Blue Shield of California Executive Summary

Team 11

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Overview

The Bruin Shield of California Team was tasked with calculating annualized projected 2022 trends, using the historical data provided, as well as emerging data for the first half of 2022. We utilized the Limited Fluctuation Method and Credibility to blend our results into a weighted credibility trend that can be compared to the XGBoost machine learning model. We present our methods and analysis below, and put forth our recommendation on whether the company should pursue the machine learning results and if it should be incorporated into actuarial work.

Manual Trend

To calculate the manual trend, we first started with adding the utilization and allowed dollars of each market to obtain sum of utilization and the sum of allowed dollars. Then, we divided these two sums by the grand total of all different markets to come up with utilization weights and dollar weights. Before creating the predicted 2022 underlying trend, we excluded the 2019-2020 data because there were outliers in the Professional services category, which would significantly skew the underlying trend. Omitting the 2019-2020 data resulted in a more linear trend. Hence, to examine the weighted unit cost and weighted utilization of different markets, we used the FORECAST.LINEAR function to predict the trend for different Lines of Businesses (LOB). With an R-Squared of 40%, we are confident that a linear relationship exists (See Figure I). By using this function, we came up with the Raw Predicted 2022 Trend. Lastly, multiplying the Raw Predicted 2022 Trend and the previously-calculated market weights and taking the sigma of the product provides us with Predicted 2022 Underlying Trend/Manual Trend. The Manual Trend is significant because it allows us to use valid data from the past, which makes the prediction more well-rounded along with the experience trend.

Experience Trend

We took into account the 5% increase in expenditure for Brand drugs during January 2022 and February 2022. This led us to acquire an event-modified sum of utilization and sum of allowed dollars for the first half of 2022. Using 2021 first-half data and 2022 first-half data, we calculated the predicted annual trend, which represents the percent change from the first-half of 2021 to the first-half of 2022. In addition, we took into consideration the estimated deferment rates by type of service in 2021. This also gave us an event-modified 2021 underlying trend. Next, we predicted the 2022 second-half underlying units by multiplying the event-modified 2021 underlying units by the coefficient of the predicted underlying annual trend. In order to predict the total number of member months for the second-half of 2022, we assumed that the ratio from the first-half to the second-half of 2021 was going to be similar for 2022. Now that we have the combined 2021 and 2022 underlying units and event units, we were able to create our experience trend. The experience trend utilizes data in the present to predict future data. Along with the manual trend, the experience trend allows us to have a much more well-rounded prediction.

Greatest Accuracy Method

The Greatest Accuracy Method uses means and variances from a portfolio of risk groups to calculate a risk group's Credibility-Weighted Rate. The portfolio would consist of related risk groups. This method requires that we use the Bühlmann Credibility Formula to find the credibility weight, Z: Z = N / (N + K). However, since we could not define K in this case, we would not be able to achieve full credibility. For this reason, we decided that the Limited Fluctuation Method would be a better choice for this data set.

Limited Fluctuation Method

Once we had created our manual trend and our experience trend for each service category as well as each line of business, we decided to use the Limited Fluctuation Method because it was simple to apply to this scenario due to only having an observed population. Using this method required that we use the Credibility-Weighted Rate Formula. This formula requires a credibility weight, Z, an Observed Rate, and a Prior Rate. We chose our Manual trend to be the Prior Rate and our Experience trend to be the Observed Rate. To find Z, we used the Square Root formula, which took the square root of N_{AC}, the actual observations on which the Observed Rate is based on, divided by N_{FC}, the observations required to reach full credibility. Based on these conditions, we chose N_{AC} to equal the sum of member months for 2022 and N_{FC} to equal the sum of member months for 2014-2019. Doing so allowed us to find our Credibility-Weighted Rate, Z, and finally blend our results into a Credibility-Weighted Trend using the Credibility - Weighted Formula. The Credibility Weighted Formula was Z * (Experience Trend) + (1 - Z) * (Manual Trend). The Credibility Weighted Trend was later used to compare alongside the XGBoost machine learning model.

Recommendation: Incorporate XGBoost ML into actuarial practices as an efficient tool

As you can see, we used about 6.5 years of data, particularly from 2014-2022, excluding the years 2019 and 2020, whereas the XGBoost machine learning model only used 3-6 months of data and got close to our approximation (See Figure II). Although differences exist between XGBoost trends and ours, we believe that if the machine learning model had more data to work with, it probably would have gotten closer to our approximation or even matched it (see Figure III). It would then be a good idea to use XGBoost to save time since we were inefficient with missing data. However, we are not sensitive to outliers, unlike XGBoost. Therefore, there are both advantages and disadvantages to solely doing the trends ourselves or allowing machine learning to do the trends for us. One suggestion would be to clean up the data so that XGBoost can work efficiently and without any issues. All things considered, machine learning cannot completely replace actuarial work, but it can be a great asset to actuaries for creating trends and assisting in calculations.

Figure I. 2014-2018 Overall Trend and Predicted Trendline with 2022 Raw Predicted Trend

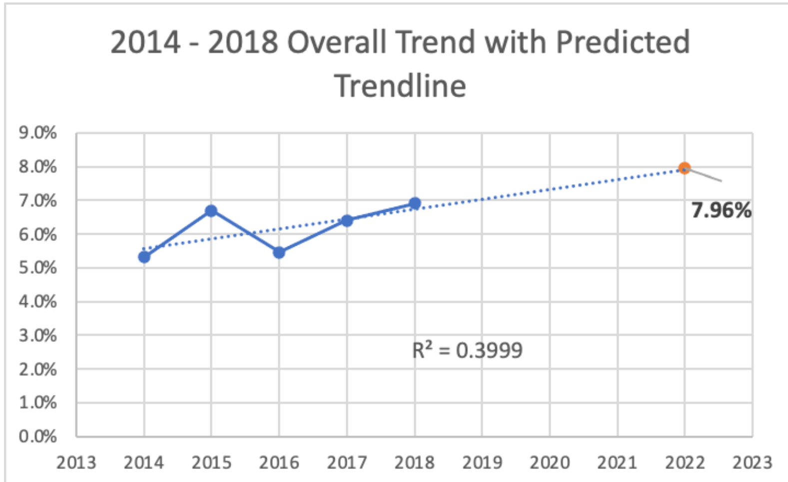

Figure II. 2022 XGBoost Trends vs. Predicted Trends for Markets

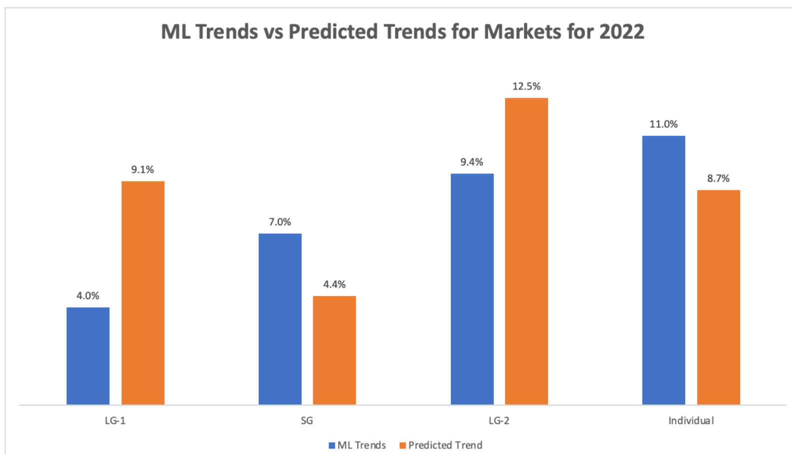

Figure III. Historical Trends with XGBoost and Overall Predicted Trends