the value is used on a regular basis for all alternatives so that the comparison of $BBBB$*expected utility* between reinsurance structures is carried out consistently.

The time horizon of the calculation is set for one year or = 1. This determination is in line with the use of annual claims frequency and the calculation of performance indicators

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declared on an annual basis. Thus, all *truin values of probability*, *profit*, *variance of retained risk*, and *expected utility* are calculated in the framework of one annual period.

In addition to these basic parameters, this study also uses the moment of gross claim distribution obtained from the *spliced distribution model*. The first, second, and third moments of gross claims are used in the formation of the moment of claims held by the company and the claims transferred to reinsurers, respectively. The value of this moment is the basis for calculating premiums, profits, *variance of retained risk*, *ruin probability*, and *the translated gamma* approach to *expected utility*.

Performance Indicator Calculation Results

Based on the results of the formation of *a composite model* in the previous section, a claim distribution model was obtained that represented the characteristics of empirical claim data, both in the *body* and *tail distribution*. This distribution model is further used as the basis for the calculation of reinsurance performance indicators in the QS-XL structure.

In the context of this study, each QS-XL reinsurance structure is represented by a combination of the proportion parameters and the maximum limit of claims held by the company (). A change in the combination of these two parameters will result in different amounts of αM*retained* claims, thus having an impact on the risk the company holds, profitability, claim volatility, and utility earned.

Therefore, after the initial claim distribution has been successfully modeled, the next stage of analysis is to evaluate various alternative pairs and based on four performance indicators, namely αM*ruin probability*, *profit*, *variance of retained risk*, and *expected utility*. These four indicators are then used as a basis in the decision-making process to determine the most optimal reinsurance structure.

This subchapter presents the results of the calculation of performance indicators for each alternative QS-XL reinsurance structure. The calculation is carried out using a previously obtained claims distribution model, so that each indicator produced reflects the empirical characteristics of the claim's portfolio being studied. The focus of the discussion in this section is to compare the performance of each alternative reinsurance structure based on aspects of risk, *profitability*, stability, and utility of the company.

Table 2 Performance Indicator Calculation Result Matrix for each parameter alternative in QS-XL

Alternatives	α	M	Attributes (Criteria)			
			ψ	*Profit*	V(S)	$E[u(W)]$
1	30,00	300.000.000	0,001636	65.857.672	57.463.082.559.901.500	0,46424
2	30,07	299.749.750	0,001656	63.729.583	57.737.851.097.566.700	0,46401
3	30,14	299.499.499	0,001679	63.877.496	58.000.751.264.817.000	0,46402
4	30,21	298.998.999	0,001702	64.025.425	58.264.161.533.212.000	0,46403
⋮	⋮	⋮	⋮	⋮	⋮	⋮
998	99,86	50.500.501	0,002011	124.802.435	119.642.332.643.840.000	0,46986
999	99.93	50.250.250	0,001968	124.414.836	118.852.456.597.511.000	0,46983
1000	100	50.000.000	0,001924	124.019.965	118.052.233.246.352.000	0,46979

Based on the results of the calculations in Table 2, it can be seen that each alternative QS-XL reinsurance structure produces a different performance indicator value. The difference occurs due to each combination of parameters and forms a different level of risk retention for the company. Thus, changes in value and not only affect the size of the claims held by the company, but also impact the risk of bankruptcy, αM αM profitability, volatility of claims, and earned utility.

In the initial alternative, which is when the value is 30% and IDR 300,000,000, a αM ruin probability value of 0.16356% is obtained, profit utility of IDR 65,857,672 million, variance of retained risk of IDR 57,463,082,559,901,500, and expected utility of 0.46424. Meanwhile, in the final alternative, which is when the value is 100% and IDR 50,000,000, a αM ruin probability value of 0.19243% is obtained, profit utility of IDR 124,019,965, variance of retained risk of IDR 118,052,233,246,352,000, and expected utility of 0.46979.

These results show that increased retention does not necessarily result in improvements in all indicators simultaneously. Alternatives with higher retention rates tend to provide greater profit utility, but on the other hand also increase the variance of retained risk. This shows that the greater the risk that a company holds, the greater the potential profit obtained, but with the consequence of increasing the volatility of the risks that must be incurred.

In addition, the ruin probability and expected utility values show that the relationships between indicators are not simple or linear. An alternative can lead to higher profits, but it is not necessarily the best alternative if the increase is accompanied by an imbalanced change in risk. Therefore, the selection of a reinsurance structure cannot be based solely on one specific indicator, such as the highest profit or the lowest ruin probability.

These findings show that there is a trade-off between risk and profitability in determining the QS-XL reinsurance structure. Ruin probability and variance of retained risk represent the aspects of risk that need to be minimized, while profit and expected utility represent the aspects of benefits that need to be maximized. Thus, an approach is needed that is able to evaluate all these indicators simultaneously.

Based on these considerations, the results of the calculation of performance indicators in Table 4.5 are then used as inputs in the COPRAS method. This method is used to rank the alternatives of the reinsurance structure based on cost and benefit criteria, so that the alternative selected as the optimal structure not only reflects a high level of profitability, but also takes into account the stability of the company's risk and utility.

Complex Proportional Assessment (COPRAS)

Determination of Benefit/Cost and Weighting Criteria

In the ranking process, this study uses the weight of criteria based on company preferences. The weight reflects the relative importance of each indicator in determining the optimal reinsurance structure. The weights used are as follows.

Table 3 Determination of Weights and Classification of Decision Criteria

Criteria	Indicator	Purpose	Criteria Type	Weight
C_1	*Ruin probability*	Minimum	*Cost / non-beneficial*	0,05
C_2	*Profit*	Maximum	*Benefit / Beneficial*	0,7324
C_3	*Variance of retained risk*	Minimum	*Cost / non-beneficial*	0,0984
C_4	*Expected Utility*	Maximum	*Benefit / Beneficial*	0,12

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Based on the table, profit gained the largest weight, which was 0.7324. This shows that in the context of this study, companies give top priority to the ability of the reinsurance structure to produce optimal financial performance. Expected utility is weighted at 0.12, reflecting considerations of the company's risk preferences. Meanwhile, the variance of retained risk and ruin probability gained weights of 0.0984 and 0.05, respectively, indicating that the stability aspects of risk and bankruptcy risk are still considered, but are not the top priority in the company's preferences.

With this weight composition, the results of COPRAS in this study are directed to choose an alternative QS-XL reinsurance structure that best suits the company's preferences, namely a structure that is able to provide high profits, still consider utility, and maintain the risk and volatility of retained claims at an acceptable level.

Value Calculation Results

Based on *the benefit/cost* criteria and weights that have been determined in the previous section, a weighted normalized value is calculated for each alternative QS-XL reinsurance structure. Each alternative represents a combination of parameters and, with a total of 1,000 alternatives evaluated in this study. αM

Table 4 Results of Value Calculation in the COPRAS Method Q_i

Alternatives	α	M	Attributes (Criteria)				S_{+i}	S_{-i}	Q_i
			Weighted norm ψ	*Weighted norm Profit*	*Weighted norm* V(S)	*Weighted norm* $E[u(W)]$			
1	30,00	300.000.000	0,000181	0,012430	0,001069	0,003757	0,01619	0,00125	0,029201
2	30,07	299.749.750	0,000183	0,012028	0,001074	0,003755	0,01578	0,00126	0,028722
3	30,14	299.499.499	0,000186	0,012056	0,001079	0,003755	0,01581	0,00126	0,028674
4	30,21	298.998.999	0,000188	0,012084	0,001083	0,003755	0,01584	0,00127	0,028626
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
778	**84,44**	**105.555.556**	**0,001342**	**0,028139**	**0,003674**	**0,003816**	**0,03196**	**0,00502**	**0,035198**
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
998	99,86	50.500.501	0,000223	0,023554	0,002225	0,003802	0,02736	0,00245	0,034002
999	99,93	50.250.250	0,000218	0,023481	0,002210	0,003802	0,02728	0,00243	0,033982
1000	100	50.000.000	0,000213	0,023407	0,002195	0,003802	0,02721	0,00241	0,033962

The results of the calculation are presented in Table 4.7. The Weighted norm ψ, Weighted norm Profit, Weighted norm V(S), and Weighted norm columns E[u(W)] show the value of each indicator after going through the normalization and weighting process. Thus, the value in the column already reflects the relative contribution of each indicator to the final assessment of COPRAS in accordance with the weight of the company's preferences.

Furthermore, the value is calculated from the sum of the criteria that are beneficial, namely S_(+i) Profit and Expected utility. This value indicates the total positive contribution of an alternative. The greater the value, the greater the benefits provided by the alternative in the context of the company's preferences. S_(+i)

Instead, the value is calculated from the sum of the cost criteria S_(-i), namely ruin probability and variance of retained risk. This value indicates the total contribution of risk or cost of an alternative. The smaller the value, the lower the relative risk that the company bears. S_(-i)

Value is the relative significance value of each alternative. This value is used as the basis for ranking in the COPRAS method. The alternative with the highest value is chosen as the best alternative because it shows the most optimal combination of Qi benefit and cost contribution based on the weight of the company's preference.

Based on the calculation results in Table 4.7, the 778th alternative obtained the highest score, which was 0.035198. This alternative has a parameter and. The alternative value is 0.03196, while the value is 0.00502. These results show that alternative 778 provides the strongest Q_i α=84,44%M=Rp105.555.556S_(+i) S_(-i) benefit contribution compared to other alternatives, although it is accompanied by a higher cost value than some alternatives at lower retention rates.

Thus, the 778th alternative was selected as the best QS-XL reinsurance structure based on the COPRAS method. The combination and exhibit a relatively high retention structure, but still provide the most optimal balance between α=84,44%M=Rp105.555.556profitability, utility, risk volatility, and bankruptcy risk according to the company's preferences.

Implications of Research Results on POJK and Company Provisions

The determination of the reinsurance structure in this study is related to the applicable regulatory provisions in the insurance industry, especially related to self-retention, reinsurance support, financial health, and the adequacy of *Tabarru'* funds. POJK Number 14/POJK.05/2015 regulates self-retention and domestic reinsurance support, which has since undergone changes, including through POJK Number 39/POJK.05/2020. This provision emphasizes the importance of insurance companies and sharia insurance companies in determining their own retention and obtaining reinsurance support in accordance with the characteristics of the risks managed.

The results of this study can be seen as a quantitative approach that supports the process of determining self-retention and the company's reinsurance structure. Through the QS–XL model, companies can evaluate a combination of parameters and based on several indicators, namely αM ruin probability, profit, variance of retained risk, and expected utility. Thus, the recommendations of reinsurance structures are based not only on historical considerations or commercial negotiations, but also on more systematic risk measurements. This is relevant to the need for companies to establish their own retention that is in line with the risk profile of the portfolio and the capacity of the funds it has.

In the context of Islamic insurance companies, the implications of this study are also related to financial health provisions. POJK Number 72/POJK.05/2016 regulates the financial health of insurance companies and reinsurance companies with sharia principles. In these provisions, the level of financial health of the company includes the Solvency Level of the *Tabarru'* Fund and the *Tanahud* Fund, the Solvency Level of the Company's Fund, technical allowance, investment adequacy, equity, and guarantee funds. In addition, the company is required to set a target of the lowest Solvency Level of *Tabarru'* Funds and internal Corporate Funds of 120% of the DTMBR and MMBR by taking into account the risk profile and considering the results of the simulation of the change scenario or stress test.

Based on the results of the study, the optimal reinsurance structure can provide input for companies in maintaining the adequacy of *Tabarru'* funds through controlling the risk of withheld claims. The results of sensitivity to initial surplus show that increasing the capacity of the initial fund lowers the ruin probability and increases expected utility. These findings support the importance of the adequacy of *Tabarru'* funds as a risk cushion in dealing with fluctuations in claims. Meanwhile, the results of sensitivity to safety loading factors show that changes in contingency margins affect the optimal reinsurance structure. In the context of sharia, the contingency margin is not interpreted as a company's profit, but as a margin of caution over the potential deterioration of the claim experience in the *Tabarru'* fund.

The practical implication for the company is that the results of this study can be used as a tool in developing an annual reinsurance strategy, especially in determining the retention limits and reinsurance protection needs for Financing Life Insurance products. The optimal QS–XL structure can help companies balance between the risk of retained claims, reinsurance costs, the stability of the *Tabarru'* funds, and the profitability of the portfolio. In addition, the results of the model can be used as an analytical basis in discussions with reinsurers, as the company has a quantitative picture of the impact of parameter changes and on bankruptcy risk, claims volatility, and utility. αM

However, the results of this study are not intended as a substitute for regulatory compliance obligations. The determination of the actual reinsurance structure still needs to take into account the applicable POJK provisions, reinsurance capacity and ratings, self-retention limits, availability of reinsurance support, the company's financial condition, and internal risk management policies. Thus, the model developed in this study is more appropriately positioned as a decision support tool that can strengthen the company's decision-making process in establishing a reinsurance structure that is in line with the principles of prudence and regulatory provisions.

CONCLUSION

Based on the results of the analysis and discussion, this study concludes that the optimal QS–XL reinsurance parameters for financing life insurance products at PT Asuransi Jiwa Syariah XYZ can be determined through the Complex Proportional Assessment (COPRAS) method. The study formed several alternative pairs of quota-share retention proportion parameters (α) and excess of loss retention limits (M), then evaluated each alternative using four performance indicators: ruin probability, profit, variance of retained risk, and expected utility. The results show that each combination of α and M produces different effects on the company's risk and financial performance. Higher retention can increase profit potential because the company bears lower reinsurance costs, but it may also increase claim volatility and bankruptcy risk. Conversely, greater reinsurance protection can reduce risk exposure, but may reduce profitability due to higher reinsurance costs. Therefore, reinsurance decisions must consider the balance between risk reduction, profitability, retained risk volatility, and company utility preferences. Based on the COPRAS ranking, the best parameter pair is α = 84.44% and M = Rp105,555,556. This combination is considered the most optimal QS–XL reinsurance structure because it provides the best balance between profitability, expected utility, risk volatility, and ruin probability. The relatively high retention proportion allows the company to retain a larger share of premiums or contributions, while the excess of loss mechanism still protects the company from extreme claims. Overall, this study shows that the Multi-Attribute Decision Making approach using the COPRAS method can help insurance companies determine a more objective, measurable, and data-based reinsurance structure. The findings also confirm that reinsurance optimization should not rely on a single indicator, but must consider the trade-off between risk control, financial stability, profitability, and company risk preferences.

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