



Bruin Actuarial Society 11th Annual Case Competition

Background

You are a trend actuary for Blue and Gold Health, a health insurance company offering coverage for large employer groups (100+ employees), small employer groups (2-100 employees), and individuals. Recently, there has been a modernization effort across the company and as a result your Chief Actuary wants you to begin incorporating machine learning results into your trend analysis. In addition to producing the year-end 2022 trend recommendation for your company, you are expected to understand some of the benefits and disadvantages of the XGBoost machine learning algorithm and give a recommendation regarding the continued use and incorporation of machine learning models into existing processes.

Case Study

Due to certain irregularities, there are several events affecting the current year that are not expected to continue at the same level in the future.

Specifically:

- Due to the lifting of COVID mandates, utilization rates for flu vaccines affecting 2022 pharmacy expenditure are observed to be elevated by 5% in January and February 2022 for Brand drugs compared to historical years.
- Blue and Gold Health is renewing their contract with their Pharmacy Benefits Manager (PBM) beginning the second half of 2022. The new contracts are expected to generate 7% in generic drug savings and 2% in brand drug savings for the second half of the year compared to historical cost.
- Due to the concerns surrounding COVID, 2020 and 2021 claim levels were considerably depressed as people were reluctant to seek non-emergency medical care. The following chart depicts the overall level of estimated deferred services by type of service in 2021.

| Type of Service | % Deferred |
|-----------------|------------|
| IP | 9.2% |
| OP | 1.4% |
| Prof | 0.8% |
| Anc | 17.3% |

What's Provided

Excel sheet:

- | Core Trend Summary | - An example of what the final summarized trend tables should display. You will need to create additional charts/tabs for your work.
- | Historical Trends | - Historical trend results by type of service. The historical data should aid you in formulating your manual trends. You will need to use judgement to determine how many years to include and whether to exclude certain years.
- | 2022 ML Trends | - Trend results produced by the XGBoost model.
- | 2020-2022 Claims | - Aggregated claims data by LOB for experience trend calculation.

Tasks

Part 1 – Excel calculations:

1. Using the data provided in the excel document, calculate the annualized, projected 2022 trends. You will need to produce a manual trend calculated using historical data as well as an experience trend based on emerging 2022 data for the first half of the year.
 - a. For both views, break out the trends by unit cost, utilization, and PMPM as well as by service categories. You will also need to isolate the impacts by the underlying trend and event trends.
 - i. For the manual trends, two unit tables are provided in the | Core Trend Summary | tab to aid you in laying out your results. The unit tables should display the annualized units by category:
 1. Util/K – a measure of utilization on an annual basis per year per thousand lives covered. For example, if the total pharmacy script count in 2022 was 100, then $\text{Scripts/Thousand} = 100 * 12000 / \text{Total Member Months}$.
 2. Unit Cost – cost per unit of utilization in service. For example, if the 2022 pharmacy scripts count was 100 and the total allowed cost was 5000, then the unit cost will be $5000 / 100$.
 3. PMPM – the annualized cost per member per month. For example, if the total pharmacy allowed cost in 2022 was 5000, then the PMPM will be $5000 / \text{Total Member Months}$.

- ii. When completing the 2022 table, be sure to annualize the results as experience data only goes through June. You can use the 2021 seasonality patterns to do so. The exact method is up to your judgement.
 - b. Once you have the two views, credibility blend the results and justify your methodology. You will need to produce the results for each LOB as well as a blended view combining all LOBs together.
2. Using the results produced by the XGBoost model, analyze the difference between the machine learning model and your calculated trends.

Part 2 – Written/presentation response:

1. Present your trend results to your Chief Actuary. Explain your methodology and justify your recommendation. Be sure to use charts and other graphical representations to show your results. You may use PowerPoint to present your results.
2. Make a recommendation regarding whether the company should pursue using the machine learning results. Explain both benefits and disadvantages of the model and justify your recommendation.

Glossary of Terms

Allowed Dollars – Total dollars paid for health service. Allowed dollars are made up of a paid portion paid by the health insurer and a copay portion paid by the member.

Anc – Ancillary. Services and supplies provided by organizations outside of the other service components. Examples include ambulance and durable medical equipment.

Brand Drugs – Drugs marketed under a proprietary, trademark-protected name.

Core Trend – The trend of underlying medical services.

Deferred Services – Services not rendered in a particular year but that is expected to return in the future. For example, an individual needing knee surgery deferring the procedure by one year.

Event Trend – Trend of one-time events that are unlikely to occur again.

Experience Trend – Trend calculated using a portion of the experience data that is deemed credible for the trend year.

Generic Drugs – Typically the lowest cost and most commonly dispensed prescription drug. A generic equivalent drug is a generic version of a brand drug, created once a brand's patent expires.

IP – Inpatient. Services generally requiring an overnight stay at a hospital.

LG-1/LG-2 – Large groups comprised of different employer groups with different benefits.

LOB – Line of Business.

Manual Trend – Trend calculated using historical data. Especially at the beginning of a year when there is no experience data, historical trends are used to project the future time periods. Generally, judgments and adjustments are applied to incorporate known information about the future time periods.

Member Months – Total members participating in a month.

OP – Outpatient. Medical services that do not require an admission into the hospital.

PBM – Pharmacy Benefits Manager. A third-party administrator of prescription drugs responsible for negotiating drug benefits and discounts.

PMPM – Per member per month. The PMPM trend is equivalent to the combination of the Unit Cost and Utilization trends.

Prof – Professional. Services rendered by a physician, e.g., annual checkups, etc.

Rx – Pharmacy. Cost associated with prescription drugs.

Unit Cost – Cost per unit of utilization in service. For example, if the 2022 pharmacy scripts count was 100 and the total allowed cost was 5000, then the unit cost will be $5000 / 100$.

Utilization Per Thousand (Util/K) - A measure of utilization on an annual basis per year per thousand lives covered. For example, if the total pharmacy script count in 2022 was 100, then Scripts/Thousand will be $100 * 12000 / \text{Total Member Months}$.

Yearmmo – Year and month.

Suggested Resources

- Trend development:
 - [Trend Rate Development \(milliman.com\)](https://www.milliman.com) – slides 1-8, 15-19
- Credibility:
 - [Credibility Methods Applied to Life, Health, and Pensions \(soa.org\)](https://www.soa.org) – Sections 1.1-1.2, pg. 9-10
 - [limited-fluctuation-method-eample.xlsx \(live.com\)](https://live.com)
 - [credibility-weights-based-confidence-intervals.xlsx \(live.com\)](https://live.com)
- Seasonality:
 - [Seasonality Index Formula & Calculation | How to Calculate Seasonal Index - Video & Lesson Transcript | Study.com](https://www.study.com) (An account is not required – the available snippets should suffice)
 - [Seasonally Adjusted Annual Rate \(SAAR\) - Overview. \(corporatefinanceinstitute.com\)](https://corporatefinanceinstitute.com)