Block Dental

Executive Summary

Team 28

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In order to lower the loss ratio, the Block Dental actuarial team first made a two-factor probability model to predict the win rate based on the rate increase and the loss ratio. Based on the model, one strategy to maximize revenue and one to maximize profits in a three-year period were developed respectively, and the corresponding expected loss ratios were calculated. The targeted loss ratio 70% lay between the expected loss ratios based on the two strategies. Finally, through a blend of the two strategies, we derived our desired rate increases in each of the three years to arrive at the desired loss ratio. Our reasoning and methodologies are presented below.

Probability Model

The correlations between each potential factor and the win rates were accessed by bar graphs. We looked for factors that had strong associations with win rates, that were independent with each other, and it was concluded that potential factors included channels, rate increases and loss ratios. To make more accurate predictions of the win rate, the two-factor probability model was developed. Among the three factors above, rate increases and loss ratios were selected to be the independent variables for the probability model because they were the most accurate compared with the win/loss results in the training data. The model was a three-dimensional curve based on logistic regression, a popular machine learning tool. The curve generated by the model is shown in graph 1.

Profit and Revenue Optimization Strategy

Based on the probability model, we could devise strategies to maximize revenue and maximize profits respectively. Assumptions included that factors other than rate increase and loss ratio did not significantly impact the win rate and so on. The reasoning was that to maximize total revenue was to maximize the individual revenue in each group, because the variables within one group were independent from variables in other groups. Thus, the calculation process was simplified. For each individual function, the formula to calculate revenue was the product of premium and

win rate, with the rate increases in each year as the independent variables. Then, by using Solver in Excel, we obtained the rate increases and the maximized expected revenue for each group. The process of maximizing the profit was similar, except that claim was added into the formula. Finally, the average expected loss ratios for the two strategies were calculated, offering more insight for the final problem. The expected premium, expected claim and expected loss ratio for each year are shown in chart 1.

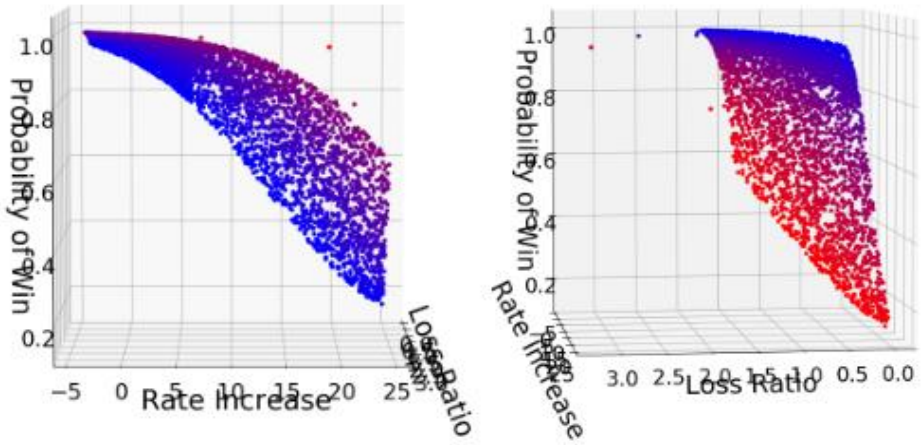
Final Strategy

Based on the results from the last question, we tried to create a blend of the two strategies to arrive at our expected loss ratio. The loss ratios based on the two strategies constituted an interval that included our desired loss ratio. In order to blend the strategies with proper weights and considering the concerns of companies about giving large rate increases, we established a connection between the revenue and the weight of the strategies in each of the three years. Then, we maximized the revenue restricted by the constraint of the 70% loss ratio. By using Solver again, we obtained the weight for each year and thus were able to finalize the rate increases for each group in each year. Finally, the average rate increase for each loss ratio band was calculated by considering group size. The values are shown in chart 2.

Implications

We believe that combining the two-factor probability model and the strategy to lower loss ratio, we could derive satisfying solutions. However, we are also aware that the model and the strategy could be improved if more powerful tools are available or channels and previous rate increases are taken into consideration. Meanwhile, other ways to reduce loss ratio exist, such as implementing stricter underwriting guidelines and developing new products.

In summary, this problem is indeed a selection of the trade-offs between revenue and loss ratio. To maintain a high revenue and thus a high market share, the loss ratio has to be sacrificed, explaining the currently high loss ratio 88% under the aggressive policy. To lower the loss ratio, a portion of the revenue has to be sacrificed. Our strategy aims to maintain as much revenue as we could while lowering the loss ratio, providing a smooth transition from an expanding policy to a more sustainable one in the long run.



Graph 1 Probability Model

Note: the left graph shows probability of win with respect to rate increase, the right graph shows probability of win with respect to loss ratio.

Revenue Optimization			
	Year 1	Year 2	Year 3
Expected Loss Ratio	86%	84%	**81%**
Expected Premium	$102m	$98m	**$95m**
Expected Claim	$88m	$83m	$78m

Profit Optimization			
	Year 1	Year 2	Year 3
Expected Loss Ratio	71%	60%	**53%**
Expected Premium	$87m	$74m	**$64m**
Expected Claim	$62m	$45m	$34m

Chart 1 Expected Loss Ratio, Claim & Premium Based on Two Strategies

Average of Rate Increase			
LR Bands	**Year 1**	**Year 2**	**Year 3**
(0,25]	**-2.3**	**-2.3**	**-2.2**
(25,50]	**0.4**	**0.5**	**0.7**
(50,70]	**3.3**	**3.5**	**3.6**
Benchmark : LR = 70%			
(70,100]	**9.2**	**9.0**	**8.8**
(100,150]	**17.2**	**16.1**	**15.3**

Chart 2 Average Rate Increases Based on Loss Ratio Bands