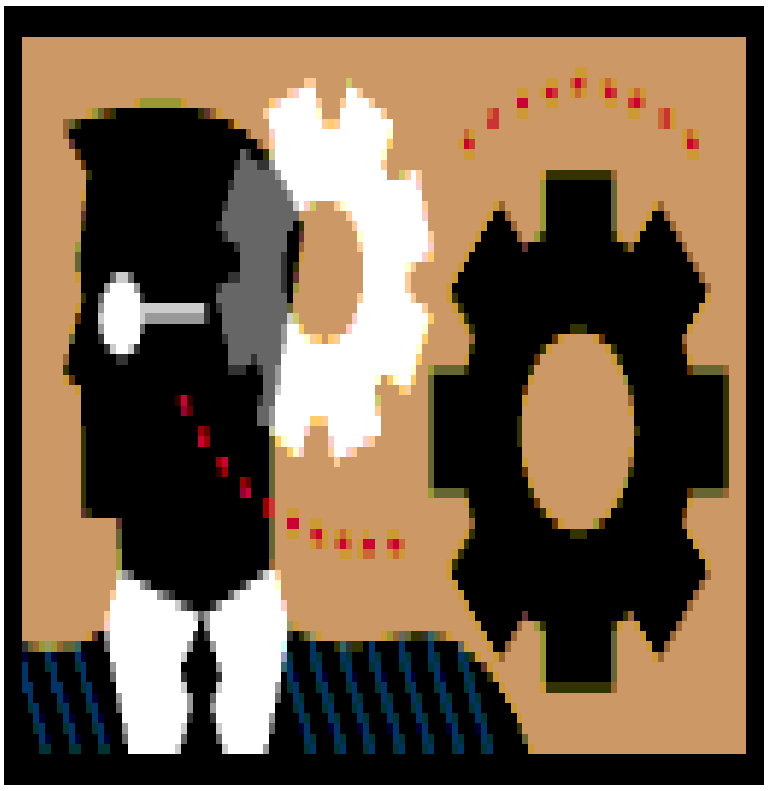
KRISPY ENGINEERING

REPORT ON CHOOSING THE BEST INVESTMENT WITH DECLINE CURVE ANALYSIS



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ENGR 101-Freshman Engineering Design

Project #1

Group #1

Executive Summary

My company was hired by you to prepare a report that will assist in the choosing of a well to make an investment in. I was provided with data from ninety-six wells. From these I chose three wells which exhibited similar gas and oil production numbers. Finally, using decline-curve analysis, I chose the one well that will make the most profit over the next ten years. The best well to invest in is McMordie #3-86.

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Introduction

I was presented with information about ninety-six different wells in the form of almost six thousand lines of spreadsheet data and asked to find out which one would make the most money over the next ten years.

I began by using Microsoft Excel to filter all of the data into more manageable groups. First, I put them into a group by well name and location. Then, I used pivot tables to get the total amount of oil and gas production for each well. I then put this data on two bubble graphs (one for oil and one for gas) and selected three wells which were comparable in oil and gas production (indicated by the size of the bubble). After choosing three wells to work with, I plotted the recorded data on an "x-y scatter graph". Then, I used "decline-curve analysis" to forecast oil and gas production for each well over the next ten years. With these predictions I was able to calculate revenue, operating costs, taxes, net cash flow, and net positive value for each year, as well as the total net positive value of each well for all ten years combined. This is the number that I used to choose McMordie #3-86 as the best well to put your money into.

Methodology

I took several complex and meticulous steps to reach my conclusion. These steps involved filtering data in a Microsoft Excel spreadsheet, plotting the wells on a bubble chart, choosing three wells that were similar in oil and gas production, and then predicting each wells future production using decline curve analysis.

Before I go into detail about these processes, I will first provide a list of the terms I will be using, as well as their definitions.

- BBLS – unit measurement of oil production
- MCF – unit measurement of gas production
- Decline Curve Analysis – the process of fitting a hyperbolic decline curve into a set of pre-plotted data to provide a general estimate of the decline of production.
- Hyperbolic Decline Formula – equation used to manipulate the decline curve to best fit the actual data
    - $q=q_i(1+bD_it)^{(-1/b)}$
        - q = production (bbls or mcf)
        - q_i = initial production (bbls or mcf)
        - b = decline exponent
        - D_i = initial decline (bbls/month or mcf/month)
        - t = time (months)
- Revenue – amount of money made from production
    - R = qP
        - q = amount of oil or gas produced (bbls or mcf)
        - P = price of oil or gas ($/bbls or mcf)
            - I obtained the current gas and oil prices from Bloomberg of $5.10/MCF and $28.63/BBL and I assumed that they will stay relatively the same for the next ten years.
- Operating Cost – amount of money required to operate well
    - $C = qC_o$
        - C = operating cost ($)
        - q = amount of oil or gas produced (bbls or mcf)
        - C_o = cost to produce one bbl of oil or one mcf of gas
            - The operating costs that you provided to me are $4.35/bbl and $0.65/mcf.

- Tax – 48% of revenue minus operating costs paid to the government
  - $T = (R - C)*.48$
    - T = amount of money paid to government ($)
    - R = revenue ($)
    - C = operating costs ($)
- Net Cash Flow – amount of money that the well will make in the future minus operating cost and tax
  - $NCF = R - C - T$
    - NCF = net cash flow ($)
    - R = revenue ($)
    - T = tax ($)
- Net Present Value – future monetary value translated into today's dollar value
  - $NPV = NCF/(1+i)^n$
    - NPV = present worth ($)
    - NCF = net cash flow (future value of oil or gas) ($)
    - i = interest rate (%)
    - n = length of period (years)

You presented my company with almost six thousand lines of spreadsheet data and asked us to find out which well would provide the best investment over the next ten years.

The first step I took in doing this job was to filter the data into smaller, more usable pieces. I used MS Excel to organize the data into columns of well names and location by latitude and longitude.

Then I used pivot chart reports to sum up the oil and gas production of each well to date and place these totals in columns next to their respective well name and location.

Once I had everything organized into ninety-six lines of spread sheet data, I plotted each well on a bubble chart using longitude and latitude as the x and y axis values, respectively, and the size of the bubbles to indicate total oil and gas production (each on separate graphs). I used this chart to choose three wells which were comparable in gas and oil production.

After I narrowed the choice down to three wells, I created two tables for each well, one for oil and one for gas, to calculate the revenue, operating cost, tax, net cash flow, and net positive value for each well over the next ten years. I then added the net positive values for oil and gas of each well to come up with a total net positive value which I used to choose the best well.

Results and Discussion

As stated before, I predicted the production of three wells over the next ten years using decline curve analysis. The results of this process are shown by the charts below.

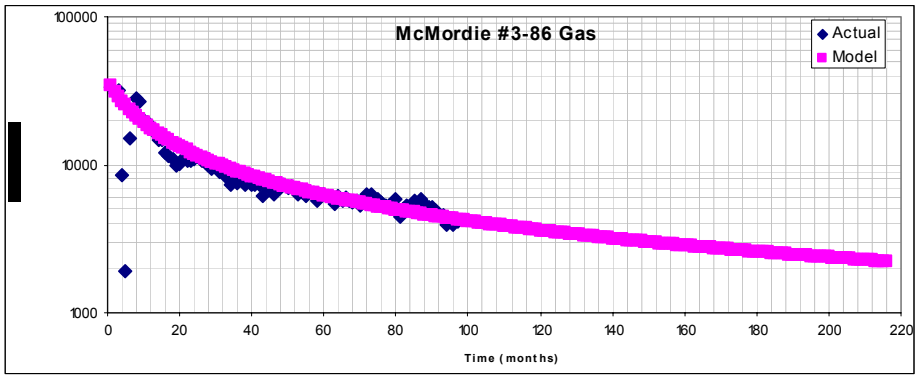

Figure 1: Projected decline in oil production of McMordie #3-86

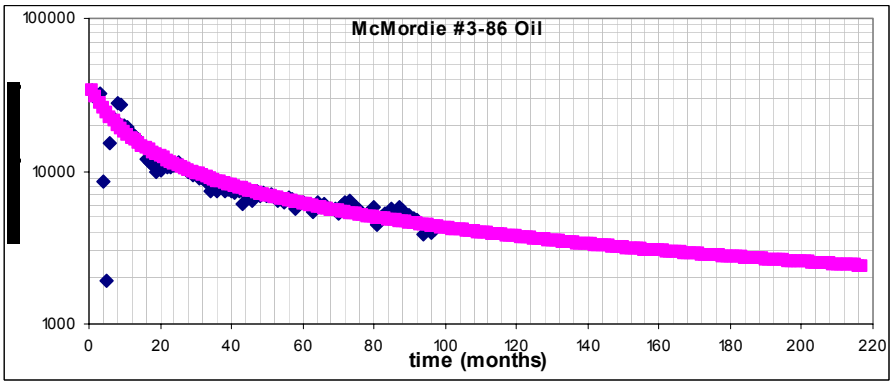

Figure 2: Projected decline in gas production of McMordie #3-86.

The two charts above illustrate the decline in production over the next ten years for both oil and gas production of the well McMordie #3-86. The points in blue are the previously recorded data and the points in pink represent the projected decline using the hyperbolic decline curve.

Below are similar charts for the other two wells, McMordie #3-129 and McMordie #7-86. As in the charts above, the blue points represent previously recorded data while the pink points represent data obtained using the hyperbolic decline curve.

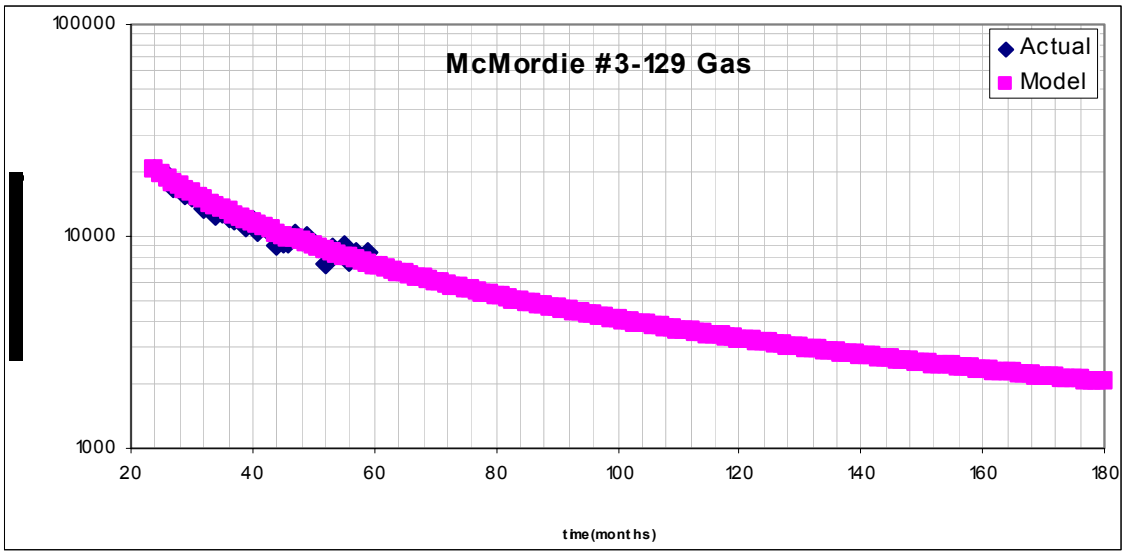

Figure 3: Decline in gas production of well McMordie #3-129.

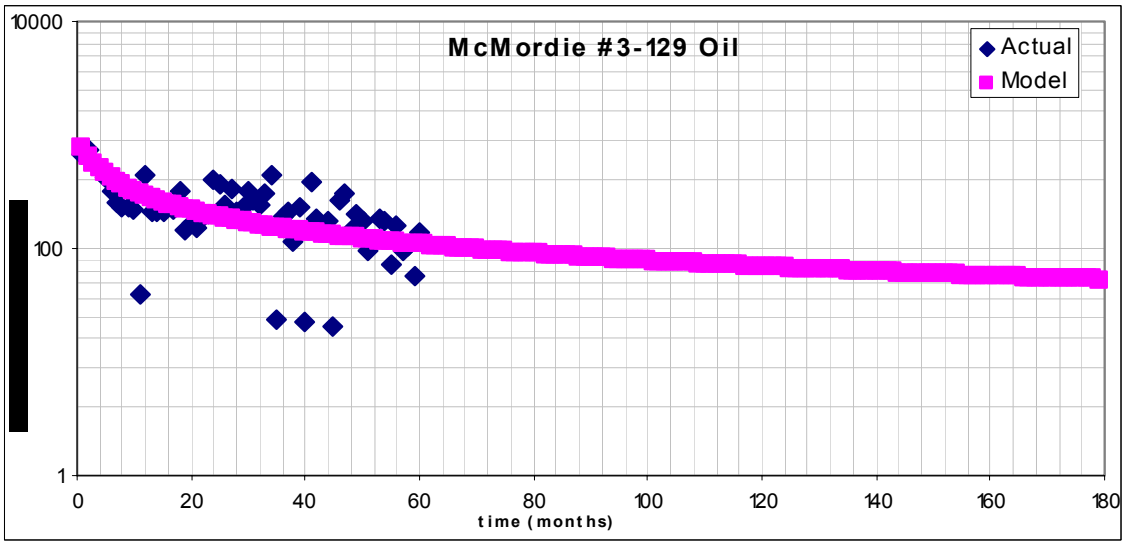

Figure 4: Decline in oil production of well McMordie #3-129.

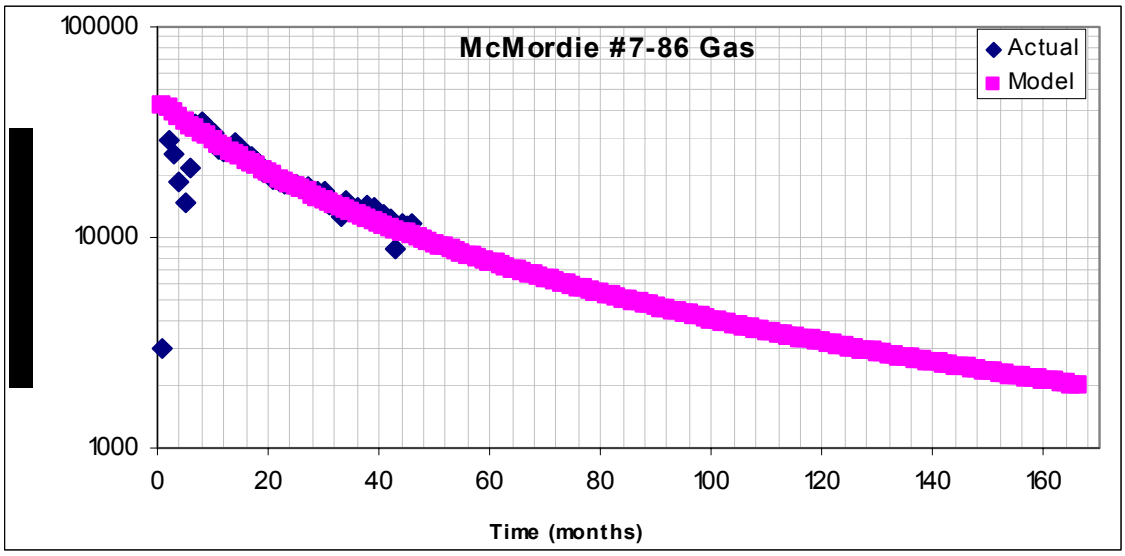

Figure 5: Decline of gas production for well McMordie #7-86.

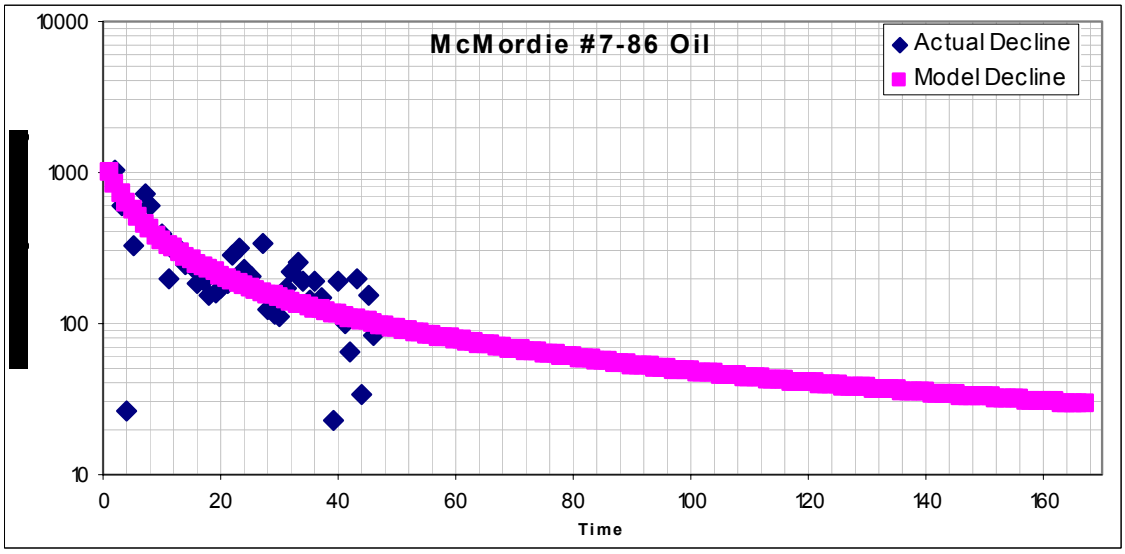

Figure 6: Decline of oil production for well McMordie #7-86.

Using the charts as a visual reference, I used the projected production to calculate the future revenue, operating costs, tax, net cash flow, and net positive value for oil and gas for each well.

Table 1: Net positive value calculations for gas production for well McMordie #3-86.

Yr.	Gas Production (MCF/YR)	Revenue ($)	Operating Cost ($.65/MCF)	Tax 48% ($)	NCF ($)	NPV @ 10% ($)
1	49106	250438	162785	42074	45580	45129
2	44912	229053	148884	38481	41688	40866
3	41421	211245	137309	35489	38447	37316
4	38465	196171	127511	32957	35703	34310
5	35929	183236	119103	30784	33349	31730
6	33727	172006	111804	28897	31305	29491
7	31796	162159	105403	27243	29513	27527
8	30088	153449	99742	25779	27928	25791
9	28566	145687	94697	24475	26515	24244
10	27201	138723	90170	23305	25248	22856

Table 2: Net positive value calculations for oil production of well McMordie #3-86.

Yr.	Oil Production (BBLS/YR)	Revenue ($)	Operating Cost ($4.35/BBL)	Tax 48% ($)	NCF ($)	NPV @ 10% ($)
1	50132	1435265	218072	584253	632940	575400
2	46244	1323972	201162	538949	583861	482530
3	42987	1230725	186995	500991	542740	407768
4	40214	1151326	174931	468670	507725	346783
5	37821	1082803	164519	440776	477507	296495
6	35731	1022991	155432	416429	451131	254652
7	33890	970272	147422	394968	427882	219571
8	32253	923412	140302	375893	407217	189970
9	30788	881452	133926	358812	388713	164852
10	29467	843633	128180	343417	372036	143436

These tables show the oil and gas production every year, the revenue that each well will produce, the operating costs that will be incurred, the tax, the net cash flow, and the net positive value. The net positive value column is probably the most important part of the table. By adding up the values for each year, you come up with a total net positive value which is how much money in today's dollars the well will be worth in ten years. This is the number I used to decide which well will be the best investment.

Below are the tables for the other two wells. As you can see, the numbers for production and net positive value are well below those of McMordie #3-86.

Table 3: Net positive value calculations for gas from well McMordie #3-129.

Yr.	Gas Production (MCF/YR)	Revenue ($)	Operating Cost ($.65/MCF)	Tax 48% ($)	NCF ($)	NPV @ 10% ($)
1	85273	434890	282678	73061	79150	71954
2	65335	333207	216585	55979	60644	50119
3	55300	282032	183321	47381	51330	38565
4	47790	243729	158424	40947	44359	30298
5	41973	214061	139139	35962	38959	24190
6	40719	207667	134983	34888	37795	21334
7	36331	185287	120436	31128	33722	17305
8	32744	166997	108548	28055	30393	14179
9	29763	151789	98663	25501	27626	11716
10	27247	138960	90324	23345	25291	9751

Table 4: Net positive value calculations for oil from well McMordie #3-129.

YR	ANNUAL OIL PRODUCTION (BBLS/YR)	REVENUE ($)	OPERATING COSTS ($4.35/BBL	TAX (48%)	NCF ($)	NPV ($)
1	1232	35264	5358	14355	15551	14138
2	1104	31618	4804	12871	13943	11523
3	1006	28789	4374	11719	12696	9538
4	926	26518	4029	10795	11694	7987
5	861	24649	3745	10034	10870	6749
6	806	23078	3506	9394	10177	5745
7	759	21735	3302	8848	9585	4919
8	719	20572	3126	8374	9072	4232
9	683	19554	2971	7960	8623	3657
10	652	18652	2834	7593	8226	3171

Table 5: Net positive value calculations for gas from well McMordie #7-86.

Gas Production (MCF/YR	Revenue ($)	Operating Cost ($.65/MCF)	Tax 48% ($)	NCF ($)	NPV @ 10% ($)
109017	555986	361391	93406	101189	91990
86301	440136	286088	73943	80105	66202
70169	357860	232609	60120	65130	48933
58275	297203	193182	49930	54091	36945
49240	251125	163231	42189	45705	28379
42206	215251	139913	36162	39176	22114
36616	186742	121382	31373	33987	17441
32096	163689	106398	27500	29791	13898
28386	144767	94098	24321	26348	11174
25300	129032	83871	21677	23484	9054

Table 6: Net positive value calculations for gas from well McMordie #7-86.

Oil Production (BBLS/YR)	Revenue ($)	Operating Cost ($4.35/BBL)	Tax 48% ($)	NCF ($)	NPV @ 10% ($)
1066	30518	4637	12423	13458	12235
878	25141	3820	10234	11087	9163
747	21379	3248	8703	9428	7083
650	18597	2826	7570	8201	5601
575	16456	2500	6699	7257	4506
515	14758	2242	6008	6508	3674
467	13378	2033	5446	5899	3027
427	12234	1859	4980	5395	2517
394	11270	1712	4588	4970	2108
365	10447	1587	4253	4607	1776

Using the data from the above tables, I was able to determine that McMordie #3-86 is the best well to invest your money in by the following method.

McMordie #3-86	**McMordie #3-129**	**McMordie #7-86**
NPV of gas => $319,260	NPV of gas => $289,411	NPV of gas =>$346,130
NPV of oil => $3,081,457	NPV of oil => $71,660	NPV of oil => $51,690
Total NPV => $3,400,717	Total NPV => $361,071	Total NPV =>$397,820

As you can clearly see from the above figures, the well McMordie #3-86 will by far return the most money and is therefore, in my opinion, the best investment.

Conclusion

You asked me to find a well that will be the best investment over the next ten years. After sorting through data and performing meticulous calculations, I have concluded that the best well to invest in is McMordie #3-86. The amount of oil and gas production of this well was higher than two others that were similar in production. The net positive value of this well is also much (over three million dollars) higher than the other two. Again, I recommend that you invest in McMordie #3-86.