Improving Capital Investment Decisions by Increasing the Fidelity of Return on Capital Employed

Team: Austin Knabe, Kyle Kraichely, Sydney R. Motes, Theo Munoz, Josselyn Terrazas
Industry Contacts: Kirby Clark, Jacob Huffstetler

UNIVERSITY OF ARKANSAS INDUSTRIAL ENGINEERING

ABF Freight — An ArcBest Company

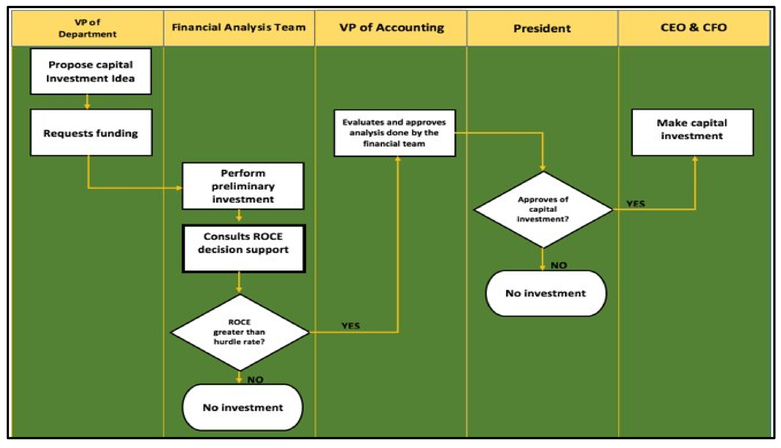
Abstract

ABF Freight is one of the largest LTL motor companies and provides service to 98% of U.S. cities in all 50 states. ABF Freight is interested in determining the quality of their capital equipment investments by estimating how these investments will perform over time in terms of expenses incurred and effect on the overall financial performance of the company. The company measures the value of an investment by calculating its Return on Capital Employed (ROCE) which is a ratio that represents how efficiently a company turns a profit on its invested capital.

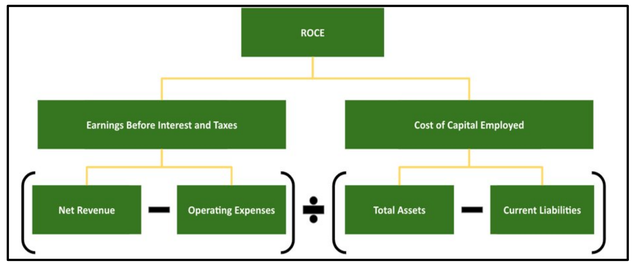
This project focuses on increasing the fidelity of the ROCE calculation using simulation to project a range of possibilities for a given piece of equipment through its useful life. Our team has developed an Excel-based decision support tool that allows an analyst to compare various investment scenarios before proceeding in making an equipment purchase. Statistical distributions are used to model key inputs in the ROCE calculation that enables our tool to project confidence intervals representing possible financial return from the investment over time. The decision support tool gives analysts a better understanding for potential behavior of their equipment purchases before moving forward with a large-scale capital investment.

Introduction

In their 2017 annual report, ArcBest operated with $793.5 million in revenue equipment, and since 2012 has invested over $200 million in revenue generating equipment. The process of carrying out a financial analysis for capital investment begins with identifying a need on both the finance and operations divisions. The company currently measures the value of investment by comparing the Return on Capital Employed (ROCE) to the company wide hurdle rate. If ROCE is less than the hurdle rate, the investment is not considered further. ROCE is a ratio that represents how efficiently a company turns a profit using the capital it has invested in. The equation to calculate ROCE is simply the Earnings Before Interest and Taxes (EBIT) divided by the Cost of Capital Employed.



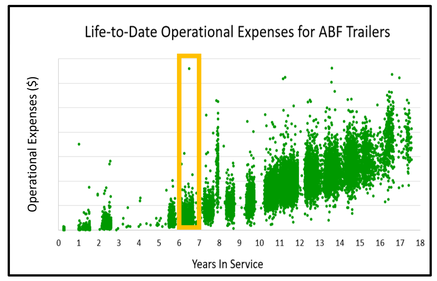
Swim Lane Diagram of Investment Decision Making Process

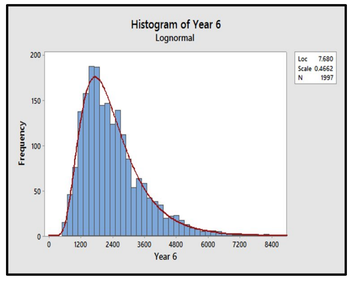


Return on Capital Employed Equation Break-Down

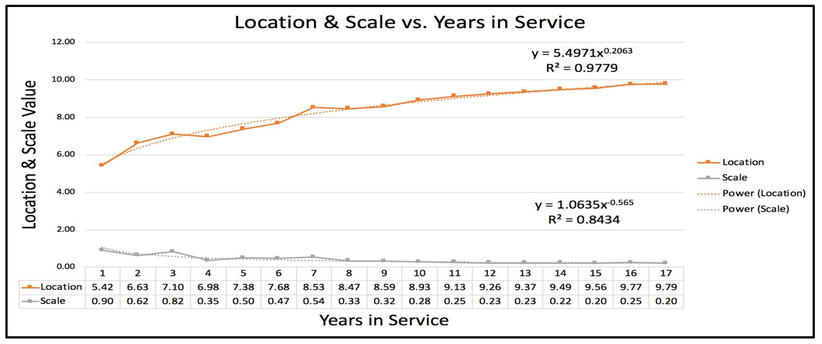
Modeling

An Access database with life-to-date expenses for ABF trailers was provided that included over 18,000 pieces of equipment. These expenses comprised primarily of maintenance costs including tires, repairs, fluids, etc. This scatterplot was presented to our industry partners and faculty advisor, and we came to the consensus that the best way to model the operational expenses would be to subset the data in year intervals. Using Minitab statistical software, histograms were plotted and fit with Lognormal distributions to each of the year intervals.



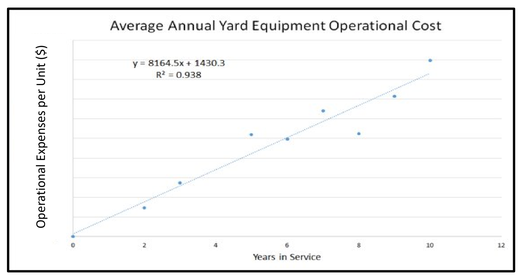


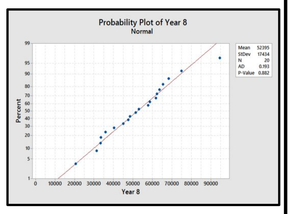
The parameters' associated with a lognormal distribution are Location and Scale which are an analogous to the mean and standard deviation parameters of the Normal distribution. The next step in creating the model was to plot each of these parameters against time as they change through each year interval. Once the parameters were plotted, power curves were fit in order to build a function of these values over time.



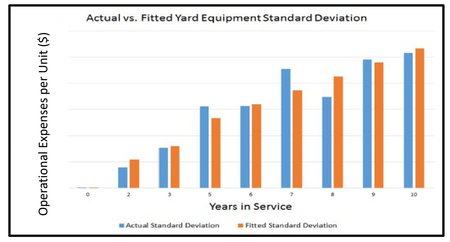
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Location	5.42	6.63	7.10	6.98	7.38	7.68	8.53	8.47	8.59	8.93	9.13	9.26	9.37	9.49	9.56	9.77	9.79
Scale	0.90	0.62	0.82	0.35	0.50	0.47	0.54	0.33	0.32	0.28	0.25	0.23	0.23	0.22	0.20	0.25	0.20

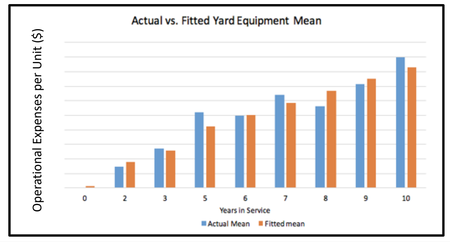
The team also modeled yard equipment and straight truck operational expenses. Histograms of the yearly intervals were constructed in order to determine which type of distribution would be best in modeling the operational expenses. Based on visualization, a normal distribution would be valid in modeling each yearly interval. We then conducted normality tests on each interval before moving forward. Taking a similar approach to our trailer expense model, we plotted the parameters (μ & σ) for the normal distributions against time.





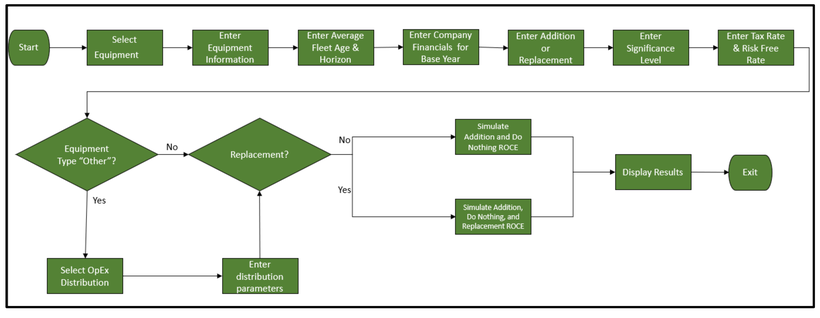
After plotting the parameters for the distributions, the actual versus fitted values of the mean and standard deviation were compared. This was done to validate the cost models before implementing them into our decision support tool. The small difference in comparing both values was deemed insignificant by our industry contacts. We followed the same methodology to validate cost models for all equipment types.





Results

Our team implemented the operational expense analysis into a decision support tool that simulates ROCE of a given investment over a given time horizon. The tool utilizes a series of user inputs that populate into Free Cash Flow Templates. A spreadsheet simulation approach is used to construct confidence the ROCE in each year. The results are displayed to the user comparing a specific investment scenario to the "Do Nothing" alternative and the Weighted Average Cost of Capital.



ROCE Simulator Tool Process Map

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Sample Average	10.0%	14.4%	17.6%	19.6%	20.7%	21.1%	21.0%	20.7%	20.2%	19.5%	18.9%	18.2%	17.5%	16.8%
Median	9.9%	14.3%	17.4%	19.4%	20.5%	20.9%	20.9%	20.6%	20.1%	19.5%	18.8%	18.1%	17.4%	16.8%
Standard Deviation	0.5%	0.8%	1.0%	1.1%	1.0%	1.0%	0.9%	0.8%	0.7%	0.6%	0.5%	0.5%	0.4%	0.4%
Range	2.6%	4.4%	5.3%	5.5%	5.3%	4.9%	4.4%	4.0%	3.5%	3.1%	2.8%	2.5%	2.3%	2.1%
Minimum	9.1%	12.9%	15.7%	17.6%	18.7%	19.2%	19.3%	19.2%	18.8%	18.3%	17.8%	17.2%	16.6%	16.0%
Maximum	11.7%	17.3%	21.0%	23.1%	24.0%	24.1%	23.8%	23.1%	22.3%	21.5%	20.6%	19.7%	18.9%	18.1%
Num. Replications	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Alpha	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
T-value(Alpha/2,n-1)	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28
CI Half-Width	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%
LL-Confidence Interval	9.9%	14.2%	17.3%	19.3%	20.4%	20.9%	20.8%	20.5%	20.0%	19.4%	18.7%	18.1%	17.4%	16.7%
UL-Confidence Interval	10.1%	14.6%	17.8%	19.8%	20.9%	21.3%	21.2%	20.9%	20.3%	19.7%	19.0%	18.3%	17.6%	16.9%

ROCE Simulator 'Results' Page Output

Special Thanks to:
Kirby Clark & Jacob Huffstetler – ABF Freight
University of Arkansas Department of Industrial Engineering Faculty & Staff
Dr. Haitao Liao - University of Arkansas Industrial Engineering
Dr. Aswath Damodaran – NYU Stern School of Business