Oil and Gas Well Predictions

Ryan Bell

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Engineering 101

Project # 1

Group 6 “Liberty”

Executive Summary

Liberty Inc. gathered information on 96 wells that produce gas and oil. The data was all carefully analyzed so that we could select three wells that are comparable in the following ways: location, amount of oil produced, and amount of gas produced. From the three chosen, it was then predicted which one would be the best investment over the next 10 years. Bubble graphs, scatter plot graphs, and decline curve analysis made the comparisons possible. To make a final selection, the well that could produce the most profit over the allotted time period was chosen.

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Introduction

Liberty Inc. was hired to solve the problem of selecting a gas and oil producing well that would be a good investment over the next ten years. The process that was chosen, which was considered the best way to approach the problem, was to pick three wells that were comparable, and then select one out of the three. This allows for more precision when determining the one that is the best, because it is easier to compare 3 wells than to compare 96 wells. Selecting three wells was an important part of the project.

After sorting all the data, it was important to keep the main objective in mind, which was to choose the well of the three that would make the most money over the next ten years. Oil production, gas production, operating costs, and location all became a factor in the decision. These are the aspects that influence a wells profit, and thus are ones that allow a decision to be made so the investor can make a successful deal.

Background

After analyzing the problem and information, many tasks became apparent, and a simple solution would not be found. Liberty Inc. formed a series of steps to solve the problem. Location, oil production, gas production, and net profit of the wells all must be determined and compared. To conclude the final decision of a well, decline curve analysis of the wells was used to predict how they would prosper in the future. This allows one to use a hyperbolic curve equation and produce a graph that yields an outlook of the expected production of a well. The process is as accurate as most and allows for easy comparison.

One could have taken only the past and present production of the wells into consideration, which is a choice made in many fields of investment; but then the decline curve might not be noticeable and a bad investment will be made. If production starts to quickly recede, then the future of that well is in danger.

Others do forecasting to make the decision, but use a trend line to view the curve of decline. This often works as an easy estimation of what could happen, but isn't as precise as the hyperbolic curve analysis. The trend line will only consider the slope of the line that represents the production, where as the hyperbolic equation includes the actual values, time periods, and production of the wells.

Methodology

To approach the selection of three wells, location was first compared. In Excel a graph, x-y scatter plot graph, of latitude and longitude was made. This made for an easy view of all the wells' locations. But it was then decided that this was not the only field that must be compared. Oil and gas production must also be considered. Excel offers a graphing option that is referred to as PivotTable/Chart. This was used to separate the 96 wells and also group their location, oil production, and gas production with them. After completing the pivot table, we next used a valuable graphing tool in Excel called the Bubble Graph. This allowed us to graph the wells according to latitude and longitude and also compare oil or gas production at the same time by producing different size bubbles on the graph. All the wells were graphed on bubble graphs, one for oil and one for gas production. Three wells could now be chosen based on relevant comparisons.

We selected the following wells: Moore WH #4-64, Moore WH #6-64, and Chambers FM #6-64. They all were very close in location, and produced nearly the same amount of oil and gas. Next we keyed in on the information for those three wells only and hid the rest, to reduce the chance of confusion. The next task was to create x-y scatter plot graphs of each of the wells' oil and gas production. We plotted the production over the seven year period of time that we had information available for. The objective of this task, was to take it a step further and predict the production over the next ten years. To complete this, we used an equation called the Hyperbolic Equation that allowed us to do a Decline Curve Analysis. It is: $Q=qi(1+Di*b*t)^{-1/b}$; where Q is the production rate, ex. barrels/month, qi is the initial production, Di and b are created constants, t is the function of time in months, and b is another created constant. We

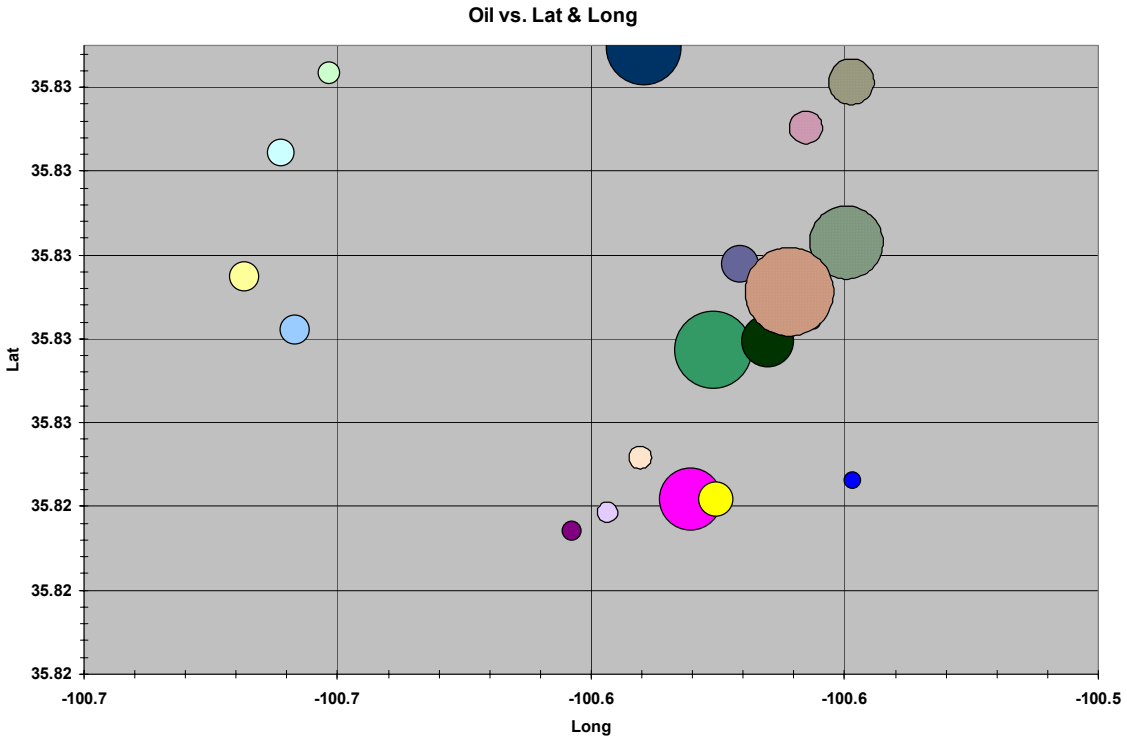
extended the time for ten years, and the equation took the previous seven years of production information and predicted the next ten years, which was in reality the decline curve over that time period. This was a visual representation of how the wells production would look and reduce over the investor's time of interest.

With these values now available, it was possible to create tables that will convert the information to dollar values and allow us to select a final well. For each of the wells, we proceeded to create a table that would calculate the net present value for each well. A table of gas and oil production was created for each well. On the table, the necessary categories were: oil/gas produced per year, revenue per year, operating costs, tax deductions, net cash flow, and finally net present value. Operating costs and tax deductions were both subtracted from the revenue to obtain a net cash flow. Then an equation that takes into consideration the time value of money was used to calculate the net present value. The equation is: $P=F/(1+i)^n$; where P is the net present value, F is the net cash flow, i is the interest rate, and n is the number of years.

After the Net Present Value of all three wells oil and gas were calculated, the sum of the oil and gas profits were added together for each of the wells. This gave a single dollar value for each well over the next ten years. The well that made the most money was chosen, which was Moore, WH #4-64.

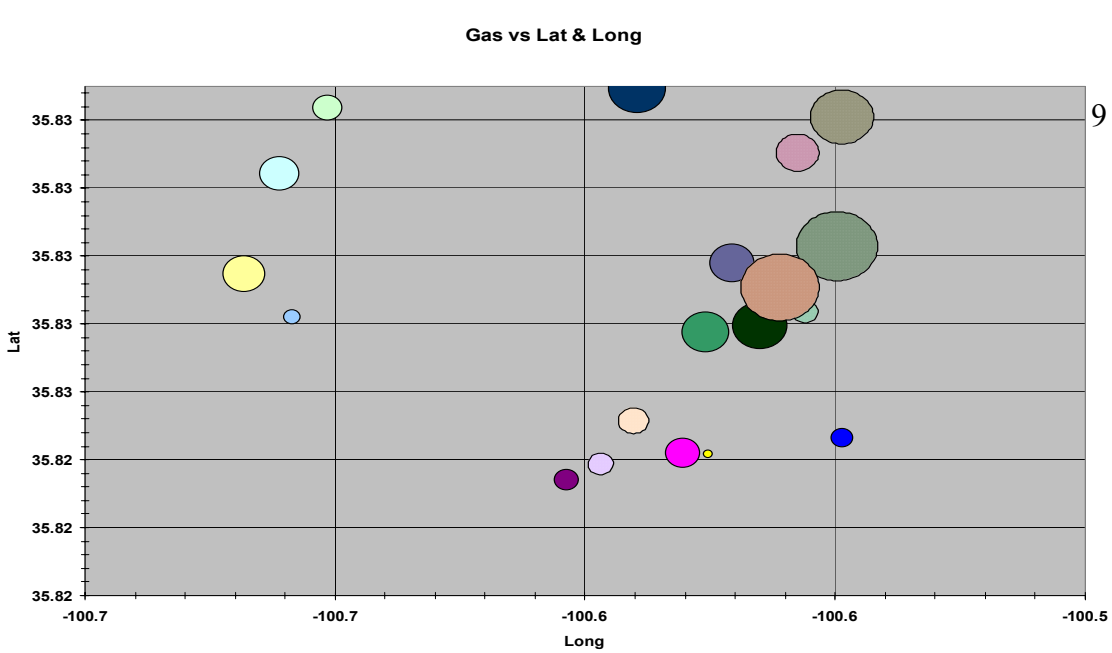
Results

As described earlier, the way three wells were selected was by the comparisons of their Bubble Graphs. Two graphs are shown below, one showing Oil Production vs. Latitude and Longitude, and one showing Gas Production in the same manner.



This graph represents Oil vs. Latitude and Longitude

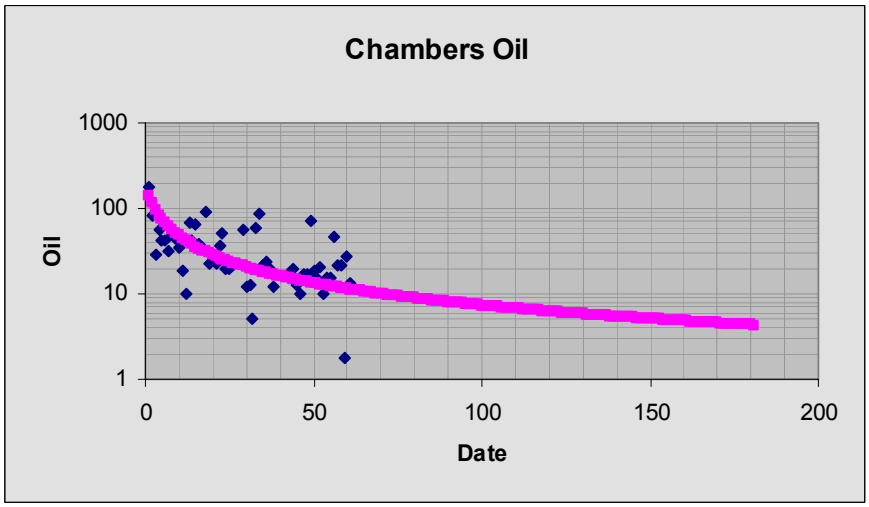
The three wells selected are the three larger size bubbles to the right of the center of the graphs. It is easy to see that they were all similar in our comparisons.



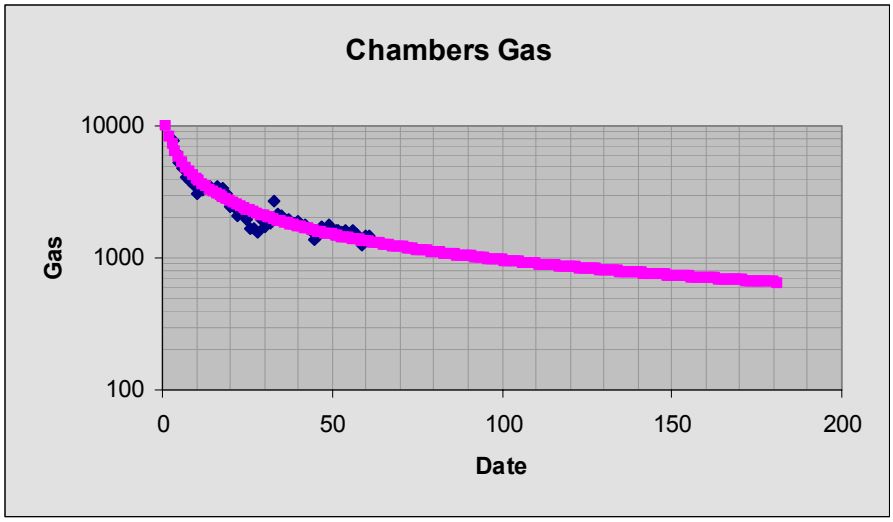
This graph shows Gas Production vs. Latitude and Longitude

The three wells start at the green bubble and proceed in a northwest diagonal direction continuing with the two light brown bubbles in that direction.

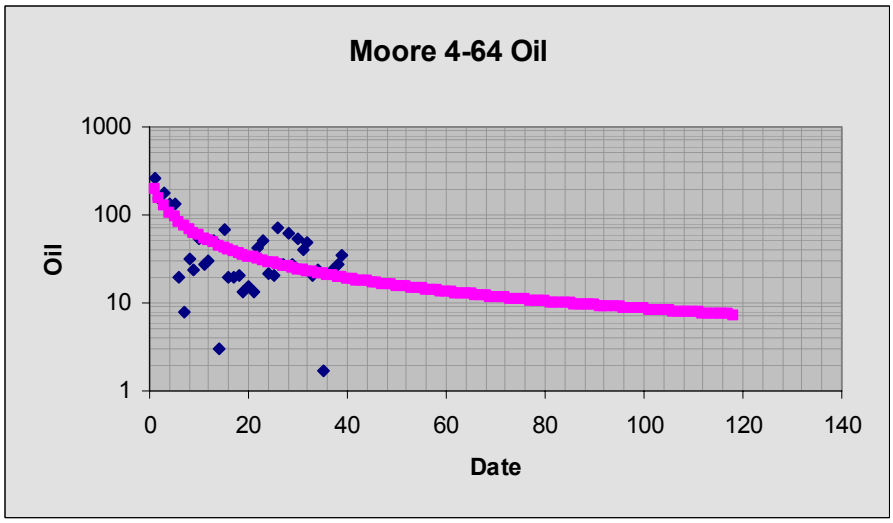
The next important task was produce graphs that would show the oil and gas production of these three wells along with the predicted decline curve for the next ten years. Each well had two graphs, one for gas and one for oil. They are shown below.



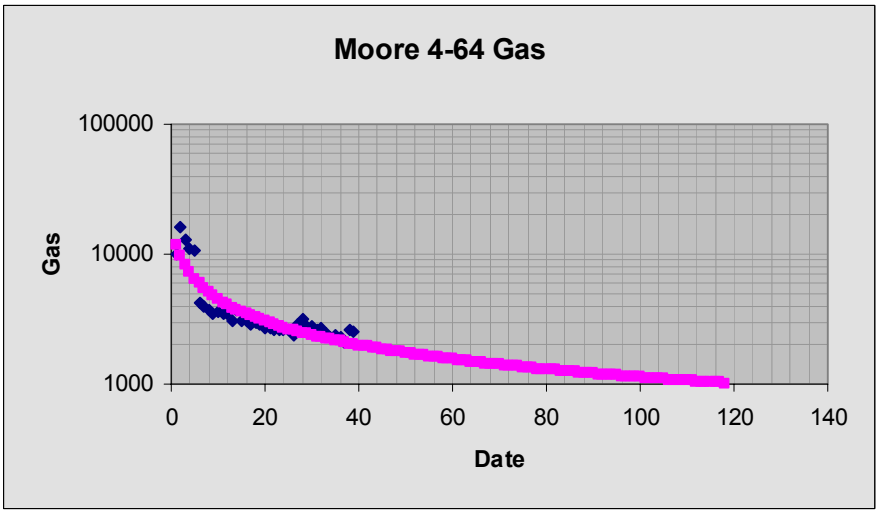
A graph of the Chambers Well showing Oil production over a 17 year period



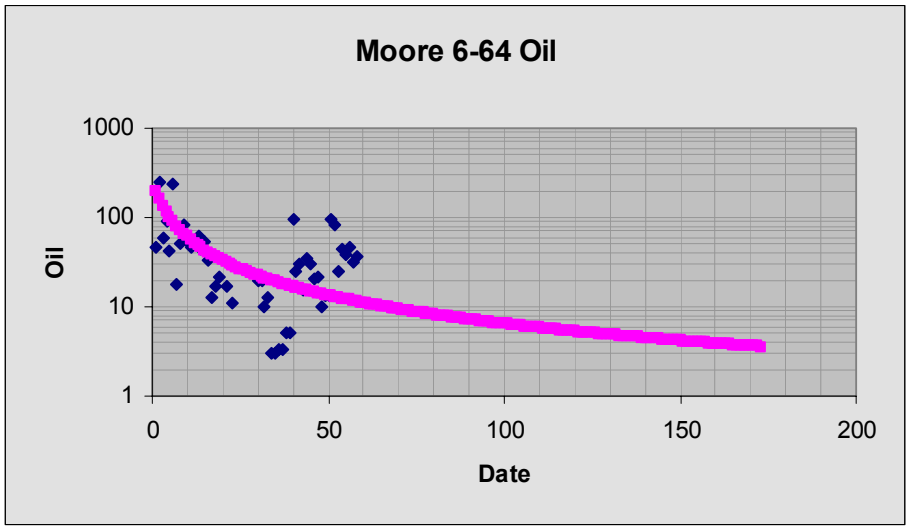
Chambers Gas Production during a 17 year period



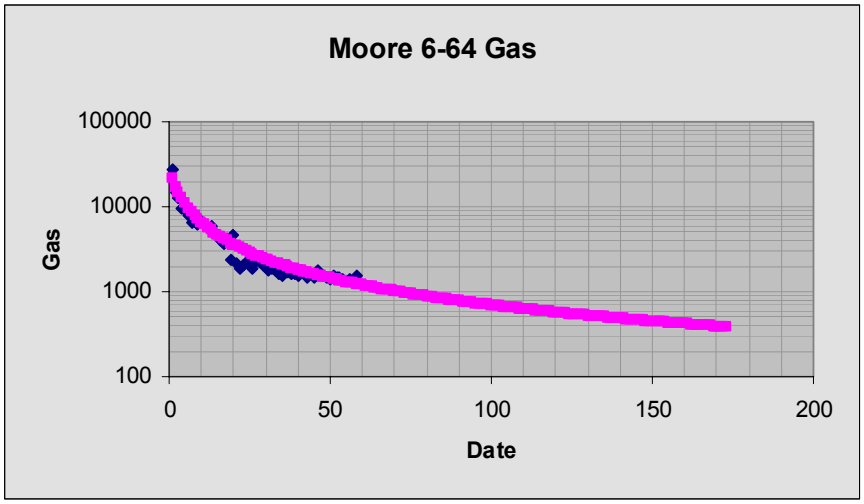
Moore #4-64 Oil Production graph



Graph of Moore #4-64 Gas Production



Moore #6-64 Oil Production



Moore #6-64 Gas Production Graph

After the Decline Curve Analysis was completed, we used the predicted production values to forecast the future profits that will be produced. Tables were constructed and the Net Present Value equation as described previously was used to do this.

Net Present Value
25187
20807
17482
14868
12769
11049
9622
8422
7405
6386

Values of Chambers Gas

Net Present Value
1324
1088
879
727
607
508
433
372
323
284

Values of Chambers Oil

Net Present Value
37452
29668
24237
20213
17106
14639
12439
10503
8691
7170

Values of Moore 4-64 Gas

Net Present Value
2180
1622
1263
1011
819
684
577
476
393
324

Values of Moore 4-64 Oil

Net Present Value
22407
17095
13425
10771
8785
7258
6062
5107
4335
3618

Values of Moore 6-64 Gas

Net Present Value
1314
1005
785
632
519
427
358
302
258
224

Values of Moore 6-64 Oil

The above tables show the calculated values of the Net Present Value. These values represent profit made. Each row of the tables represent a year's profit, and the ten rows represent the predicted ten years of production. Each of the wells gas and oil profits over the ten year period were added together and the results are shown below.

Chambers	Moore 4-64	Moore 6-64
$140,540	$191,465	$104,686

Moore # 4-64 was the well selected, based on the final calculation of profit made over the next ten years.

Conclusion

The problem was a multi-step process that was broken down into different tasks. The three wells were selected by similarities in location, gas production, and oil production. After three wells were chosen, then the Decline Curve Analysis was completed, by calculations of the equation, and by graphing the results. From the values obtained, another set of math problems could be worked that would produce the Net Present Values for each of the wells. This was done for oil and gas production for all of the wells. The results were tabulated giving us the final numbers allowing a decision to be made. Moore #4-64 was the well that proved to be the best investment over the next ten years. This is the well we recommend to the investor.