Research Paper

Study on General Insurance & General Takaful Risk Margins

June 2023

A Collaboration Between

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1. Introduction

This report is a joint publication by ISM Insurance Services Malaysia Berhad (ISM) and Malaysian Reinsurance Berhad (MRe). The report provides a summary of risk margins for several classes of business for general insurance companies and general takaful operators in Malaysia and is intended to give some insight into the range of risk margins in the general insurance and general takaful industry.

Set at the 75% confidence level, risk margins are an important aspect of Bank Negara Malaysia's (BNM) Risk Based Capital Framework (RBC) as well as the Malaysian Financial Reporting Standard 17 (MFRS 17) and have a direct impact on the financial soundness of insurance companies and takaful operators (ITOs) and their ability to protect the interests of policy holders.

Risk margins allow for the risk that outcomes will differ from the best estimate of insurance liabilities, both because of the inherent uncertainty of the distribution of possible outcomes and because of the randomness of future outcomes. Combined with the best estimate, the resulting provision for insurance liabilities should be sufficient to pay claims as they fall due 75% of the time.

The scope of this report covers direct general insurance companies and direct general takaful operators only and is limited to risk margins for the claim liabilities (CL). The Malaysian Motor Insurance Pool (MMIP) is excluded from this study.

2. Methodology

Claims and premium data as at 31/12/2020 was provided by ISM for each direct general insurance company and direct general takaful operator in Malaysia. The data provided was Gross of Reinsurance recoveries and covered claims from Accident Years 2013 to 2020. Data was provided for the following classes of business:

- Fire
- Motor Act
- Motor NonAct
- Cargo
- Marine Hull

All data provided were anonymized to protect the confidentiality of data submission by the respective companies. Analysis could not be carried out on classes of business other than those listed above as the data ISM has for those classes are not granular enough.

Risk margins were derived for each company using both the Mack[1] method and Bootstrap[2] method and the results from both methods are presented in this report. The Bootstrap results are adopted as the default set of results in this report as it is considered to be the more robust method (refer to Section 5 for details).

Claims incurred data was used to carry out the analysis for all classes of business except for Motor NonAct and the analysis by vehicle class where claims paid data was used.

No adjustments for large losses were made to the data.

[1] Thomas Mack, 1993
[2] England and Verrall, 1999

3. Overall Results

In this section, the CL risk margins for each class of business are presented as well as the variability of these risk margins by quartile range. The risk margins are gross of reinsurance recoveries and are before diversification benefit.

It is observed that the distribution of risk margins are right skewed with the majority of the weighted average below the median. This is probably due to larger ITOs having more stable claims experience due to the size of their portfolios which produces lower risk margins.

Figure 1: CL Risk Margins
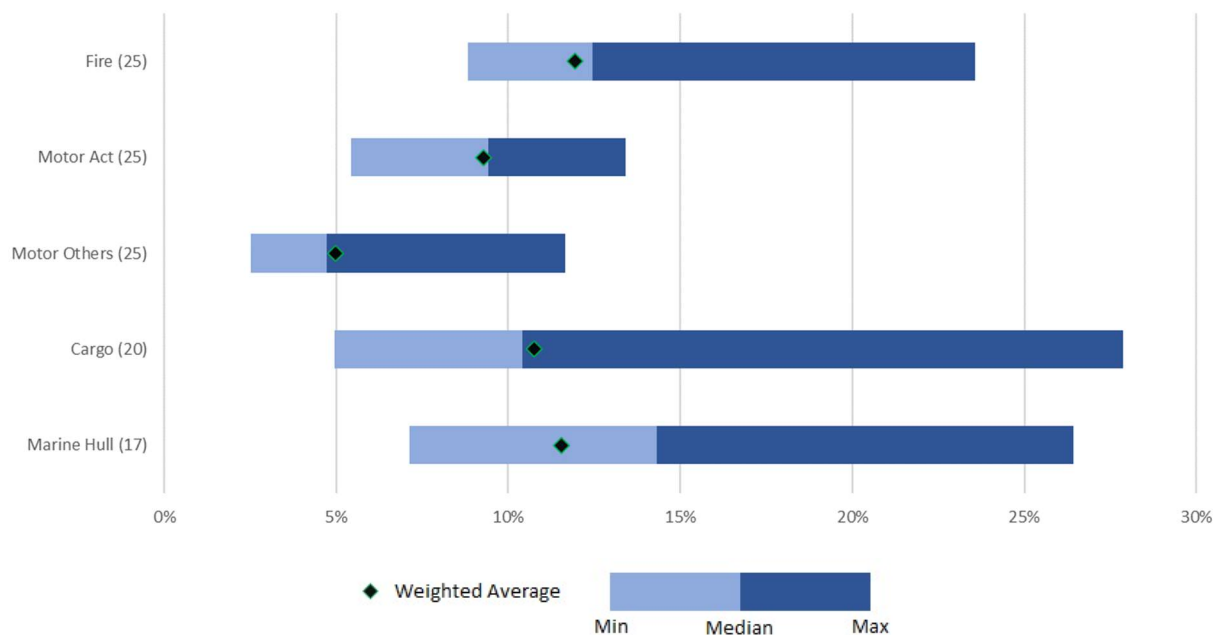
4. Results by Class of Business

In this section the risk margins for each class of business are presented in greater detail.

Companies are split into 3 categories – Large, Medium and Small based on the premium volume for that particular class of business. By grouping similar sized companies together, a certain level of homogeneity is introduced into the analysis and a lower level of variability is expected to be observed in the range of results of each category.

For Motor class of business, two sets of analysis are produced. The first is done based on Motor Act and Motor NonAct classes and the second is done by vehicle class. The reason for this is Motor is the largest class of business in Malaysia and a more detailed analysis may be useful especially for companies that break down their Motor business by vehicle type to facilitate a more accurate IBNR estimation.

The results are presented in both numerical and graphical format. The description of the column headings in the table of results are as follows:

Table 1: Description of Column Headings

Column Headings	Description
No. Companies	The number of ITOs n in the category.
Min	The smallest risk margin in the category. i.e. $\min(\%RM_1, \%RM_2, \cdots, \%RM_n)$
Average	The weighted average of the risk margins in the category
Max	The largest risk margin in the category. i.e. $\max(\%RM_1, \%RM_2, \cdots, \%RM_n)$
Std Dev	The weighted standard deviation of the risk margins in the category.

Note: The notation $\%RM_i$ denotes the Risk Margin for company i

The formula used to derive the weighted average and weighted standard deviation are in Appendix A.

4.1 Fire

Fire class of business refers to property insurance and is the second largest class of business by premium volume. In 2021, Fire class recorded Gross Direct Premiums/Contributions of RM 4.3 billion[3] across both conventional insurers and takaful operators. This class has significant exposure to flood risk which is a regular occurrence especially during the northeast monsoon season which runs from November to March annually.

The risk margins for the 25 companies analyzed are presented in Table 2 and Figure 2.

Table 2: Summary of Risk Margins - Fire

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	4	9.5%	10.5%	15.3%	2.2%	11.0%	11.9%	18.2%	2.1%
Medium Companies	11	8.8%	11.9%	23.6%	3.0%	9.4%	17.6%	25.5%	5.1%
Small Companies	10	10.9%	12.5%	23.5%	3.0%	11.0%	14.5%	25.2%	4.8%

Figure 2: Summary of Risk Margins – Fire
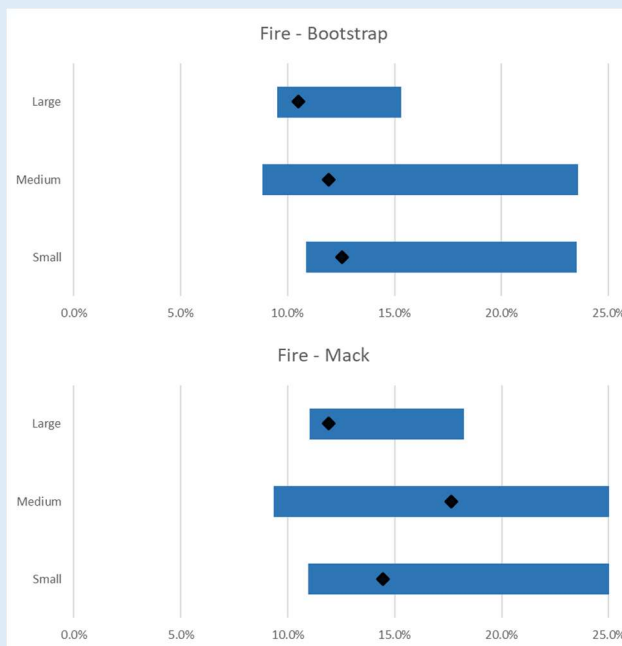
Given that this class of business has significant flood risk exposure as well as potential for total loss on very large risks (i.e. industrial risks), the high risk margins generated are not unexpected.

However, Fire class of business tends to be heavily reinsured and the risk margins produced on a Net of Reinsurance basis should be significantly lower than that observed in this study.

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[3] ISM Statistical Yearbook 2021

4.2 Motor

The results for Motor class of business are presented in two parts. The first showing the split between Motor Act and Motor NonAct and the second showing the split by vehicle class. The analysis showing the split by vehicle class is not further split into the Act and NonAct components as splitting the data into such granular level produced unreliable results for some companies, especially those with smaller Motor portfolios.

4.2.1 Part 1 – Act and NonAct

4.2.1.1 Motor Act

Motor Act class of business generated RM 3.2 billion in Gross Direct Premiums/Contributions in 2021 and this class covers the compulsory components of Motor insurance which is primarily Third Party Bodily Injury. 25 companies were analyzed and the summary of results are presented in Table 3 and Figure 3.

Table 3: Summary of Risk Margins – Motor Act

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	6	5.6%	8.0%	12.0%	2.0%	21.0%	23.7%	25.4%	1.6%
Medium Companies	13	5.4%	10.4%	17.6%	3.8%	13.1%	20.4%	25.5%	4.5%
Small Companies	6	11.0%	12.4%	20.3%	2.0%	8.1%	19.1%	25.4%	7.3%

The Mack method generates risk margins that are significantly higher than the Bootstrap for this class of business. It is believed that this is caused by the long tailed nature of this class of business. For a large majority of companies, the claims incurred peaked in the third development year while for some others it peaked only in the fourth development year. Coupled with some releases in reserves in the later development years, the Mack method assesses this as significant volatility and hence the higher risk margins. The impact of this is not as severe for the Bootstrap probably due to the resampling methodology which reduces the effect of the releases in reserves in the later development years.

Figure 3: Summary of Risk Margins – Motor Act
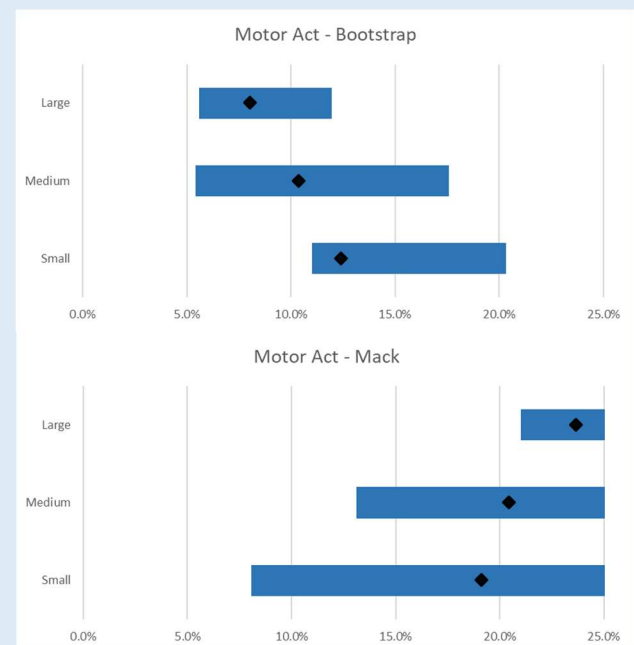
4.2.1.2 Motor NonAct

Motor NonAct covers all other components of Motor insurance that are not covered in the Motor Act class. This class recorded a Gross Direct Premiums/Contributions of RM 7.6 billion in 2021 which makes it the largest class of business in Malaysia.

For this class of business, it was observed that in the triangulation of the claims incurred data for a large majority of the companies, the claims incurred peaked by the second development year and eventually settled for less than the reserved amount. It is believed that the reason for this is mainly due to salvage and subrogation activities as well as, to a lesser extent, over-reserving in this class of business. This resulted in loss development factors (LDF) of less than 1 which produced some unreliable results. Hence, claims paid data was used to generate the risk margins for this class of business. The summary of NonAct results are presented in Table 4 and Figure 4.

Table 4: Summary of Risk Margins – Motor NonAct

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	6	4.3%	5.2%	7.0%	1.0%	8.9%	13.6%	17.1%	2.8%
Medium Companies	13	2.5%	4.8%	7.7%	1.4%	5.4%	10.1%	15.8%	3.1%
Small Companies	6	3.0%	4.6%	11.7%	2.2%	6.8%	10.7%	20.2%	4.3%

Figure 4: Summary of Risk Margins – Motor NonAct
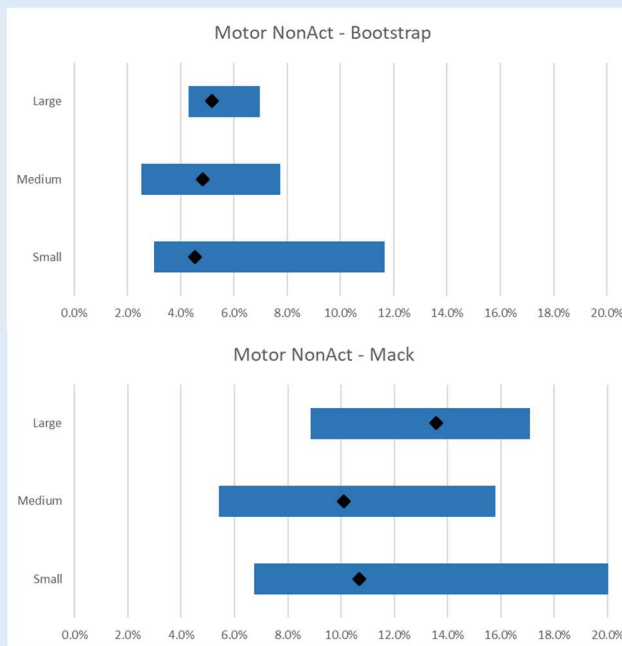
An interesting observation of the NonAct results is that the risk margins generated by the Bootstrap are roughly two times less than the Mack risk margins. This observation is consistent across all three categories of companies as well as across all summary statistics.

The consistency in the differences may indicate that the underlying assumptions behind one of the methods may not be suitable for this class of business.

4.2.2 Part 2 – By Vehicle Class

The analysis for this section was done using claims paid data as the same issue effecting the Motor NonAct analysis was encountered.

4.2.2.1 Private Cars

The summary of risk margins for Private Cars are presented in Table 5 and Figure 5.

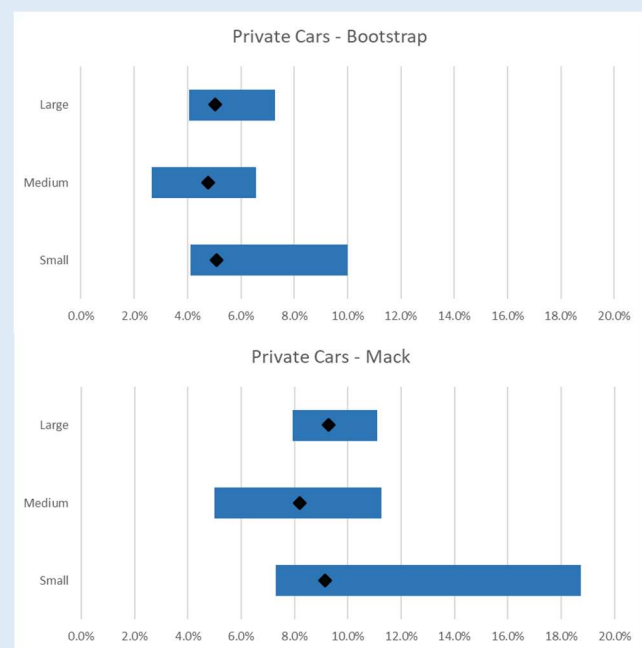*Table 5: Summary of Risk Margins – Private Cars*

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	6	4.0%	5.0%	7.3%	0.9%	7.9%	9.3%	11.1%	1.0%
Medium Companies	14	2.6%	4.8%	6.6%	1.1%	5.0%	8.2%	11.2%	1.8%
Small Companies	5	4.1%	5.1%	10.0%	1.6%	7.3%	9.1%	18.7%	3.9%

The results for Private Cars mirrors the results for Motor NonAct to a large extent. This is within expectations as Private Cars vehicle class makes up a very large percentage[4] of Comprehensive cover in Malaysia.

The difference between the Bootstrap and Mack by a factor of approximately 2 is also observed in this set of results.

[4] ISM Statistical Bulletin SB-MOTOR-00002-21 (January to December 2020)

*Figure 5: Summary of Risk Margins – Private Cars*

4.2.2.2 Motorcycles

Due to the size of the portfolio being too small, four companies out of the 25 were excluded in this analysis. The results for the remaining 21 companies are presented in Table 6 and Figure 6.

Table 6: Summary of Risk Margins – Motorcycles

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	5	5.7%	6.7%	9.4%	1.2%	7.0%	10.2%	16.1%	3.8%
Medium Companies	9	10.3%	13.3%	15.9%	2.2%	14.4%	16.4%	22.9%	5.6%
Small Companies	7	11.2%	16.2%	17.4%	2.2%	20.1%	22.3%	25.4%	7.6%

Figure 6: Summary of Risk Margins – Motorcycles
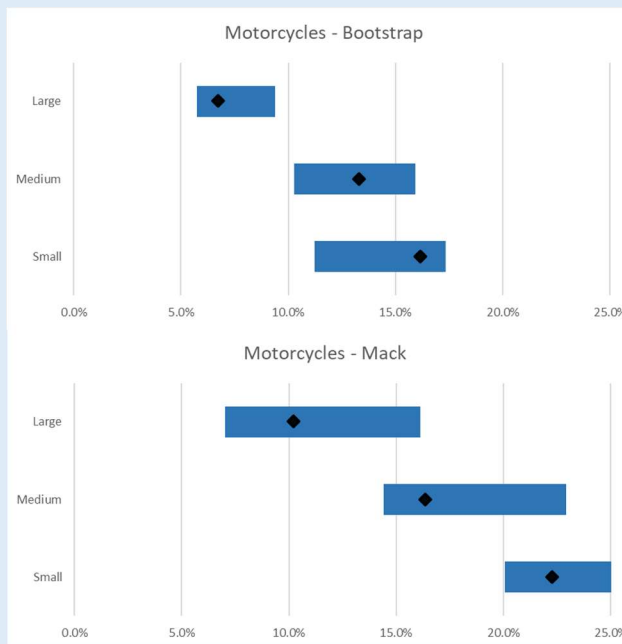
The results for this vehicle type are largely within expectations with Large companies having the lowest risk margins followed by the Medium companies and then the Small companies.

4.2.2.3 Other Vehicles

The results presented in Table 7 and Figure 7 covers all vehicles excluding Private Car and Motorcycles. Attempts to split this portfolio into more groups (e.g. buses, taxis, etc.) resulted in unreliable results for a number of companies.

Table 7: Summary of Risk Margins – Other Vehicles

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	7	4.1%	6.1%	8.5%	1.5%	6.1%	10.3%	14.2%	2.6%
Medium Companies	9	5.4%	8.5%	11.5%	2.3%	9.0%	12.2%	17.5%	2.4%
Small Companies	9	8.0%	11.7%	22.7%	3.3%	12.3%	17.4%	25.5%	3.4%

The wide range of results in the Small category indicate a high level of variability in the risk margins for Other Vehicles. This is likely due to the broad range of vehicles being grouped together in this vehicle class as well as different companies having very different vehicle compositions in their respective portfolios.

*Figure 7: Summary of Risk Margins – Other Vehicles*
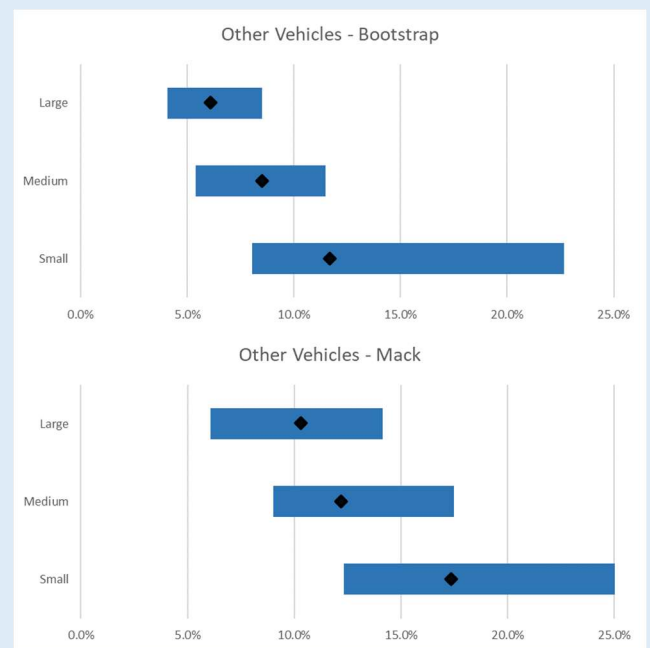
4.3 Cargo

Cargo class covers against loss or damage to property in transit and it recorded RM 519 million of Gross Direct Premiums/Contributions in 2021. Data was provided for 21 companies and of those companies, one was excluded as it's portfolio was too small and the results produced were not credible. Table 8 and Figure 8 summarized the results for the remaining 20 companies.

Table 8: Summary of Risk Margins – Cargo

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	6	4.9%	10.0%	16.6%	5.0%	8.1%	13.9%	25.3%	7.4%
Medium Companies	8	6.7%	9.9%	15.5%	2.9%	5.7%	14.8%	25.5%	6.4%
Small Companies	6	7.8%	16.2%	27.9%	5.7%	10.7%	19.0%	25.5%	6.3%

Figure 8: Summary of Risk Margins – Cargo
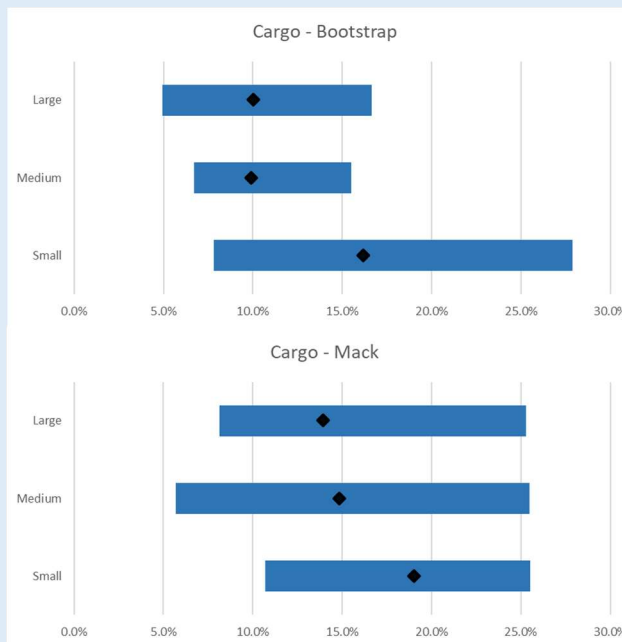
The wide range generated in the Large companies category for the Mack results is mainly due to one company which had particularly bad claim experience. With the exclusion of that company, the range of results generated for Large companies by the Mack method is very similar to the Bootstrap results.

4.4 Marine Hull

With Gross Direct Premiums/Contributions volume of RM 247 million in 2021, Marine Hull which covers accidental loss or damage to boats and seagoing vessels is one of the smallest classes of business in Malaysia. Similar to Cargo, data for 21 companies was provided for Marine Hull. Four companies out of the 21 were excluded due to the size of the portfolio. Given that Marine Hull is a relatively small class of business in Malaysia, there was not enough variability in the premiums to split the companies into three distinct categories. Hence, the results are presented in two categories in Table 9 and Figure 9.

Table 9: Summary of Risk Margins – Marine Hull

	No. Companies	Bootstrap				Mack			
		Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Large Companies	7	7.1%	11.2%	18.8%	1.9%	10.8%	15.2%	20.6%	2.0%
Small Companies	10	8.2%	15.5%	26.4%	4.7%	n/a	n/a	n/a	n/a

Summary statistics could not be provided for small companies using the Mack method as there were insufficient credible results produced across the 8 companies. The reason for this is that claims tend to be quite extreme in this class where majority of the claims are relatively small while the remaining claims can be very large especially when there is a major loss to the vessel (e.g. collision, sinking, etc.).

Figure 9: Summary of Risk Margins – Marine Hull
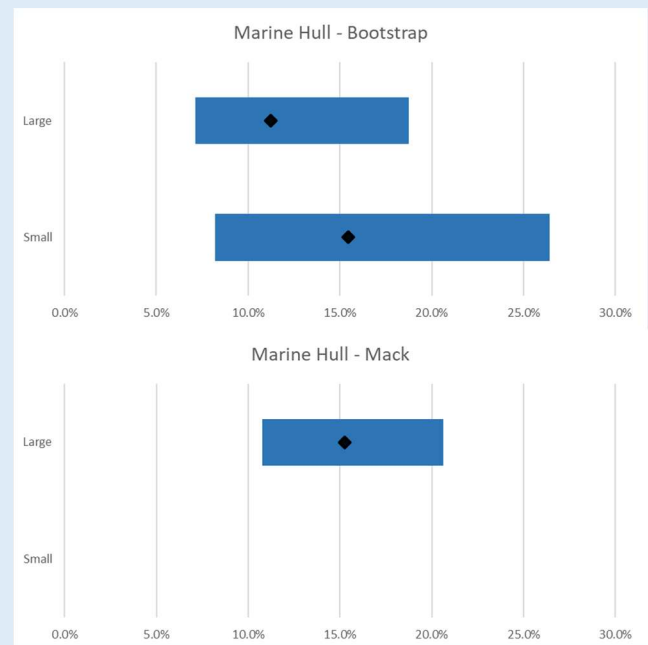
5. Conclusion

It is observed that in most cases, the Mack method produces higher risk margins than the Bootstrap. Since both methods were employed for the same purpose but produced significantly varying results, it raises a critical question about which set of results should be relied on. This question can be answered by understanding the intricacies behind the two methods.

An initial comparison indicates that the Mack method has an advantage over the Bootstrap method by virtue of its distribution free approach, i.e. it does not make any assumption on the underlying distribution of the claims data being analyzed. In contrast, the Bootstrap method assumes the claims data follows an Over-Dispersed Poisson distribution which may not always hold in practice.

However, the Mack method ultimately produces a point estimate, i.e. the mean square error of the overall reserve estimate. It is only by utilizing the mean square error with an assumed distribution (Lognormal in this study) that the 75% confidence level can be generated. It also can be argued that the point estimate produced by the Mack method does not give any other information to assist in selecting an appropriate distribution to use in conjunction with the mean square error.

In comparison, the Bootstrap method is more robust than the Mack method as it produces a whole range of results through the repetitive resampling of residuals instead of a point estimate. It is from this range of results that a distribution of the reserves can be formed to extract the value of the 75% confidence level. Another point in support of the robustness of the Bootstrap method is its treatment of potential outliers (e.g. large losses) in the data where the outliers are averaged out through the numerous repetitive resampling. This results in more stable estimates as evident by the lower risk margins produced compared to the Mack.

It is based on this reasoning that the Bootstrap is adopted as the default set of results for this study. However, the Mack and Bootstrap are not the only methods available to measure claim volatility and in practice, it is up to the actuary to exercise their best judgement on which method is best applicable in their reserving process.

Readers of this study should exercise judgement when interpreting the results and are advised to be forward looking and take into account the potential impact of latest circumstances such as rising inflation, performance of the Malaysian Ringgit, and the crystallization of Civil Law (Amendment) Act 2019 on their respective portfolios.

Author
Tony Tan, Malaysian Re

With thanks to
Henry Cheah, ISM
Lee Wei Wei, ISM
Gillian Goh, ISM
Christina Ling, ISM
Aisha Nuval Othman, Malaysian Re
Seervina Kaur, Malaysian Re
Nur Atikah Mohamed Rozali, Malaysian Re
Victor Liew, ex-ISM
Adrian Lee, ex-ISM
Nurin Faqihah, ex-ISM

Appendix A – Statistical Methodology

In the presentation of the results in this report, reference was made to the methodology used in the Australian Prudential Regulation Authority (APRA) report on risk margins.

The weighted average of risk margins utilized in Section 4 of this report was calculated using the following formula:

$$Weighted\ Average = \%WARM = \frac{\sum_{i=1}^{n} RM_i}{\sum_{i=1}^{n} CE_i}$$

The weighted standard deviation of risk margins was calculated using the following formula:

$$Std\ Dev = \sqrt{\frac{1}{(n-1)}\sum_{i=1}^{n} \frac{CE_i}{\sum_{i=1}^{n}\frac{CE_i}{n}}(\%RM_i - \%WARM)^2}$$

where

$n = Number\ of\ companies\ in\ that\ particular\ category$

$i = Company\ 1, Company\ 2, …, Company\ n$

$RM_i = 75\%\ Risk\ Margin\ in\ ringgit\ terms\ for\ company\ i$

$CE_i = Central\ estimate\ in\ ringgit\ terms\ for\ company\ i$

$\%RM_i = 75\%\ Risk\ Margin\ as\ a\ percentage\ of\ CE_i\ for\ company\ i$

$\%WARM = Weighted\ Average\ of\ Risk\ Margins$

Appendix B – 75% Risk Margin Summary Table

Class	Claim Type	# Modelled Companies	Total # Companies	Company Size	Bootstrap				Mack			
					Min	Average	Max	Std Dev	Min	Average	Max	Std Dev
Motor Act	Incurred	25	25	Large	5.6%	8.0%	12.0%	2.0%	21.0%	23.7%	25.4%	1.6%
				Medium	5.4%	10.4%	17.6%	3.8%	13.1%	20.4%	25.5%	4.5%
				Small	11.0%	12.4%	20.3%	2.0%	8.1%	19.1%	25.4%	7.3%
Motor NonAct	Paid	25	25	Large	4.3%	5.2%	7.0%	1.0%	8.9%	13.6%	17.1%	2.8%
				Medium	2.5%	4.8%	7.7%	1.4%	5.4%	10.1%	15.8%	3.1%
				Small	3.0%	4.6%	11.7%	2.2%	6.8%	10.7%	20.2%	4.3%
Private Car	Paid	25	25	Large	4.0%	5.0%	7.3%	0.9%	7.9%	9.3%	11.1%	1.0%
				Medium	2.6%	4.8%	6.6%	1.1%	5.0%	8.2%	11.2%	1.8%
				Small	4.1%	5.1%	10.0%	1.6%	7.3%	9.1%	18.7%	3.9%
Motorcycle	Paid	21	25	Large	5.7%	6.7%	9.4%	1.2%	7.0%	10.2%	16.1%	3.8%
				Medium	10.3%	13.3%	15.9%	2.2%	14.4%	16.4%	22.9%	5.6%
				Small	11.2%	16.2%	17.4%	2.2%	20.1%	22.3%	25.4%	7.6%
Other Vehicles	Paid	25	25	Large	4.1%	6.1%	8.5%	1.5%	6.1%	10.3%	14.2%	2.6%
				Medium	5.4%	8.5%	11.5%	2.3%	9.0%	12.2%	17.5%	2.4%
				Small	8.0%	11.7%	22.7%	3.3%	12.3%	17.4%	25.5%	3.4%
Fire	Incurred	25	25	Large	9.5%	10.5%	15.3%	2.2%	11.0%	11.9%	18.2%	2.1%
				Medium	8.8%	11.9%	23.6%	3.0%	9.4%	17.6%	25.5%	5.1%
				Small	10.9%	12.5%	23.5%	3.0%	11.0%	14.5%	25.2%	4.8%
Cargo	Incurred	20	21	Large	4.9%	10.0%	16.6%	5.0%	8.1%	13.9%	25.3%	7.4%
				Medium	6.7%	9.9%	15.5%	2.9%	5.7%	14.8%	25.5%	6.4%
				Small	7.8%	16.2%	27.9%	5.7%	10.7%	19.0%	25.5%	6.3%
Marine Hull	Incurred	17	21	Large	7.1%	11.2%	18.8%	1.9%	10.8%	15.2%	20.6%	2.0%
				Medium								
				Small	8.2%	15.5%	26.4%	4.7%				

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