An Uncertain Market: A Case Study of a Cow-Calf Operation

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ABSTRACT

This case study uses current dynamics in the U.S. beef cattle industry to illustrate the use of financial analysis tools such as net present value in making investment decisions. Two problems face the livestock producer in this case study: 1) should the producer purchase replacement females or keep existing unbred females; and 2) should the producer expand his operation in terms of both land and cows. Students are asked to estimate a net present value (NPV) for both investment decisions. These NPVs should account for risk as prices in the beef cattle sector are anything but certain.

Harold Landry took a sip of his morning coffee as he began to reflect on what he had just read in his county's local extension newsletter. As of January 1, 2013, the total number of U.S. beef cows was 29.3 million, the smallest U.S. beef herd since 1962. The article went on to discuss how drought, higher input costs, declining beef demand, and unprofitability had contributed to year-on-year declines in thirteen of the past fifteen years in the number of U.S. beef cows. This decline in the number of beef cows had also led to a shrinking number of feeder cattle supplies.



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While the first part of the article did little to boost Harold's confidence in the future of his cow-calf farm operation, especially since he had little control over increasing farm input costs and even less on how much beef Americans consume, there was a silver lining. Because of declining cattle inventory, cattle sales prices had begun to move higher since 2010. These higher prices were the result of feedlots competing with each other to procure available and limited supplies so they could operate their feedlots as close to capacity as possible. In response to the competition among feedlots for feeder cattle, the prices for replacement female Oklahoma City stockyards had risen to levels in excess of a $1,000 per animal. Harold's experience combined with the conversations he had with his fellow farmers at the East County Farm and Feed Store made him aware of the fact that private sales were even higher than prices at the Oklahoma City stockyards. These higher prices were often due to the perceived improved genetic potential of females sold and the reputation of sellers at private sales relative to those sold at a public auction where information on the sellers is not always available.

Harold had always sold cows that did not breed because these females cost him money without generating revenue in a given year. With the outlook for cattle prices being very good for the next few years, he certainly wanted to make sure every cow was calving each year. The high price of replacement females had made him wonder if this strategy was still wise. Harold had one young female not breed this year and was uncertain on whether to try again or sell her.

As Harold finished his coffee, he made his way to the sink, but stopped to look out his window at his neighbor Bill Edwards' farm. Bill had recently approached Harold about wanting to sell his farm. Bill had told Harold that it was time to enjoy retirement, as Bill no longer wanted to haggle over annual rental arrangements. Harold had been mulling over the decision for a couple of days, but the article he just read made him think he needed to get a little more serious about this proposition.

Harold's farm operation had weathered the recent drought in Oklahoma relatively well, as he was able to maintain pre-drought profit levels in his operation. However, he wasn't sure if he would get the same results taking on an additional 640 acres, especially if significant rainfall wasn't received. Harold knew though that if he wanted to expand his cow-calf operation, he had to have more pastureland, and Bill's farm would solve that problem. The opportunity to acquire acreage bordering his land would not likely present itself again in the near future. If he went through with the purchase of Bill's farm, he would also have to purchase replacement females from the market, an additional cost to the price of the land. Finally, Harold recognized that he also had a familiarity with Bill's land that provided him ideas on how to improve that farm. Still, he had a nagging feeling that if he took over Bill's land, it could mean financial ruin especially if the drought continued, input prices continued to rise significantly, and/or demand for beef continued to struggle. With the thought of expansion weighing heavily on his mind, Harold knew it was time to crunch the numbers, but first he would need to put pencil to paper to determine all of his potential

options for the existing farm operation. He started with the obvious: continue to do what he is doing. The next option he thought would be to expand the operation through the purchase of Bill's land, but as he started to write that down, his mind drifted back to the article and of how high the prices of replacement heifers were.

When a cow doesn't produce a calf, a farmer typically sells the open (barren) cow at auction and then either uses the revenue to purchase a replacement heifer or forgoes selling a raised heifer calf at weaning to replace the culled cow[1]. Nevertheless, given the increase in replacement heifer prices, is replacing open cows still a sound business strategy? Consequently, Harold needed to know whether he should he keep a young, open cow and hope that infertility was only a temporary issue, or sell her and purchase a replacement. Typically, any replacement heifer purchased in 2013 would be bred, which would ensure a high probability of a calf in 2014. There is also the possibility of purchasing a replacement female that is bred and that has a calf at her side to provide revenue in 2013. Even if the purchased replacement female does not have a calf to sell this year, the female will be bred for a calf to be sold in 2014.

Perhaps just as important as the profitability of the expansion decision to Harold was whether he would be able to cash flow the expansion with the purchase of Bill's farm. If the bank did not think his analysis considered everything, he would be out of luck. Therefore, Harold decided he needed to call his local extension agent Wayne Stephens, an agricultural economics graduate from the state's land grant university, who seemed to have a good understanding of numbers and where to get the data they would need to do the analysis.

Potential Courses of Action for Harold's Farm Operation

Wayne knew Harold was familiar with the concept of net present value (NPV) analysis, as they had used it before to analyze Harold's decision to build a hay storage facility for his existing operation. However, Wayne still wanted to provide Harold with a refresher on why he would be using NPV to analyze Harold's options. NPV analysis would allow them to determine if Harold would be better off keeping the young open cow or sell her and purchase a bred replacement female. The importance of this analysis is that it compares the present value of a stream of future expected cash flows discounted at a desired rate of return. This desired rate of return would need to be at least as high as five percent, i.e., the return on assets (ROA) that Harold is currently earning on his existing farm operation. If the NPV is greater than or equal to zero, then the investment strategy will provide a return that equals or exceeds the desired rate of return, which means the investment would be a good business decision. When comparing investment options, the alternative with the highest NPV would generally be considered the best option.

To conduct the NPV analysis for Harold, Wayne had obtained data on estimates on future cash revenues (inflows) and expenses (outflows), and IRS depreciation schedules (Tables 1 through 4). The desired rate of return (discount value) was set at five percent. Other assumptions made by Wayne are: 1) calves would be sold at a weight of 550

pounds; 2) culled cows would weigh 1,100 pounds and sell for $80/cwt. in 2013 and have a salvage value of $75/cwt. in 2020 at the same weight; 3) bred replacements purchased in 2013 are expected to cost $1,400 and have a calf on the female's side; 4) expenses would grow two percent each year through 2020; 5) Harold can finance replacements with a five-year loan at an interest rate of four percent, and the loan will require him to make a single payment each year; and 6) marginal tax rates are assumed to be 30 percent.

Wayne presented Harold with the NPV analysis of keeping the young open cow or selling her and purchasing a cow/calf pair (Tables 5, 6, and 7), but cautioned him as he reviewed the numbers that he had not done any risk analysis, and that was something they would want to discuss at the end of their meeting. As Harold examined the numbers, he immediately noticed that no income would be generated by keeping the open cow in 2013 (Table 6), but that cow in the model was assumed to produce a calf in each of the subsequent years (2014-2020). This would suggest the failure of the young open heifer to produce a calf in 2013 was a single year issue and not indicate long-term fertility problems. Harold wondered if this was a good assumption and would have to remember to ask Wayne about this. The purchased replacement female would be expected to produce a marketable calf in each of the subsequent years.

Under the assumptions made by Wayne for Harold's farm, assuming that the genetic potential of the purchased cow/calf pair is equal to the currently owned and open cow, the NPV analysis favors the strategy of keeping the young open cow and not purchasing a replacement female. Once the purchase price of the replacement female is less than $1,304.96, it becomes optimal for him to sell the young open female because the NPV of purchasing a replacement female is greater than that of keeping the young open female. Harold also noted that both investments generated a positive NPV and exceeded the desired rate of return of five percent for both alternatives. Harold was confident that the results might change if he had better data on the likelihood of an open cow breeding back.

Harold noted that Wayne had been very thorough as his analysis included tax implications of both options, which should be considered when making any investment decision. Purchasing a replacement female allowed him to depreciate the value of that animal unlike the owned and open cow, as a raised replacement female cannot be depreciated for tax purposes.

After Wayne was confident that Harold was comfortable with the analysis of how he should manage his current herd, Wayne knew it was time to move to on to the analysis of the purchase of his neighbor's farm, something that made him both nervous and excited at the same time. The only additional data needed for the farmland purchase decision was the price of Bill's farmland and the amount of cattle that needed to be purchased or retained. With that, Wayne gave the NPV analysis on the expansion option (Tables 8 and 9) to Harold. The results of the analysis indicated Harold should proceed with the expansion of his beef cattle operation. Again, these numbers confirmed Harold's

a priori expectations that he should purchase Bill's farm, and suggested that the bank would seriously consider his proposed expansion plan, given the positive NPV.

Making the Decision

Upon the conclusion of their meeting, Harold thought back to his question about what would happen if the infertility of the young open cow continued into the future. Obviously, the NPV of keeping the currently owned cow would decline, but how fast?[2] Wayne had left him with some additional information with respect to calving statistics for an open cow (Table 10) that Harold could utilize to develop a more complete model, one that incorporated production risks associated with a cow-calf operation. Harold knew this was important, because in his own experience cows calving every year with 100 percent certainty was not likely to happen. Harold also felt good about the price projections Wayne had given him, but he also knew that they were just expected prices. In Harold's experience, cattle prices were rarely what they were projected to be. In fact, Harold had a lot of historical data from his farm operation that showed him the statistics for his farm operation often deviated from what was expected (Table 11).

Harold concluded that he was overwhelmed when it came to synthesizing all of this information, although he was certain he understood the results. This meant Harold was going to have to find some help, and he knew Wayne wasn't the one to do this, as Wayne had to assist other farmers. Knowing he needed additional assistance, Harold decided it was time to make a call to the state's land grant university and speak to its agricultural economics department to see if they still took on special projects for their classes to supplement their coursework, as when he was in college. The secretary of the department put Harold in touch with Dr. Steve Haselwood, a farm management and finance professor who was more than willing to help. Dr. Haselwood was always looking for real world examples to incorporate in his undergraduate and graduate level farm management classes, especially if Harold was willing to provide all of the necessary data and answer all pertinent questions. Dr. Haselwood also stated that the students would be willing to put together some additional analysis of his problem if Harold was willing to come to campus to listen to the students present their analysis, a proposition that Harold could not resist. As Harold emailed Dr. Haselwood all of the requested information, he couldn't help but wonder how different his farming operation might look this time next year.

Dr. Haselwood's Assignments

Dr. Haselwood had read over Harold's email with great interest and knew that it would reinforce the concepts he was teaching in his classes. He was particularly intrigued by the use of risk to make operational decisions including expansion, which would be of great interest to both his senior level undergraduate and his masters' students who work with risk. As Dr. Haselwood read over the email one more time, he recognized that Harold was dealing with two separate problems: 1) should Harold purchase replacement females or keep existing unbred females; and 2) should Harold expand his operation in terms of both land and cows. He also noted none of the current analysis Harold had

provided accounted for the potential risk in the price of cattle, the likelihood of a cow being barren, or the increase in input costs. This was of great concern to Harold, as he knew the future is uncertain.

Based upon the information in the email, Dr. Haselwood put together a set of assignments, one being geared for his graduate students that centered on the expansion of the operation, and one for his undergraduate students that would focus on how he managed his herd in the existing operation. The combination of these assignments would provide the answers Harold would need to decide the future of his farm operation.

Undergraduate Students Assignment Section

With all of this information, your farm management consulting team is ready to develop a quantitative model to determine the net present value (NPV) of purchasing a bred replacement with a calf on her side or keeping a barren cow in Harold's herd. To complete your team's assessment of Harold's problem they need to:

1. Identify a key output variable (NPV) and input variables;
2. Design output tables;
3. Formulate equations for calculating the final output variables;
4. Identify the stochastic variables (females not calving, the price of calves, and operating costs); and
5. Develop an NPV model that allows for a what-if analysis by varying a stochastic variable one at a time to be created.

Once your team's quantitative model is complete, the team will need to prepare a report that can be delivered to Harold. Remember your team's job is not to tell Harold what he needs to do, but provide him with a synopsis of the situation, so that he can make the best decision as to whether he should use replacement heifers or continue to operate his farm in the same manner he is currently operating it. You will need to provide Harold with estimated NPVs for the eight-year risk analysis for both options.

Master Students Assignment Section

Buying the farm from Bill means that Harold would have to take out a significant loan from the bank. The size of the loan could put Harold's financial future in serious jeopardy if cattle prices declined suddenly as result of factors that include weakened beef demand, economic recession, and/or continued or worsening drought conditions. Harold has informed Dr. Haselwood that he will need to finance 75 percent of the 640 acre purchase ($1,468 per acre for pasture), over its twenty-year life at an annual interest rate of 4.5 percent. The lender, according to Harold, would require Harold to make a single payment each year In addition to this cost, Harold must also purchase an additional 200 females, which will cost Harold $280,000. Harold has indicated that an additional $50,000 in equipment purchases and facility upgrades will be needed.

Based on the information in Harold's email, Dr. Haselwood has instructed your team that he is relatively certain that production characteristics of Bill's farm are very similar to Harold's current farm. Consequently, Harold's historical data should serve as a good proxy for any analysis of expansion.

With all of this information, your farm management

consulting team is ready to develop a quantitative model to determine the net present value of expansion. To complete your team's assessment of Harold's problem it will be necessary to do the following:

1. Identify a key output variable (NPV) and input variables;
2. Design output tables;
3. Formulate equations for calculating the final output variables;
4. Identify the stochastic variables (including females not calving, the price of calves, and expenses); and
5. Develop a stochastic simulation model that calculates both the NPV and the financial feasibility of the expansion option.

Harold needs an estimated NPV based on an eight-year risk analysis for the expansion; this estimate should include the expected NPV as well as the likelihood of having a positive NPV. Because you have a limited amount of information, the distributions your consulting team selects should account for this and any correlation between these random variables. At the end of the eight years, both the farmland and cattle could be sold at their market value. For the financial feasibility analysis, assume that you would make a balloon payment for the remaining amount of the mortgage.

Once your team's quantitative model is complete, a two to four page report will need to be prepared that summarizes your team's findings and that can be delivered to Harold. Remember your job is not tell Harold what he needs to do, but provide him with a synopsis of the situation, so that he can make the best decision regarding the future of his operation.

Endnotes

[1] As with most cow-calf operations, calves are sold to pay for the annual expenses associated with each cow with the difference being income retained by the operator. Cows that don't produce a calf are not generating income for the operation to cover the cow's portion of farm expenses. Females typically have their first calf at the age of two and are expected to annually produce a calf until they are ten years old.

[2] If multiple cows are open, then adjustments to existing management practices are likely needed to improve profitability and productivity of the operation.

References

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Appendix A

General Teaching Notes

While the topics in this case study should be familiar to the intended audiences, we suggest referencing one of the following texts should audience need a refresher on financial topics in agriculture:

1. Moss, C.B. 2013. *Agricultural Finance*. New York, NR: Routledge.
2. Barry, P.J., and P.N. Ellinger. 2012. *Financial Management in Agriculture*, 7th ed. Upper Saddle River, NJ: Prentice Hall.

Before the students begin model development and after case discussion, it is important to go over the following information with the students: define any input variables and output variable, discuss the equations needed to calculate these output variables, discuss how to design output tables, and determine which of the variables will be stochastic. In addition, make sure the students are familiar with whatever statistical package is being used to analyze the data.

We also recommend that you give the students specific guidelines regarding their report. The report is recommended to be two to four pages in length, double-spaced, 12-point font, and 1-inch margins. They may include all the tables and graphs they want to support their report, but they must be referenced in the text. The spreadsheet and the report should be submitted in electronic format so that you can verify and validate each team's spreadsheet.

Undergraduate Teaching Points of Emphasis and What to Look for in Their Solution

When working with undergraduate students or farm managers, the case study should be taught after the students have been introduced to the core topics in farm management, finance, and risk. This case study reinforces those concepts by providing students with a real world case to make strategic decisions facing a farm operation. When teaching this case, a considerable amount of time should be spent discussing the risks Harold faces in his decisions, how they might measure risk, the implications of his decisions, and why NPV is the appropriate analysis, before the students begin development of the model. Consequently, it is important that when they prepare their report, students are able to identify and discuss how these influence the results of their model.

To aid the students, we suggest that you have them do the following steps in order:

1. Construct a deterministic NPV model for the decision regarding keeping the young open cow or purchasing a replacement.
2. Convert the deterministic models into stochastic models. Here, it is important that you have students change stochastic variables one at a time, i.e. a what-if analysis, which allows for systematic analysis of

how the risk surrounding a particular variable affects the NPVs of the decision regarding keeping the young open cow or purchase of a replacement. When students get to this step, make sure you review how you want them to measure risk in the model.

Students can then compare the NPV using various methods of ranking including, but not limited to, mean, standard deviation, mean-variance, coefficient of variation, minimum, maximum, and maximum-minimum range. Each ranking method has potential drawbacks and benefits that should be addressed with the students.

Graduate Teaching Points of Emphasis and What to Look for in Their Solution

The graduate level assignment expands on the undergraduate level assignment by teaching the students how to use stochastic simulation for modeling the risk in an entire system given limited information and uncertainty. Attention should be given to how the random variables are modeled. For example, if they simulate two random variables that are correlated and they ignore the correlation, they will either over or underestimate the risk in the NPV model. By improperly estimating the risk in the model, recommendations based on the results of the model will be faulty and could lead to economics disaster for Harold and his farm operation.

As with the undergraduate assignment, we suggest that you have graduate students build their model in a systematic fashion beginning with a deterministic model, then progressing to a model which incorporates risk, and finally advancing to the simulation model. The deterministic model for the graduate students is more advanced than the one used by the undergraduate students. Particular emphasis should be placed on correctly separating the deterministic component from the random component for each of the random variables via statistical analysis. The random component will be utilized to create the stochastic component of the random variable. When adding variability to the model, the students should focus on selecting the appropriate probability distribution for each of the random variables. Once the variability is added to the model, students can begin the simulation. The simulation model will allow for multiple iterations of the model to be run so that students create multiple estimates of the output variables. Once again, you should emphasize the importance of making sure the students control for correlation among the random variables.

To help the students in preparing their final report, we suggest that you ask them to run the simulation model for a minimum of 1,000 iterations, build a table that shows the mean; standard deviation; coefficient of variation; 5th, 25th, 50th, 75th, and 95th percentiles; and probability of being above zero for the NPV. In addition, graphs that contain the cumulative distribution function for both expansion options' NPV and distribution graphs for the cumulative cash flow should be developed. These tables will aid the students in their effort to provide an overall risk assessment of Harold's expansion options.

Table 1. U.S. Department of Agriculture and FAPRI Baseline Projections for Beef Cattle Prices

	Calves, Farm ($/cwt)	Fed Steers, 5-Area Price ($/cwt)	Yearling Steers, Oklahoma City ($/cwt)	Utility Cows, Sioux Falls ($/cwt)
2011	$141.59	$114.73	$133.74	$69.92
2012	$163.90	$122.47	$145.54	$76.58
2013	$165.40	$128.00	$147.25	$81.83
2014	$169.13	$129.29	$150.57	$81.83
2015	$173.65	$129.78	$154.59	$82.30
2016	$174.34	$128.44	$155.20	$78.59
2017	$167.86	$126.34	$149.44	$73.39
2018	$163.47	$125.26	$145.53	$70.34
2019	$165.08	$128.45	$146.97	$66.49
2020	$165.52	$129.61	$147.36	$69.16
2021	$168.23	$131.58	$149.77	$71.59
2022	$171.47	$130.40	$152.65	$74.06

Source: USDA Economic Research Service (2013) and FAPRI (cull cow prices) (2013)

Table 2. Oklahoma City Annual Average Prices

	Feeder Steers, 500-600 lbs ($/cwt)	Feeder Steers, 700-800 lbs ($/cwt)	Cull Cows, 1200-2000 lbs ($/cwt)	Bred Heifers, Medium & Large #1 ($/head)	Bred Cows, Medium & Large #1 ($/head)
2000	$98.77	$82.60			
2001	$101.32	$84.28			
2002	$91.45	$77.64			
2003	$100.47	$86.74	$48.83		
2004	$120.46	$100.88	$50.06	$970.19	$932.19
2005	$129.27	$107.21	$51.86	$966.41	$974.82
2006	$126.11	$103.56	$45.47	$945.75	$919.44
2007	$121.72	$105.08	$48.00	$1,018.25	$942.32
2008	$115.55	$99.98	$49.13	$840.83	$953.08
2009	$108.51	$93.34	$43.30	$752.50	$869.20
2010	$123.08	$106.16	$53.70	$940.00	$883.32
2011	$147.06	$129.99	$64.61	$993.34	$1,034.43
2012	$169.60	$141.88	$79.46	$1,359.17	$1,238.45

Source: USDA Agricultural Marketing Service, compiled by Livestock Marketing Information Center (2013)

Table 3. Historical Cost of Production and Herd Production Data from Standard Performance Analysis Program

	Cost Per Cow	Weaning Percentage	Average Weaning Weight
1991	$437.97	80.2	526.5
1992	$401.49	84.0	508.5
1993	$372.96	84.8	509.8
1994	$391.15	82.8	520.4
1995	$322.63	83.8	540.8
1996	$373.48	84.6	530.1
1997	$360.91	79.0	518.2
1998	$442.88	83.5	528.3
1999	$461.47	78.6	520.5
2000	$431.21	83.3	527.7
2001	$503.73	79.4	515.8
2002	$538.21	82.1	521.5
2003	$498.50	79.1	515.1
2004	$507.57	80.5	516.6
2005	$527.10	83.7	533.7
2006	$574.21	82.8	517.3
2007	$594.37	79.5	545.8
2008	$587.04	83.1	525.6
2009	$607.04	83.9	521.5
2010	$586.51	81.3	518.8
2011	$630.85	83.1	396.5

Source: Bevers (2013)

Note these costs are accrual cash-adjusted operating expenses

Table 4. MRCS 150% Declining Balance Depreciation Method for Purchased Replacement Females and Equipment (Half-Year Convention and Property Placed in Service during Any Month of the Year)

	Recovery periods in years	
Year	**5-year**	**7-year**
1	15.00	10.71
2	25.50	19.13
3	17.85	15.03
4	16.66	12.25
5	16.66	12.25
6	8.33	12.25
7		12.25
8		6.13

Source: IRS (2012)

Table 5. Deterministic Inputs for NPV Calculation of the Decision to Purchase Replacement Female or Keep Existing Female

Inputs	
Price of Culled Cow Today ($/cwt)	$ 80
Weight of Cow if Culled Today (lbs)	1,100
Expected Longevity of the Cow (# of years)	8
Weight of Sold Calves (lbs)	550.00
Number of Calves Sold Each Year	1.00
Initial Cash Costs per Cow/Calf	$483.89
Expected Increase in Annual Cash Costs:	2%
Expected Salvage Value of Culled Cow in Eight Years ($/cwt)	$75.00
Expected Weight of Culled Cow in Eight Years (lbs)	1,100.00
Bred Replacement Purchase Price	$1,400.00
Number of Replacements Purchased	1.00
Profitability	
Discount Rate	5.00%
Tax Rate	30.00%
Financing	
Livestock Loan	
Life of Loan (# of years)	5.00
Interest Rate	4.00%
Equity Requirement	20%

Table 6. Deterministic NPV Solution for Retaining an Existing Female

Year	0	1 2013	2 2014	3 2015	4 2016	5 2017	6 2018	7 2019	8 2020
Weaning Percentage		0.00%	82.05%	82.05%	82.05%	82.05%	82.05%	82.05%	82.05%
Calf Price ($/cwt)		$165.40	$169.13	$173.65	$174.34	$167.86	$163.47	$165.08	$165.52
Total Cash Revenue Calf Sales		$0.00	$763.26	$783.66	$786.78	$757.53	$737.72	$744.99	$746.97
Cull Cow Cash Revenue		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$825.00
Total Cash Revenue		$0.00	$763.26	$783.66	$786.78	$757.53	$737.72	$744.99	$1,571.97
Total Cash Expenses[a]		$483.89	$493.57	$503.44	$513.51	$523.78	$534.25	$544.94	$555.84
Net Cash Revenue		($483.89)	$269.70	$280.22	$273.27	$233.75	$203.47	$200.05	$1,016.13
Depreciation Factor		0.1500	0.2550	0.1785	0.1666	0.1666	0.0833	0.00	0.00
Depreciation		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Income Before Taxes		($483.89)	$269.70	$280.22	$273.27	$233.75	$203.47	$200.05	$1,016.13
Taxes		($145.17)	$80.91	$84.07	$81.98	$70.13	$61.04	$60.01	$304.84
Net Income After Taxes		($338.72)	$188.79	$196.16	$191.29	$163.63	$142.43	$140.03	$711.29
Annual After-Tax Cash Flow		**($338.72)**	**$188.79**	**$196.16**	**$191.29**	**$163.63**	**$142.43**	**$140.03**	**$711.29**
Discount Factor		0.9524	0.9070	0.8638	0.8227	0.7835	0.7462	0.7107	0.6768
Present Value of Cash Flow		($322.59)	$171.24	$169.45	$157.37	$128.21	$106.28	$99.52	$481.43
Sum of PV Cash Flows		**$990.90**							
NPV		**$990.90**							

[a] Note that cow-calf expenses is equal to total cash expenses

Table 7. Deterministic NPV Solution for Purchase of Replacement Female

Year	0	1 2013	2 2014	3 2015	4 2016	5 2017	6 2018	7 2019	8 2020
Weaning Percentage		100.00%	82.05%	82.05%	82.05%	82.05%	82.05%	82.05%	82.05%
Calf Price ($/cwt)		$165.40	$169.13	$173.65	$174.34	$167.86	$163.47	$165.08	$165.52
Total Cash Revenue Calf Sales		$909.70	$763.26	$783.66	$786.78	$757.53	$737.72	$744.99	$746.97
Cull Cow Cash Revenue		$880.00							$825.00
Total Cash Revenue		$1,789.70	$763.26	$783.66	$786.78	$757.53	$737.72	$744.99	$1,571.97
Total Cash Expenses		$483.89	$493.57	$503.44	$513.51	$523.78	$534.25	$544.94	$555.84
Net Cash Revenue		$1,305.81	$269.70	$280.22	$273.27	$233.75	$203.47	$200.05	$1,016.13
Depreciation Factor		0.1500	0.2550	0.1785	0.1666	0.1666	0.0833	0.00	0.00
Depreciation		$195.87	$68.77	$50.02	$45.53	$38.94	$16.95	$0.00	$0.00
Net Income Before Taxes		$1,109.94	$200.92	$230.20	$227.74	$194.81	$186.52	$200.05	$1,016.13
Taxes		$332.98	$60.28	$69.06	$68.32	$58.44	$55.96	$60.01	$304.84
Net Income After Taxes		$776.96	$140.65	$161.14	$159.42	$136.37	$130.56	$140.03	$711.29
Annual After-Tax Cash Flow		**$972.83**	**$209.42**	**$211.16**	**$204.95**	$175.31	**$147.51**	**$140.03**	**$711.29**
Discount Factor		0.9524	0.9070	0.8638	0.8227	0.7835	0.7462	0.7107	0.6768
Present Value of Cash Flow		$926.50	$189.95	$182.41	$168.61	$137.36	$110.08	$99.52	$481.43
Sum of PV Cash Flows		**$2,295.86**							
NPV		**$895.86**							

Table 8. Inputs for the Deterministic NPV for the Farm Expansion

Inputs	
Price of Culled Cow Today ($/cwt)	$80.00
Weight of Cow if Culled Today (lbs)	1,100.00
Expected Longevity of the Cow (# of years)	8.00
Weight of Sold Calves (lbs)	550.00
Number of Calves Sold Each Year	200.00
Initial Cash Costs per Cow/Calf	$483.89
Expected Increase in Annual Cash Costs:	2.00%
Expected Salvage Value of Culled Cow in Eight Years ($/cwt)	$75.00
Expected Weight of Culled Cow in Eight Years (lbs)	1,100.00
Bred Replacement Purchase Price	$1,400.00
Number of Replacements Purchased	200.00
Number of Acres Available for Purchas	640.00
Price of Land ($/acre)	$1,468.00
Expected Growth Rate in Land Values	9.14%
Initial Outlay	
Total Cash Outlay for Additional Animals	$280,000.00
Total Cash Outlay for Additional Facilities and Equipment	$50,000.00
Total Cash Outlay for Land	$939,520.00
Profitability	
Discount Rate	5.00%
Tax Rate	30.00%
Financing	
Livestock	
Life of Loan (# of years)	5.00
Interest Rate	4.00%
Equity Requirement	20.00%
Land	
Life of Loan (# of years)	20.00
Interest Rate	4.50%
Equity Requirement	25.00%

Table 9. Deterministic NPV Solution for the Farm Expansion

Year	1 2013	2 2014	3 2015	4 2016	5 2017	6 2018	7 2019	8 2020
Weaning Percentage	100%	82.05%	82.05%	82.05%	82.05%	82.05%	82.05%	82.05%
Calf Price ($/cwt)	$165.40	$169.13	$173.65	$174.34	$167.86	$163.47	$165.08	$165.52
Total Cash Revenue Calf Sales	$181,940	$152,653	$156,732	$157,355	$151,506	$147,544	$148,997	$149,394
Cull Cow Cash Revenue								$165,000
Value of Purchased Land								$1,891,375
Total Cash Revenue	$181,940	$152,653	$156,732	$157,355	$151,506	$147,544	$148,997	$2,205,769
Total Cash Expenses	$96,778	$98,714	$100,688	$102,702	$104,756	$106,851	$108,988	$111,168
Net Cash Revenue	$85,162	$53,939	$56,045	$54,654	$46,751	$40,693	$40,010	$2,094,602
Depreciation Factor (5 year)	0.1500	0.2550	0.1785	0.1666	0.1666	0.0833	0.00	0.00
Depreciation (5 year)	$42,000	$71,400	$49,980	$46,648	$46,648	$23,324	$0	$0
Depreciation Factor (7 year)	0.1071	0.1913	0.1503	0.1225	0.1225	0.1225	0.1225	0.0613
Depreciation (7 year)	$5,355	$9,565	$7,515	$6,125	$6,125	$6,125	$6,125	$3,065
Net Income Before Taxes	$37,807	($27,026)	($1,450)	$1,881	($6,022)	$11,244	$33,885	$2,091,537
Taxes	$11,342	($8,108)	($435)	$564	($1,807)	$3,373	$10,165	$345,605
Net Income After Taxes	$26,465	($18,918)	($1,015)	$1,316	($4,216)	$7,871	$23,719	$1,745,932
Annual After-Tax Cash Flow	**$73,820**	**$62,047**	**$56,480**	**$54,089**	**$48,557**	**$37,320**	**$29,844**	**$1,748,997**
Discount Factor	0.9524	0.9070	0.8638	0.8227	0.7835	0.7462	0.7107	0.6768
Present Value of Cash Flow	$70,305	$56,278	$48,789	$44,499	$38,046	$27,849	$21,210	$1,183,790
Sum of PV Cash Flows	**$1,490,766**							
NPV	**$221,246**							

Table 10. Pregnancy Rates in Heifers Failing to Conceive at First Breeding (14 to 15 Months of Age) and Held Over for a Second Breeding Six Months Later

Number	Breed	Pregnancy Rate at Second Breeding	Year
160	Hereford	53%	1975
64	Hereford	56%	1975
79	Brangus Cross	98%	1996
92	Brangus Cross	47%	1997
145	Brangus Cross	54%	1998
43	Brangus Cross	63%	1999
71	Brangus Cross	61%	1999
124	3/4 to full Brahman	32%	1999

Source: Sprott (2000)

Weighted Average Pregnancy Rate at Second Breeding 55.23%

Table 11. Harold's Historical Farm Data

	Cost Per Cow	Weaning Percentage	Calf Prices Received
1991	$389.79	81.80	$91.76
1992	$293.09	87.36	$94.42
1993	$354.31	89.89	$99.49
1994	$352.04	95.22	$86.17
1995	$358.12	93.86	$67.66
1996	$351.07	94.75	$59.66
1997	$386.17	86.11	$85.93
1998	$385.31	95.19	$76.33
1999	$392.25	74.67	$88.15
2000	$435.52	89.96	$92.84
2001	$528.92	86.55	$93.21
2002	$495.15	85.38	$85.05
2003	$523.43	88.59	$102.48
2004	$390.83	83.72	$122.87
2005	$442.76	92.91	$127.98
2006	$528.27	83.63	$138.72
2007	$511.16	88.25	$111.98
2008	$557.69	89.75	$114.39
2009	$582.76	88.10	$103.08
2010	$662.76	86.18	$115.70
2011	$479.45	84.76	$142.65