Oil and Gas Exploration and Production - Phase 1

Blue team 12

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Executive Summary

The main objective of this report is to simulate the possible drilling costs for Compagnie Pétrolière et Gazière, INC. in 2019. After running the simulation under the assumption of normality and under the kernel density estimation for historical changes of drilling costs, we suggest simulating the drilling costs in 2019 with the kernel density estimated returns from 2006 and 2012, and triangular distributed arithmetic returns from 2012 to 2018. After half a million iterations, we predict the median cost per well drilled in 2019 will be $3.48 million dollars. We also predict that 99% of wells will cost $9.01 million dollars or less.

Analysis

The data that was provided to us consisted of drilling costs for crude oil, natural gas, and dry wells from 1960 to 2007. With this data the arithmetic return was calculated for each year. Years prior to 1991 were discarded due to changes in the drilling industry, and 2007 was discarded as it was an outlier. The historical data from 1991 to 2006 was used to create a kernel density estimation and to create a normal distribution to predict years 2006 to 2012. For years 2012 to 2015 a triangle distribution was created with an average return of -9.17%, a maximum return of -22%, and a minimum return of -7%. For years 2015 to 2018 a triangle distribution was created with an average return of 5%, a maximum return of 6%, and a minimum return of 2%.

Before running the simulation, we first tested if the changes in historical drilling costs follow a normal distribution. We used the 48 observations (the arithmetic changes in crude oil, natural gas and dry well from 1991 to 2006) to create a qq-plot, Figure 1. The plot shows that the historical data is reasonably normally distributed. The Shapiro-Wilk normality test also indicates that the historical data follows a normal distribution, with a p-value of 0.8041. However, the historical data is slightly leptokurtic, or fat-tailed (Figure A1).

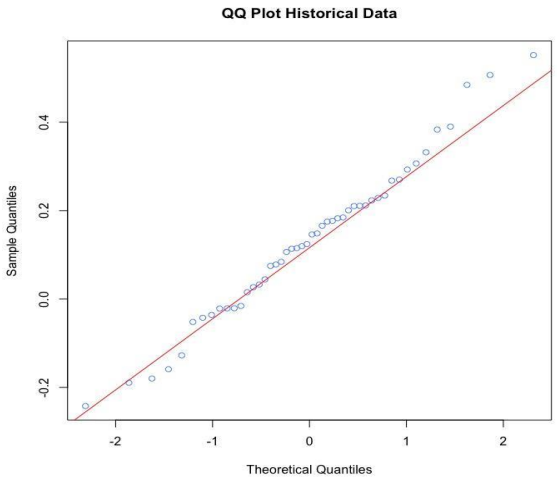

Figure 1. Historical Arithmetic Return Quantile Plot

We ran two simulations to predict the 2019 drilling costs: simulation KD with the rates of change from 2006 to 2012 using kernel density estimation, and simulation N assuming a normal

distribution from 2006 to 2012 with a historical mean of 13.15% and a standard deviation of 17.84%. The summary of the two simulations is shown in Table 1 below.

Table 1. Simulation Summary

	Min($)	Q1($)	Median($)	Mean($)	Q3($)	Max($)
Simulation KD	367,400	2,577,800	3,476,500	3,769,700	4,634,900	27,030,900
Simulation N	292,200	2,670,800	3,528,600	3,770,500	4,600,200	16,280,900

Table 1 indicates that simulation with kernel density estimated rates results in a more right-skewed distribution relative to normally distributed rates. Although the quantile, minimum, median, and mean costs are all quite similar in the two simulations, simulation KD has a much larger maximum cost. The histograms of the two predicted distributions shown in the figures below (Figure 2 and Figure 3) also indicate that the distribution with kernel density estimation has a fatter tail. Since the distribution of kernel density estimated return has a larger range, which means it considers more extreme changes, we believe it is a more conservative way to predict 2019 drilling costs.

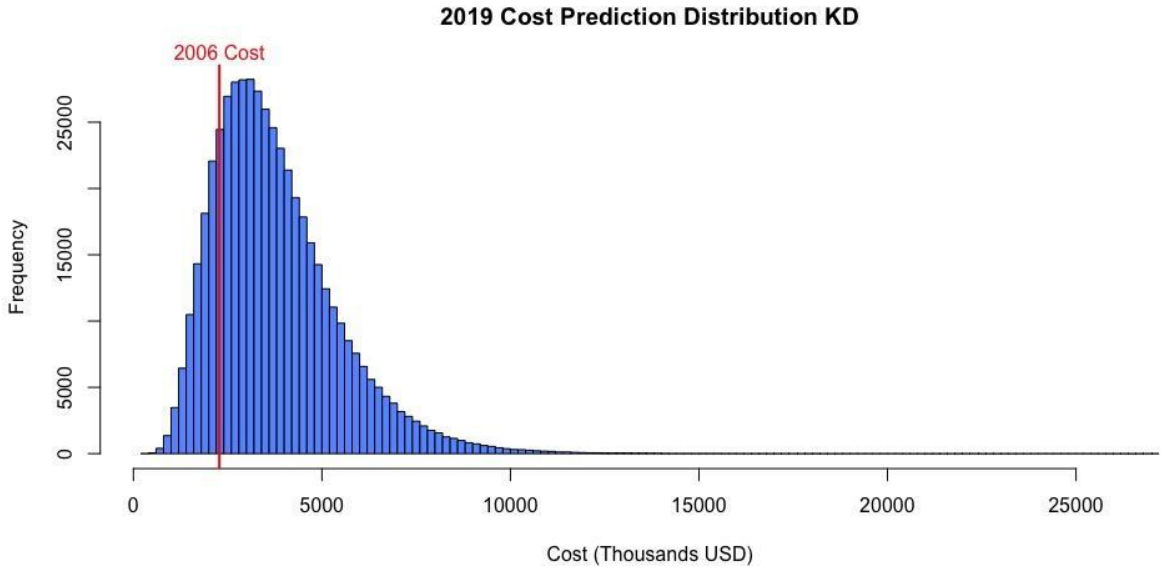

Figure 2. 2019 Distribution with Kernel Density

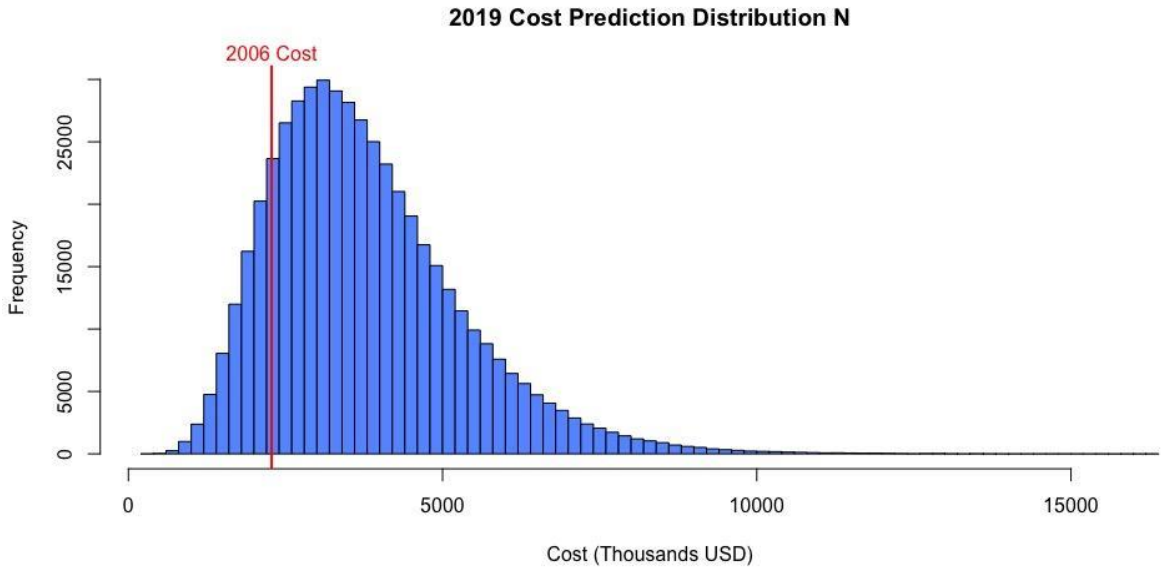

Figure 3. 2019 Distribution with Normal

Conclusion

It is our recommendation that Compagnie Pétrolière et Gazière, INC. uses the kernel density estimation to predict well drilling costs in 2019. Although the historical data follows a normal distribution, we believe it is more conservative to use kernel density estimation. This allows our client to get a better understanding of the potential range of well drilling costs and will allow them to determine if the costs fit into their business plan. We would recommend continuing our analysis by including more risk factors in order to make better investment decisions.

Appendix

Figure A1. Historical Data Arithmetic Return Distribution

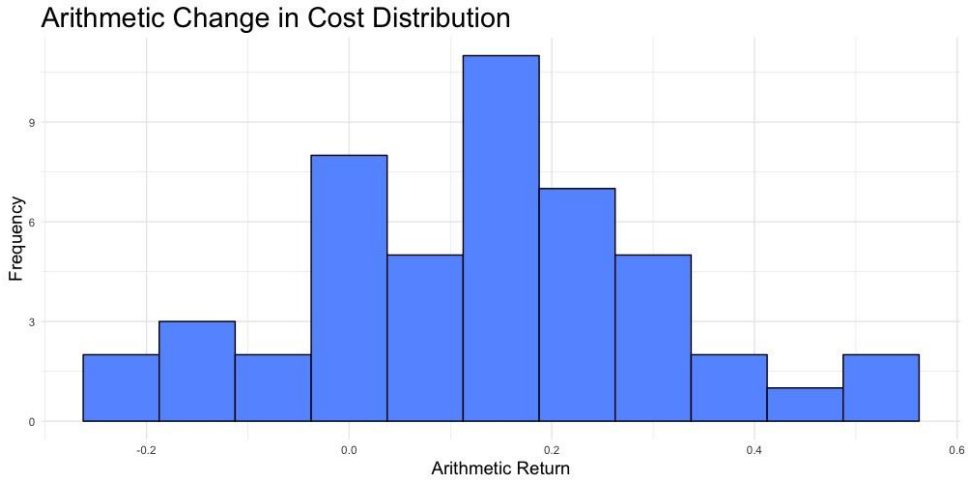

Figure A2. Kernel Density Arithmetic Return Distribution