

# **Blue and Gold Health**

## *Executive Summary*

Case Competition, Winter 2023, Jan 27

Group 16

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### **Abstract**

The Blue and Gold Health company produced the year-end 2022 trend analysis and a recommendation regarding the usage of machine learning models in current processes. A manual and an experience trend were calculated using historical data and 2022 data from January to June, respectively. The trends were then credibility blended and analyzed for each line of business (LOB): Inpatient (IP), Outpatient (OP), Professional (Prof), Ancillary (Anc), and Drugs (Brand Drugs, Generic Drugs). Lastly, we compared the results of the XGBoost machine learning model and the calculated trends. Our methodologies and solutions are discussed below.

### **Methodology for Manual Trend**

For the manual trend calculation, the historical data provided was used. Specifically, 2014 - 2018 data was used for the underlying trend due to the timeframe containing few fluctuations and being unaffected by recent global events such as the COVID-19 pandemic, while 2019 - 2020 was used for the event trend due to abnormalities such as 2019's rises and 2020's dips relative to 2014 - 2018 data. After these considerations, the manual trend was found for each measure (unit cost, utilization per thousand, and per member per month) and service category. Annual averages of unit cost and utilization data by service category were calculated by dividing the sum of each LOB by the market volume for the same year. The curves of these average points are shown in Graph 1 and Graph 2. Using the TREND function, each LOB's trends were predicted until 2022, and equations were obtained to calculate 2022's trend units to produce the Adjusted Core Trend.

### **Methodology for Experience Trend**

According to the case study, 2022's trends were affected by COVID-19 mandate removals leading to higher flu vaccine usage and a 5% increase in brand drugs expenditure as well as Blue and Gold Health's contract renewal, leading to 2% in savings for brand drugs and 7% in savings for generic drugs in 2022's second half. These factors were considered while calculating the experience trend. The experience trend calculations are based on the 2021-2022 claims and the util/k, unit cost, and PMPM can be found for each LOB. However, these calculations require a seasonality index to be obtained from 2021's data to predict the second half of 2022's trends.

## **Seasonality**

Seasonality revolves around the idea of values varying between different quarters of the year. For this case, the 2021 claims data is used to predict the data for 2022. Based on 2021's data, each quarter's seasonality index (Jan to March, April to June, July to September, October to December) is found through the seasonality formula (Quarterly Values/Average Values), thereby creating each quarter's indices. Using the first half year of 2022's data and dividing a quarter's value by its quarter's seasonality index, we obtain the quarterly average for 2022. Therefore, by multiplying the average by the quarter's index, we obtain a fair estimation for the second half year of 2022. This provides a reasonable projection for the units of 2022's latter half.

The data for 2021 was used for the index as it is a full year's set of data and is closest to 2022, more accurately representing a world just recently recovering from the COVID-19 pandemic.

## **Data Analysis**

After making calculations for the experience trend from experience data based on the claims from 2021 to 2022 and the manual trend based on the historical data of trends from 2014 to 2020.

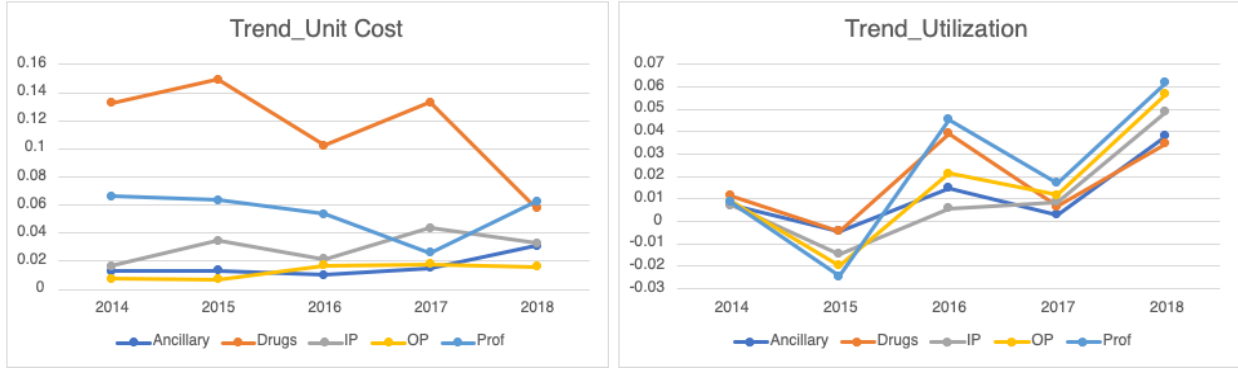
## **Limited Fluctuation Model**

To blend the two trends together, we used the limited fluctuation model (Credibility Weighted Rate =  $(Z) \text{ Observed Rate} + (1-Z) \text{ Prior Rate}$ ), due to its ability to mitigate data abnormalities and its application to trends based on emerging data, such as 2022's data in this case.

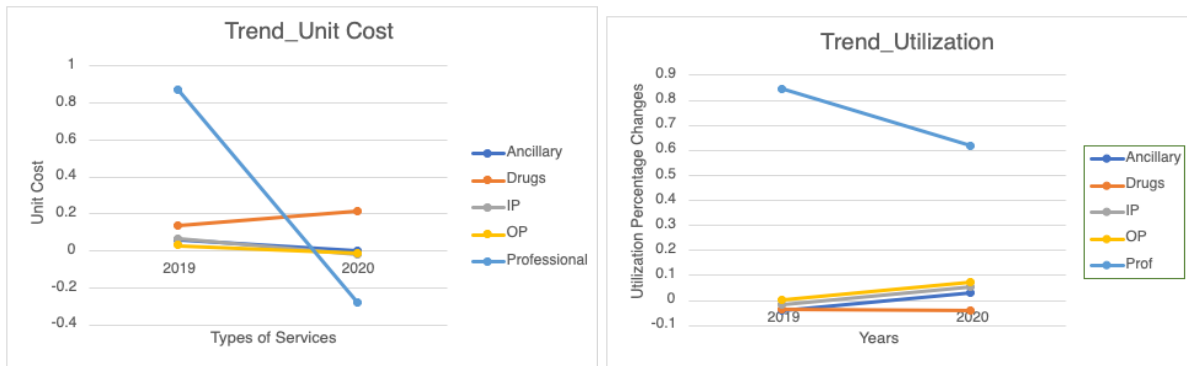
For this case, our experience trend is the observed rate and our manual trend is the prior rate. The Z value that was decided, based on the square root formula, was the square root of 972, the number of claims used to calculate the experience trend divided by 1082, a commonly used number for a confidence level of 90%. The formula synthesized our trend calculations and allowed us to compare them to the XGBoost model's produced trends.

## **Conclusion & Recommendations**

The credibility calculated trends were compared to machine learning trends and the blended ones were found to be lower than that of the machine learning ones. Using our actuarial judgment, we attributed this difference to the XGBoost model's larger sample size and intricate decision processes. In conclusion, our research finds the XGBoost Model's effectiveness in calculating large datasets and intricate decision networks allows it to produce more accurate trends compared to the weighted credibility method. The XGBoost model is better at handling large datasets but is less effective with smaller and less structured datasets. It is recommended for such data to be organized beforehand or manually calculated to produce accurate trend predictions.



Graph 1: Trends of Unit Cost (Left) and Utilization (Right) from 2014 to 2018



Graph 2: Trends of Unit Cost (Left) and Utilization (Right) from 2019 to 2020

Blended Trend			
Benefit Type	Underlying Trend	Event Trend	Adjusted Core Trend
<b>Utilization</b>			
Inpatient	10.4%	20.2%	32.9%
Outpatient	11.2%	11.8%	24.5%
Professional	5.6%	6.0%	11.9%
Ancillary	6.0%	26.0%	33.7%
Drugs	4.4%	2.7%	7.3%
<b>Total</b>	<b>5.1%</b>	<b>5.5%</b>	<b>10.9%</b>
<b>Unit Cost</b>			
Inpatient	-18.2%	-9.2%	-25.5%
Outpatient	-3.8%	-1.8%	-5.5%
Professional	0.9%	14.4%	15.7%
Ancillary	-16.0%	0.6%	-15.4%
Drugs	32.0%	23.3%	63.7%
<b>Total</b>	<b>-14.4%</b>	<b>7.5%</b>	<b>-8.0%</b>
<b>PMPM</b>			
Inpatient	-9.7%	9.1%	-1.5%
Outpatient	7.1%	9.7%	17.5%
Professional	6.5%	21.3%	29.1%
Ancillary	-11.0%	26.8%	12.9%
Drugs	37.8%	26.6%	74.5%
<b>Total</b>	<b>-10.0%</b>	<b>13.4%</b>	<b>2.1%</b>

Table 1: Calculations of blended view