

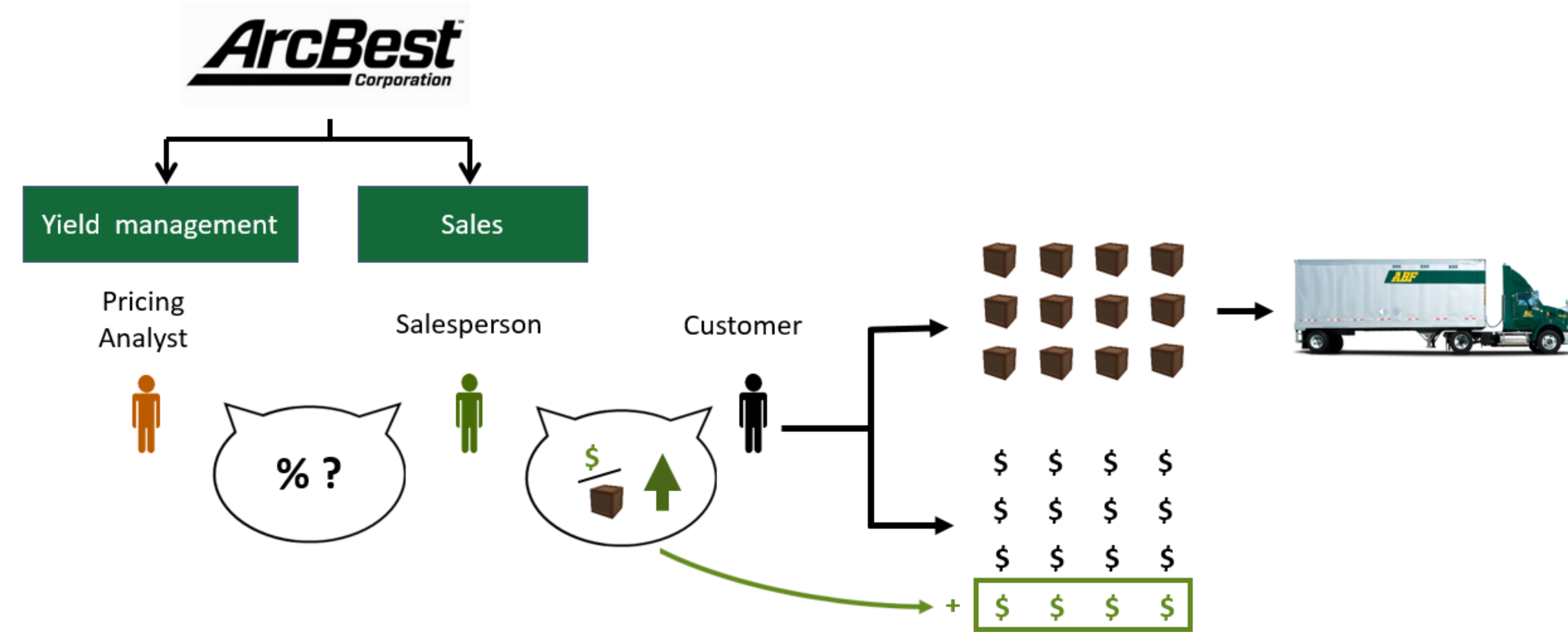


# Increase profit using data driven guidelines for the negotiation process

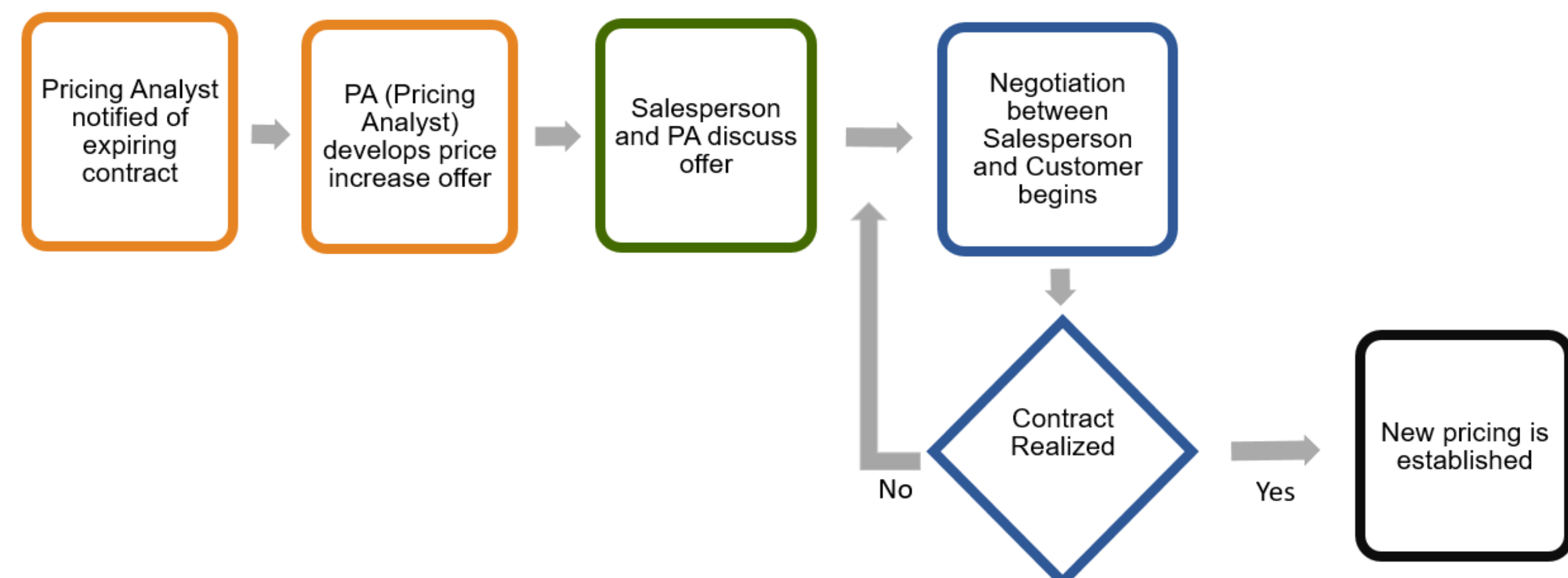
## Project and Industry Background



The team collaborated with a Forth Smith company, ArcBest, a multibillion-dollar freight and logistics solutions provider that solves complex supply chain challenges. ArcBest Corporation is made up of six subsidiaries, five of which are revenue generating. For the scope of this project our team only used historical data from ArcBest's subsidiary ABF Freight.

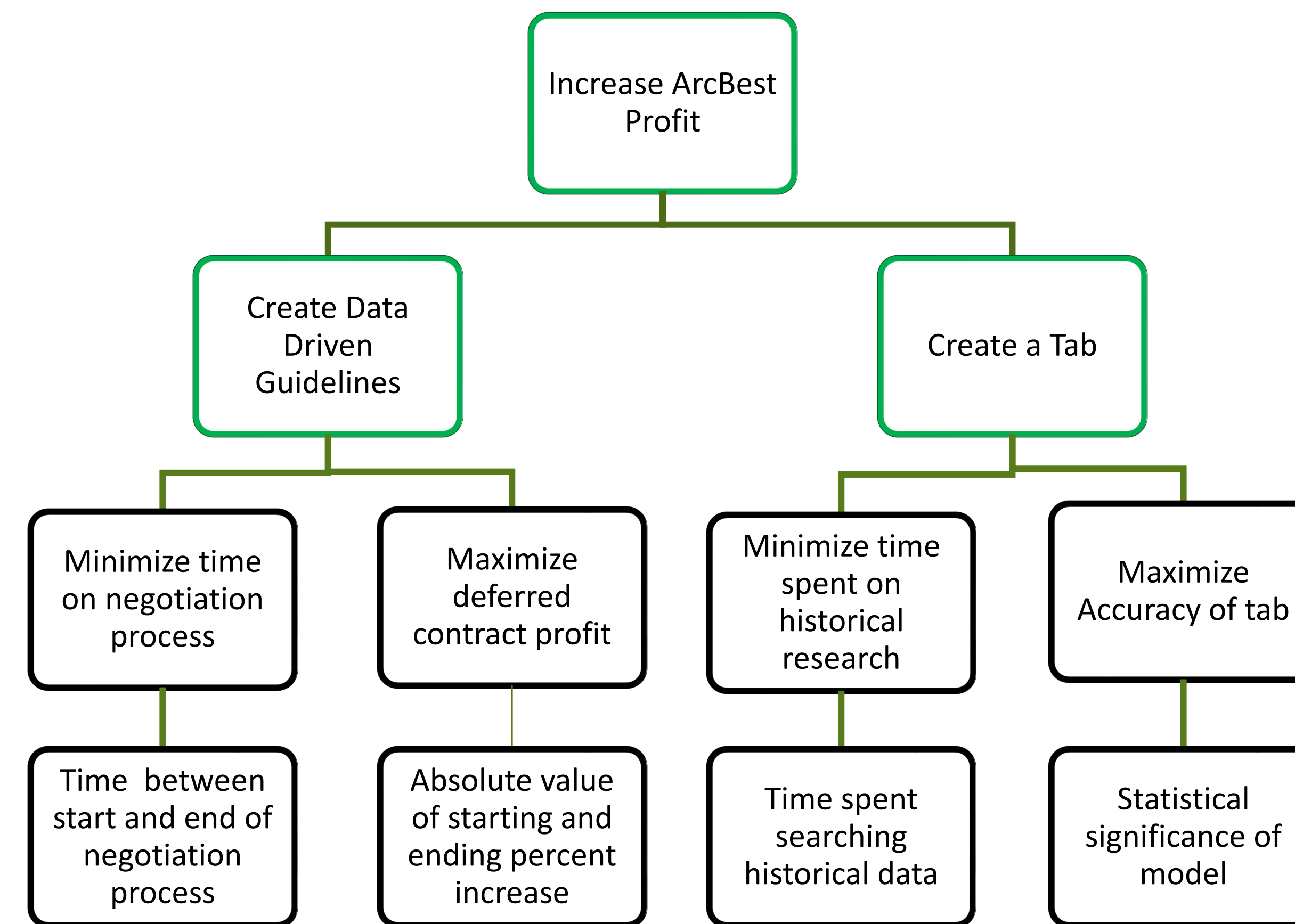


Although they are a successful LTL company, ABF Freight is still looking for ways to increase revenue. One of the method ABF Freight uses to increase their revenue is by increasing the prices with their clients. Some contracts are subject to annual, predetermined price increases. Larger clients often defer the negotiation of these future increases and require annual renegotiations called Pricing Proposal Maintenance, or PPM. These increases are facilitated by ArcBest's yield management division, which is composed of pricing analysts and sales personnel. The pricing analysts use past experience and intuition to determine pricing strategy with the sales personnel. Sales personnel then negotiate the increase with the clients.



## Project Objectives and Measures

The project proposed by ArcBest was to compose data driven guidelines that enhance the price negotiation process pricing analysts use for PPMs. DCHW Solution's primary objective is to increase ArcBest's profit gained through pricing negotiations. To achieve this, we are creating data driven guidelines, a decision support tool and financial-cost model to aid the company.



## Preliminary Analysis

ArcBest provide us with a sample size of more than 20,000 historical PPMs. The price increase and the retention of business are the two attributes selected to be response variables. The distribution of the two response variables was assessed using histograms and normal probability plots. The original distribution exhibited a few anomalies, including:

- A long tail on the distribution
- An irregular frequency of PPMs securing no increase
- Irregularities assumed to be the result of bias towards whole numbers

The data was constrained accordingly, and the resulting sample size was reduced by half the size.



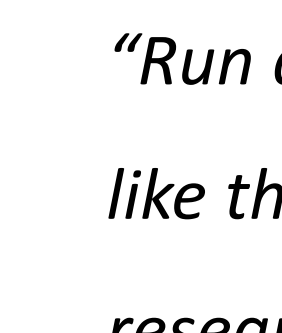
## Stakeholder Analysis

The two primary industry representatives, Christopher Adkins, Sr. Yield & Innovation Analyst and Bryan Johnson, Yield Manager, assisted the team in performing stakeholder analysis. Separate surveys were distributed to pricing analysts and salespeople to gather insight on the negotiation process that would be otherwise unattainable.



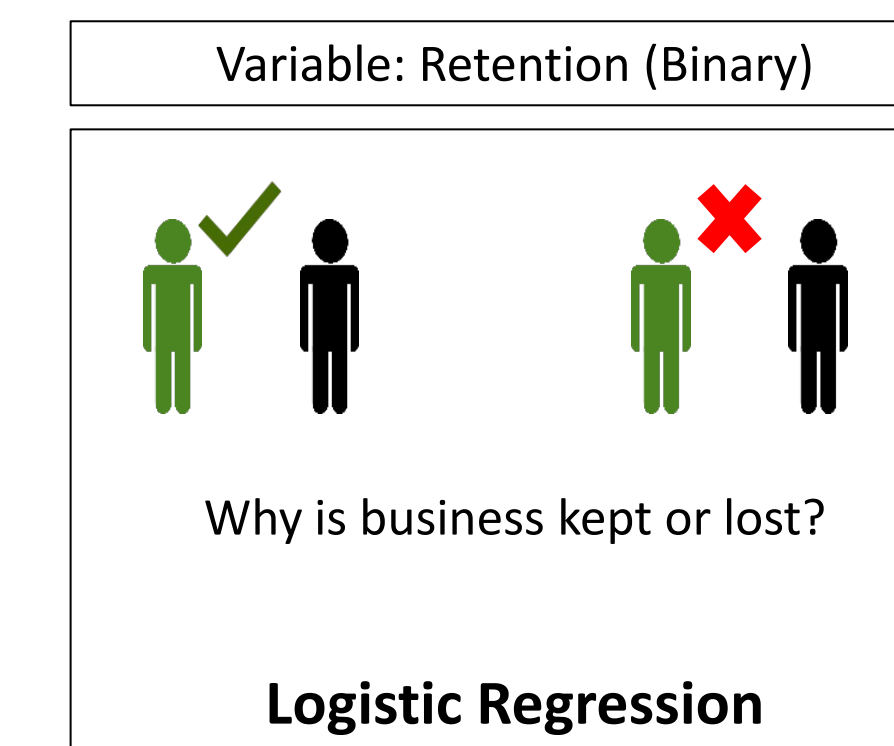
"Press for early and timely increase negotiation completion"

"A standardized approach for DEF negotiations based on IOR history, DEF history, and revenue thresholds"

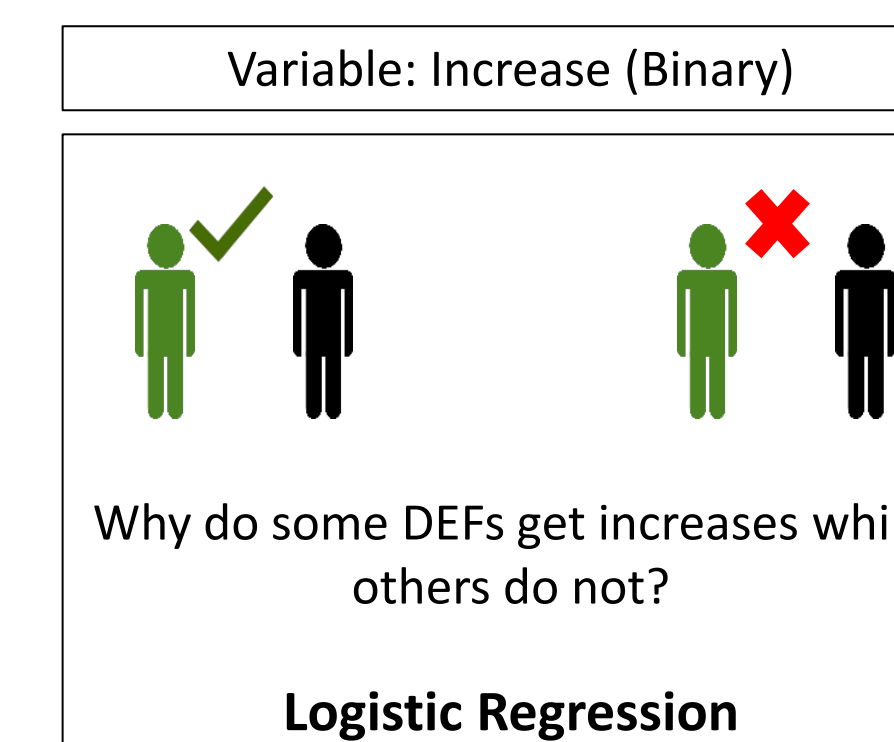


"Run analysis behind the scenes to offer suggestions for certain lanes, etc. Knowing specifics like this is crucial in negotiations and many Account Manager's are comfortable with researching in depth for this."

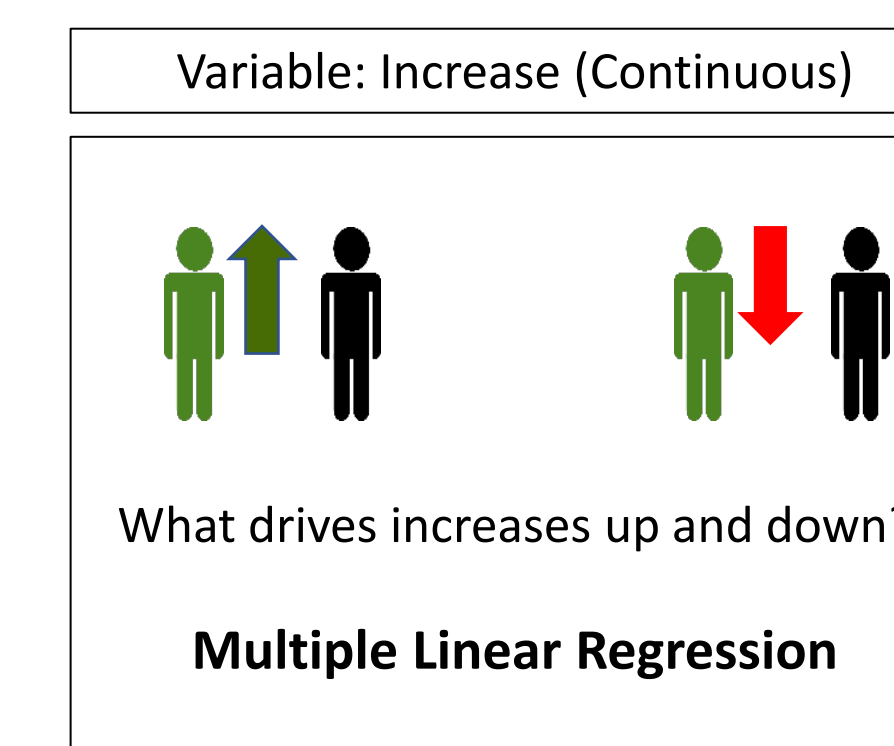
## Regression Analysis



Retention is the percent of business remaining after the PPM. It has a domain of 0, no business retained, and 1, entire business retained. Retention does not have a normal distribution, and is best understood using logistic regression. Though the substantial number of PPMs settling for 0 change in price disrupted the normality of the price change distribution, they still hold valuable information.



Logistic regression was performed again, with the occurrence of an increase as the response variable. The domain of this response variable is 0, no increase, and 1, increase secured. The goal was to create a model that provided insights into why certain contracts secured no increase.



Finally, multiple linear regression was performed on the remaining PPMs. Multiple linear regression models the relationship between the various predictors and the secured increase of the PPM. This model revealed the effect of decisions made by negotiators as well as opportunities for improvement based on characteristics of PPMs.





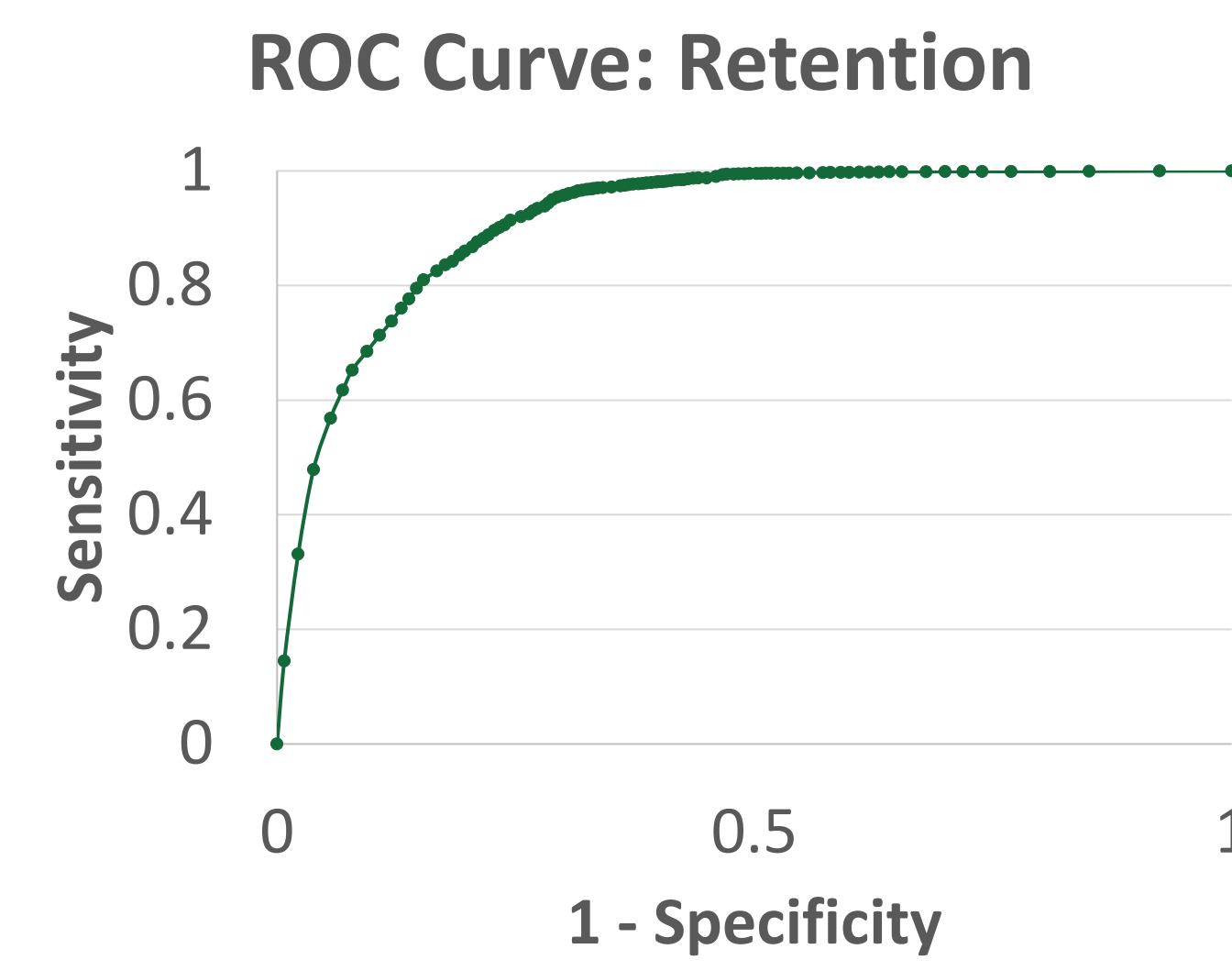
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## Logistic Regression: Retention

The variables identified as statistically significant were:

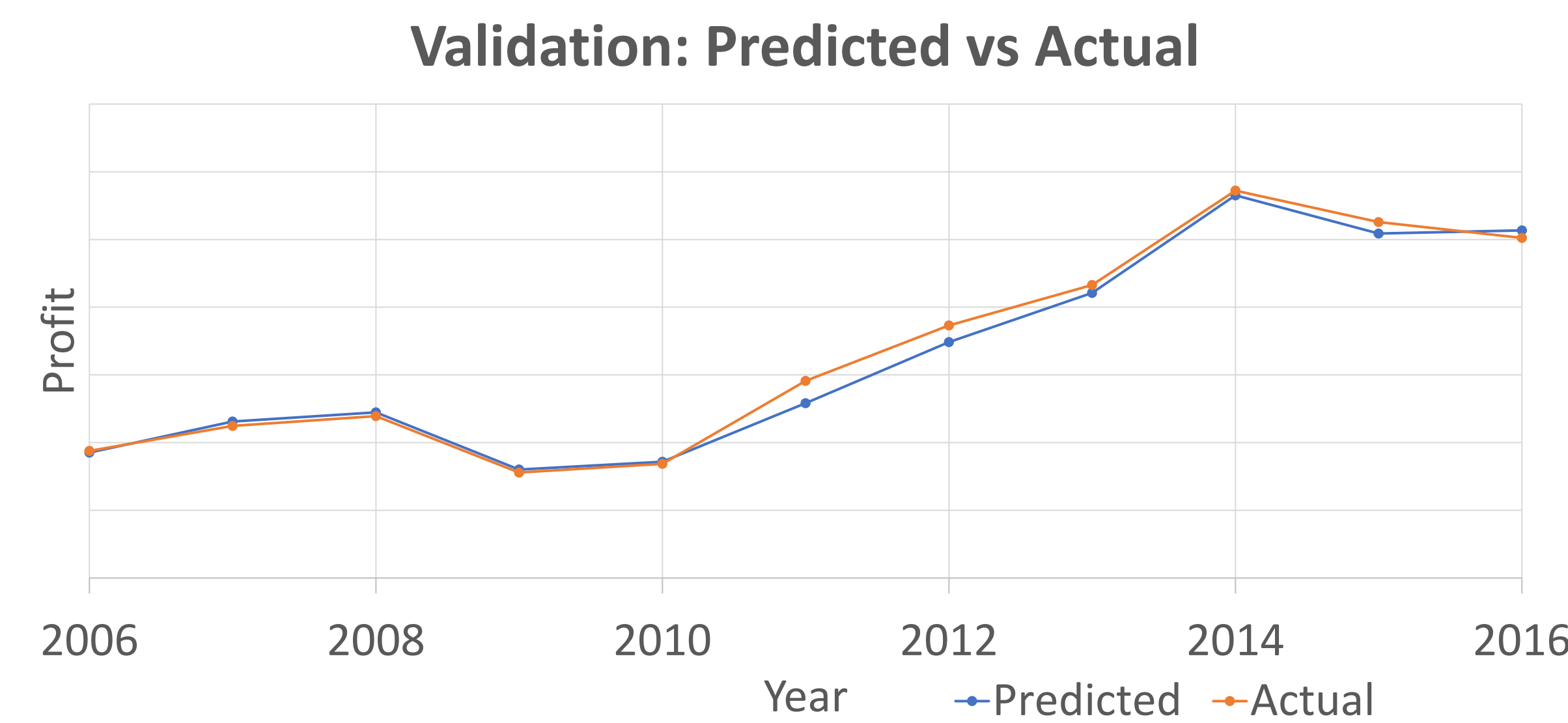
- Requested Increase
- Base Revenue Grouping
- IOR, or profitability ratio
- Number of Years with ABF Freight

The Receiver Operating Characteristic (ROC) curve had an area of 0.91, which is a strong indication of its accuracy. These results were used in two ways, to support the objective of creating data-driven guidelines and to create the model.

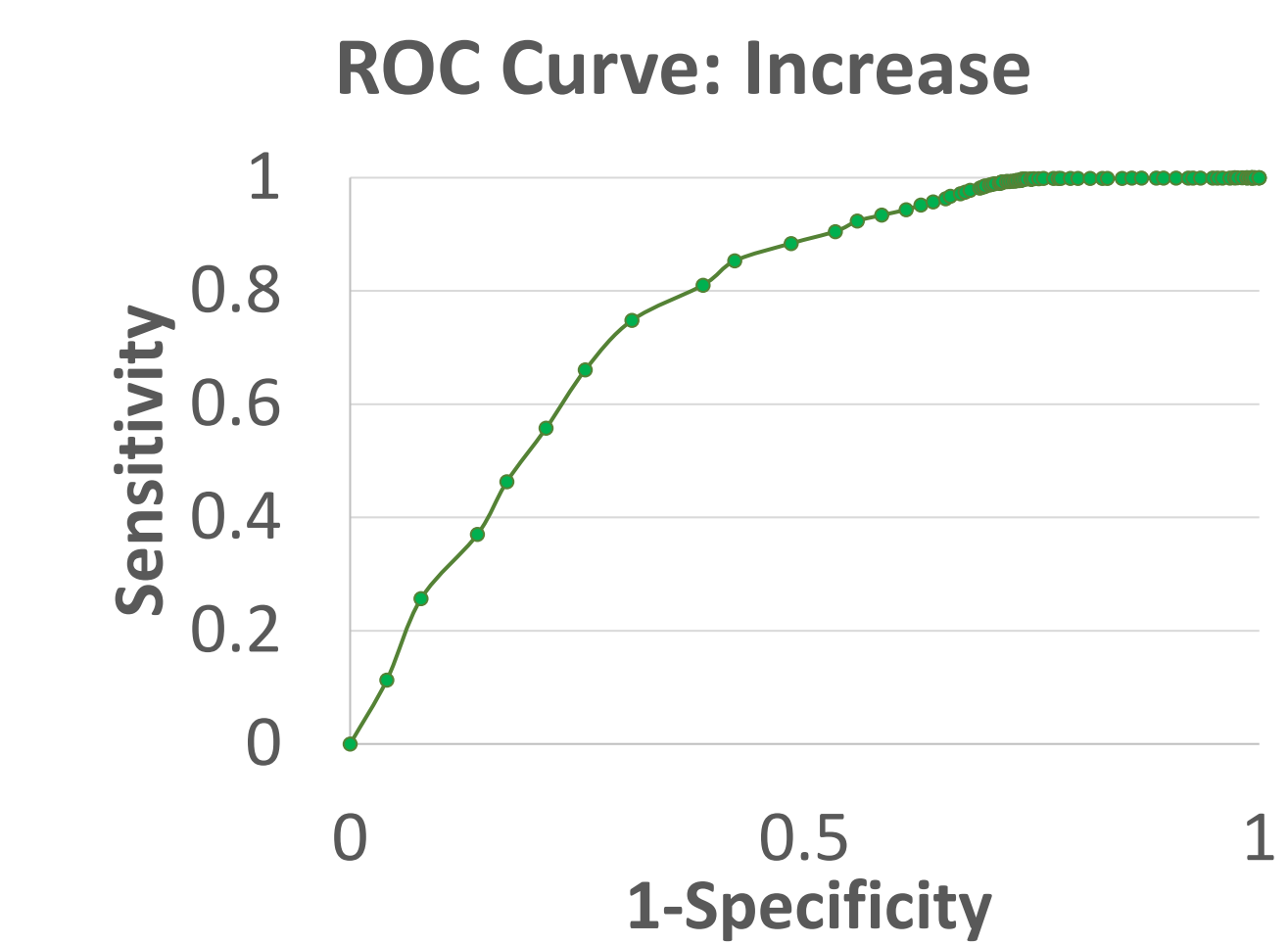


## Model Implementation

The model was created using the equations from performing logistic regression on retention and linear regression on the increase amount. The point of intersection between the two equations is where maximum profit can be achieved while accounting for risk of losing the business. Predictions were made using the available data and compared to the actual outcome, as visualized in the graph below. An ANOVA test also supported that the two means were equal.



## Logistic Regression: Increase

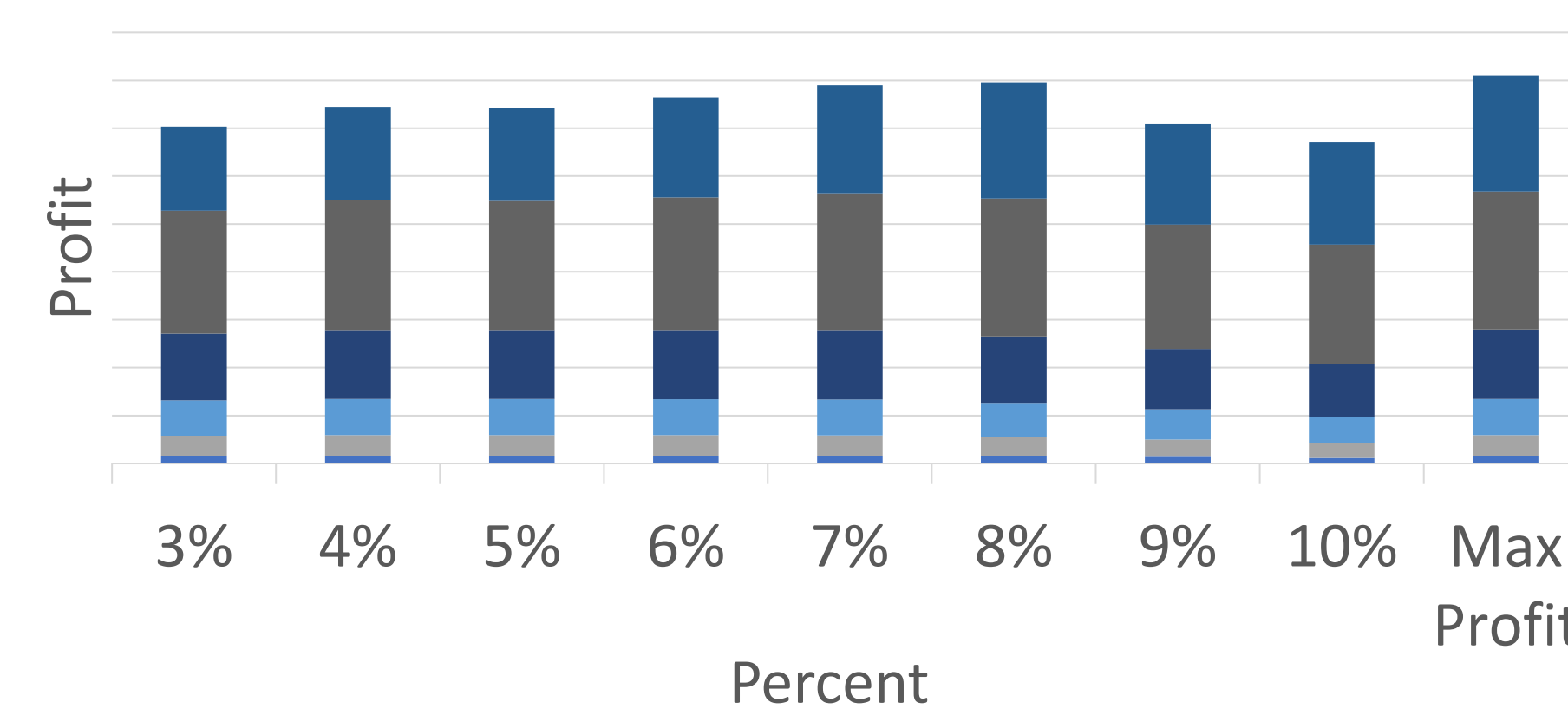


The variables identified as statistically significant were:

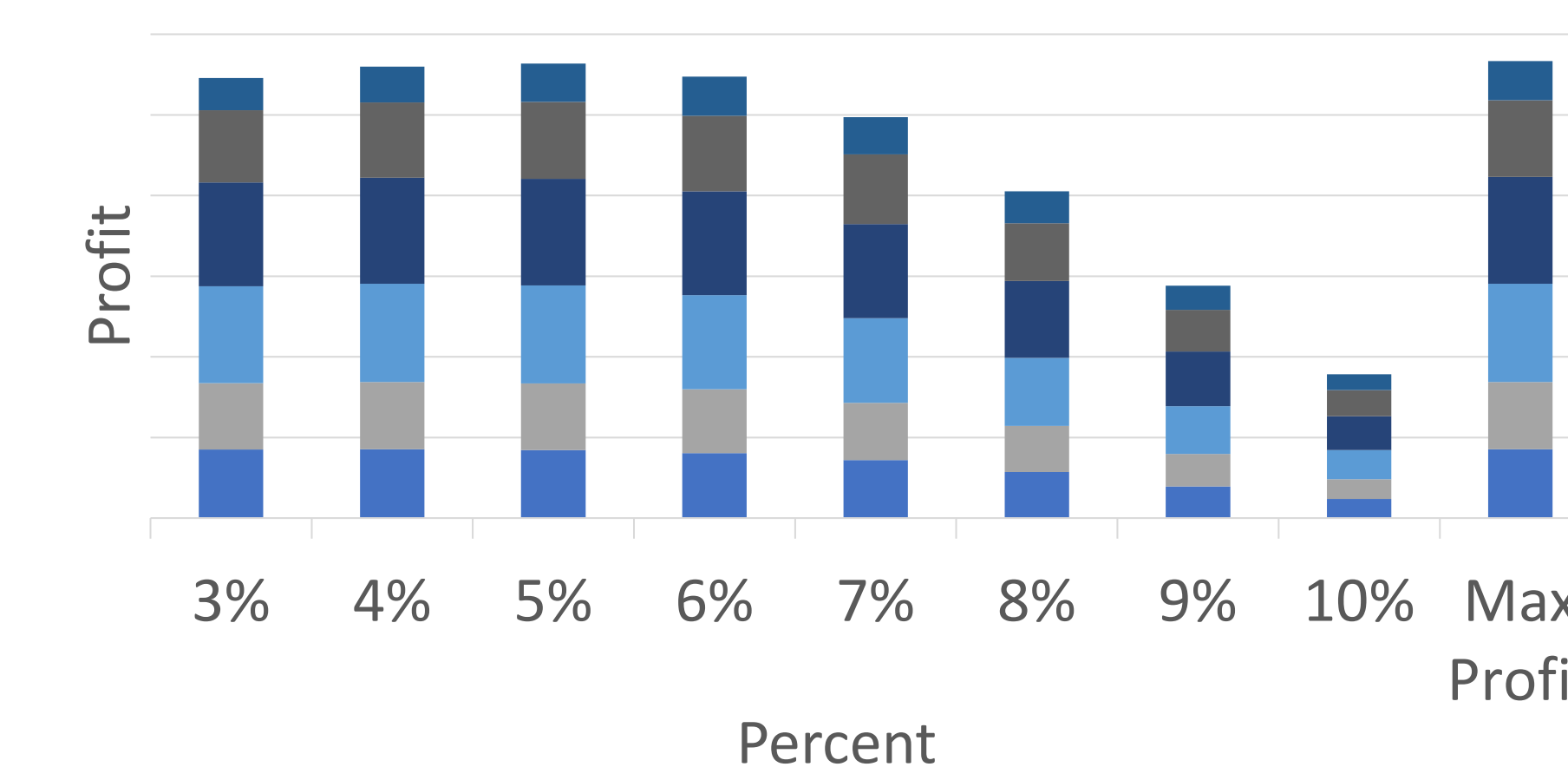
- Secured Increase from previous two PPMs
- Duration of PPM
- Requested Increase
- Years with ABF Freight
- Days before expiration the PPM began
- Quantity of notes

The model was found to be reasonably accurate with an ROC curve area of 0.77. This information will be primarily used to inform the pricing department with general guidelines concerning no-increase PPMs.

Profit for High Revenue Contracts



Profit for Low Revenue Contracts



Once the model was verified and validated, it was used to search for the maximum possible profit for various subsections within the data. For example, contracts were partitioned into seven different groups based on the revenue they produce. Additionally, contracts can be broken down by other identifying factors including industry, profitability, and region. The graphs to the left visually depict the relationship between the two models as requested increase rises in two different subsections.

Ultimately, a "Max Profit" bar is created for each subsection just like the ones in the graphs above. It solves for the combination of requested increases for each group that result in the highest predicted profit. The table to the right provides a spectrum of 42 unique groupings and their corresponding suggestions.

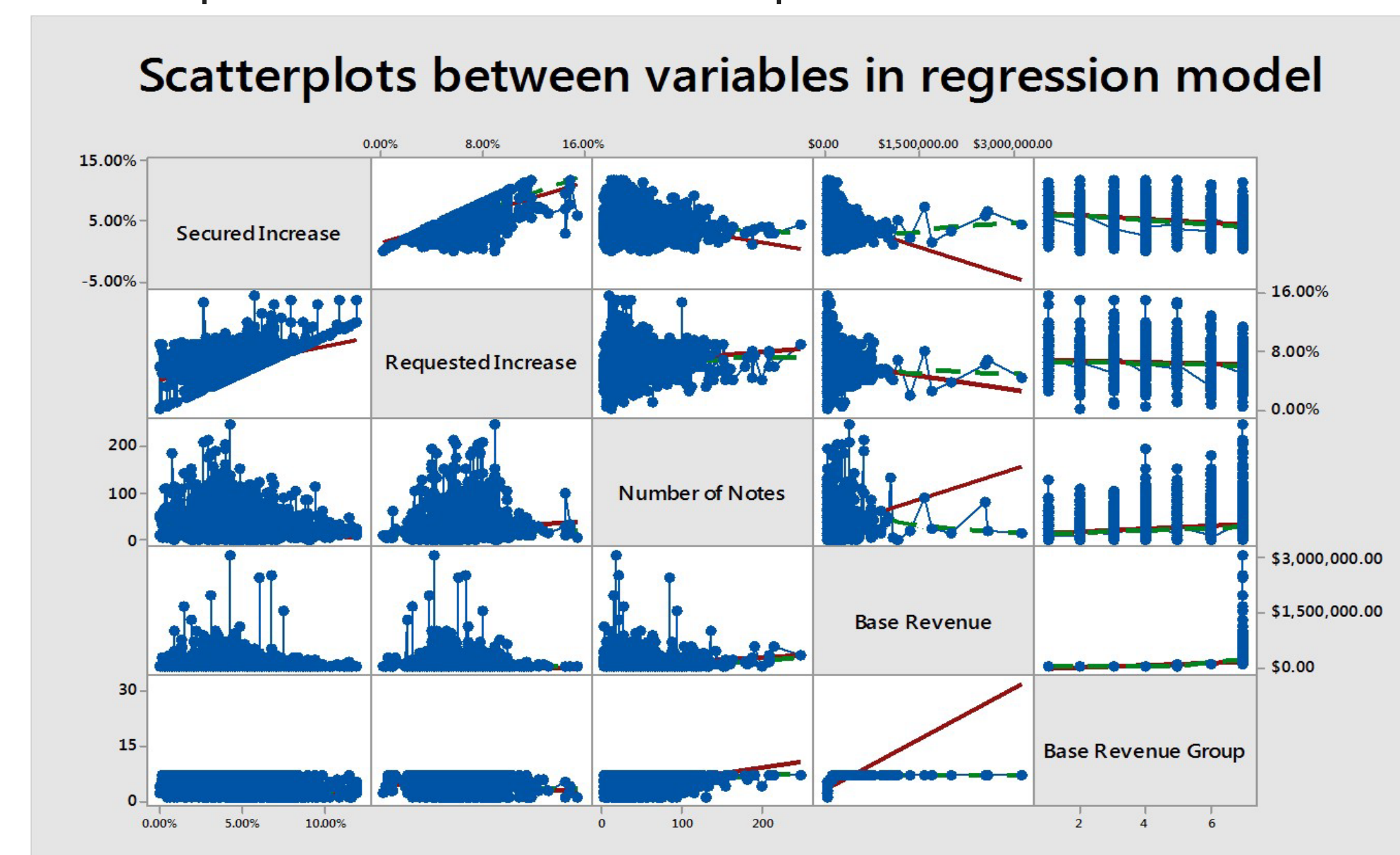
		Base Revenue Group						
IOR		1	2	3	4	5	6	7
0	50	0	0.1	0.1	0.1	0.1	0	0
50	60	0	0.1	0.1	0.1	0.1	0	0
60	70	0	0.1	0.1	0.1	0.1	0	0
70	80	0.1	0.1	0.1	0.1	0.1	0.1	0.1
80	90	0.1	0.1	0.1	0.1	0.1	0.1	0.1
90	101	0.1	0.1	0.1	0.1	0.1	0.1	0.1

## Linear Regression: Increase Amount

Techniques including cluster k-means algorithm and variable interactions were used to create the final linear regression model. With an r-squared value nearly 50%, the model does a sufficient job of predicting. The matrix-plot below helps visualize the relationship between the variables.

The variables identified as statistically significant were:

- Requested Increase
- Base Revenue Grouping
- IOR, or profitability Ratio
- Number of Notes



## Decision Support Tool

Not only does the form display historical information, it also gives prescriptive suggestions to the pricing analysts about the security of the account and how much of an account increase could be expected during a new contract negotiation. These values were calculated using our regression models.

## Future Work

There are two opportunities to provide ArcBest with ongoing support:

- the automated email system
- the pricing analysts' work interface

Historical information:		Claim Status:	On time %	IOR	Negotiation information:	
Year	% Increase	Number of claims	90%	100	Danger of losing business:	NO
2014	3.5%	34			Suggested Increase:	3.5%
2015	4.5%				Market:	Food/Consumables
2016	2.3%	\$1,348.00			Base Revenue:	\$30,500.56
					Market share:	30%
					Stock performance:	\$21.4