Navigating Shipping Contract Price Anomalies and Elasticity

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Problem Statement
CMA CGM is in need of a tool that can flag rates that are out of the market or that can predict the impact of contract rate changes on future bookings.

Which customers’ rates need adjustment each week?
What price should we adjust the rates to?
What will happen to the potential shipping quantities if we adjust the rates?

Dataset

Historical Shipping Contract Amendments (2020-2023)
17M rows × 24 features
Route specifics and rate adjustment, customers, price, contract duration, port pairs

Historical Customer Bookings & Cancellations (2020-2023)
1.4M rows × 25 features
Booking activity: booking status, customers, shipping volume, port pairs

Methodology

Phase I - Outlier Detection

Goal: design an outlier detection algorithm to identify and flag pricing outliers in 70M CMA contracts to replace the manual identification

Outlier appears when:
- Rates are not reviewed frequently enough to capture market changes
- There are errors in the rate adjustments and contract process

Algorithm:
1. Calculate the difference between rate and averages
2. Apply clustering techniques and use 5% threshold to select outliers

Phase II - Price Elasticity

Goal: For each customer and route combination, we quantified the effect of price adjustments on potential shipping quantities.

Consolidate price and quantity historical data, apply log transformation for price and quantity

Utilize K-means clustering to pick out customers with consistent booking behaviors.

Run linear regression to get the slope (x) represents the price elasticity:
1% change in price -> x% change in quantity

Business Impact
Successfully completed testing and identified 2555 critical outliers out of 4M total active contracts for week of July 16th
Estimate a saving of $500k/year if CMA adjusts rate to the our suggested levels
Algorithm already in weekly use for the trade team, ready for production and adaptation for more specific use cases

Future Work
- Statistical Significance of Elasticity Estimates: Possible reasons for high p-value are: insufficient data or the presence of confounding variables.
- Positive Price Elasticity & No Bookings: Optimize the results considering the unusual positive elasticity and lack of information regarding customers with no bookings
- Price Adjustment Strategy: Balances the potential benefits of price increases with the potential risks considering customer loyalty, competitive landscape

Results

Phase I - Outlier Detection
Run algorithm on 4M company rates and identify 2.5k outliers weekly

<table>
<thead>
<tr>
<th>Week</th>
<th>Driver</th>
<th>Name</th>
<th>Price</th>
<th>Volume Shipped</th>
<th>Weekly Potential Impact with Price Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/16/23</td>
<td>Customer Rate Decreased more than market rate decrease</td>
<td>A</td>
<td>$1,364</td>
<td>170</td>
<td>$ 752</td>
</tr>
<tr>
<td>7/18/23</td>
<td>Market Rate Increased more than customer rate increase</td>
<td>B</td>
<td>$2,100</td>
<td>34</td>
<td>$ 369</td>
</tr>
</tbody>
</table>

Figure 1. Sample outlier result deliverable

Phase II - Price Elasticity
Run algorithm for 1400+ customer-route pairs and output elasticity.

Company | Route       | Price Elasticity | Std.err |
<table>
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<tbody>
<tr>
<td>A</td>
<td>NYC-BTM</td>
<td>-2.25</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Example: 1% change in price will result in 3.25% decrease in quantity booked.

Figure 2. Sample algorithm output