Breakeven Analysis and Projected Future Earnings for a Standard Dairy Operation

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Abstract

This paper discusses the financial difficulty dairy producers are currently facing. We develop a model and explain how the model will be used to help producers plan and cope with the current market prices. We identify the resources used and also provide a description of the model and how it works. An example is used to provide the user with the assumptions of the model, to present the results, and to interpret those results.

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University of Minnesota

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**Introduction**

Our motivation in this paper is to understand the recent decline of milk prices and the effect it has had on dairy producers. During February and March of 2009 we have experienced the worst farm milk prices since 1978. These low prices have placed many dairy farmers in survival mode and the three to six month outlook is not favorable. This survival mode will have a large impact on producers and the intent of the model is to help producers through this challenging time and also put them in a better financial position in the future.

One of the main problems identified is many dairy producers, especially small operations, are unaware of their costs of production and financial breakeven point. During these tough times, it is important for producers to see how they can reduce costs without reducing milk production. The model that is developed in this paper will help producers understand their variable and overhead costs and help them identify expenses that they can potentially reduce.

**Model Data and Resources**

Most of the data for this paper comes from the University of Minnesota’s FINBIN website. Based on this data, a benchmark report is created which identifies relevant costs and revenues included in the model. The report is used as a real-life case study in which costs and revenues are inserted to gain a better understanding of the model. Historical dairy production and prices are obtained from the USDA NASS website and gathered on a monthly basis and used to predict future prices using the @Risk software add-on to Microsoft Excel. Information on milk/feed price ratio is gathered from the University of Wisconsin’s Dairy Marketing and Risk Management Program website. Dale Nordquist, from the Center for Farm Financial Management and Dennis Kelly, from AgStar answered various questions dealing with statistics and the meaning of the FINBIN data.

Real data is obtained from Seitzer Farms Inc. and Bongards’ Creameries. The data received from Seitzer Farms Inc. includes 14 months of market prices and premiums. The dairy reports the base price for each month and the premiums obtained through somatic cell count premiums and butterfat and protein premiums. Bongards’ Creameries provides a chart detailing different premium levels, depending on the somatic cell count of the herd. They also provide a
spreadsheet on how they calculate the butterfat and protein premiums. The scale ranges from 0 to 18 cents. Current milk prices are obtained through the Chicago Mercantile Exchange.

**The Model**

The Excel-based tool will allow dairy producers to track their input costs of production and changes in relevant market variables, such as milk prices and feed costs. The model will identify expenses and revenues for a standard dairy production operation in order to calculate a breakeven point and potential profit or losses due to fluctuations in relevant commodity market prices. The model also uses At-Risk software to project a producer’s future profits based on current milk prices and production.

The model will be a stepping-stone for further analysis of dairy operations, such as the cost of raising heifers or the cost of producing feed. Excel will be useful in that it is easy for the producer to use and it will allow producers to easily change prices based on market fluctuations. It will also allow producers to project potential profit or losses and enable them to identify areas where they can increase efficiencies and potentially modify their management practices to create greater profits.

The model has been developed so any dairy producer will be able to utilize it. Data, such as expenses will come from the specific producer. Data, such as feed costs and milk prices, will come from either the producer or will be brought into the spreadsheet via the internet, with current, up-to-date figures. Excel will use the data to determine the revenue, expenses, and profit for the operation.

The figures are on a per cow/year basis. However, the model is developed so a farmer can utilize it on a monthly basis. It is essential for a farmer to track his or her revenue and expenses on a monthly basis, so he or she can make changes to the operation. Excel was chosen as a means to make management decisions. The Excel model will provide the producer with a tool that is user-friendly and easy to understand and use. All the producer has to do is simply enter in the revenue and expenses of the farm. Excel will then produce three sensitivity data tables that include factors that are essential to the operation of the dairy farm. The model also allows the producer to graph and chart milk prices, revenue, and expenses on a monthly basis. It also projects future net income on a monthly and yearly basis.
The model is set up so dairy producers can enter the current price, production, and expenses, which will generate an expected net income. The model contains three different parts, which include the analysis section, graphs, and the At-Risk section. The analysis portion is the foundation of the model. In this section, the producer will enter all pertinent information. When inputting the data, the producer will only be able to enter figures in areas highlighted in orange, making the model simple and easy to use.

**Explanation of the Model**

To start, producers should enter the number of cows on their farm and the average milk production on a per cow per year basis (see Exhibit 1). The entire model relies on this information.

Exhibit 1. Input Section

<table>
<thead>
<tr>
<th>Input Box</th>
<th># of Cows</th>
<th>135</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. lbs./cow</td>
<td>20,258</td>
<td></td>
</tr>
<tr>
<td>Avg. cwt./cow</td>
<td>203</td>
<td></td>
</tr>
</tbody>
</table>

Next, producers can look up the most recent milk price by clicking on the milk price button, which brings them to the Chicago Mercantile Exchange website’s milk price quotes. They should then use the dropdown tab to select the somatic cell count bracket they fall into, which is programmed to provide the producer with a corresponding milk premium on a per hundred weight basis. For example, a producer with a SCC between 0 and 99,999 will receive an additional $0.90 for every 100 lbs of milk produced. A protein premium can also be manually entered in the revenue box. As previously stated, the premium will fall between 0 and 18 cents. Both the SCC and protein premiums are based on Bongards’ Creameries standards. Other revenues a producer has should be entered into the revenue box to produce the average revenue per cow per year. Total revenue for the dairy operation is automatically updated in the Net Income box, which multiplies revenues by the number of cows in the herd.
From there, producers can enter their relevant expenses. The model has listed expenses as: feed expenses, non-feed variable costs, and overhead costs. All information should be entered on a per cow per year basis. As producers enter their expenses, total variable and overhead costs will update in the Net Income section. Once finished entering expenses, producers can reference the Net Income section to see their total revenue less variable and overhead costs to produce a net income for the year (see Exhibit 2).

Exhibit 2. Net Income Per Year

<table>
<thead>
<tr>
<th>Net Income Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Revenue</td>
</tr>
<tr>
<td>Total Variable Cost</td>
</tr>
<tr>
<td>Total Ovhd. Cost</td>
</tr>
<tr>
<td>Total Costs</td>
</tr>
<tr>
<td>Net Income</td>
</tr>
</tbody>
</table>

Below the Variable Costs, there is a cell titled Break-even Variable Costs (see Exhibit 3), which produces a number based on the total revenue, total variable cost, and number of cows in the herd.

Exhibit 3. Break-even Variable Costs

<table>
<thead>
<tr>
<th>Total Variable Costs</th>
<th>$1,965.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break-even Variable Costs</td>
<td>$1,381.98</td>
</tr>
</tbody>
</table>

The number tells the producer what their variable costs need to be, or can be, to result in a net income of zero (the break-even point). When net income is negative, the break-even variable cost is lower than actual variable costs. When net income is positive, the break-even variable cost is higher than actual costs. Break-even analysis on variable costs was performed
because they are the easiest costs to change, especially in the short-run, unlike overhead (fixed) costs.

Once all the information is in place, the model produces three data tables (refer to Exhibits 4, 5, and 6 in the Example section) that show the different levels of net income based on various factors. The data tables compare milk production to feed costs, milk production to non-feed costs, and somatic cell count to dry cow treatment and bedding costs. All the data tables are formatted so the negative numbers are highlighted in red. The model also contains two graphs, one charts base milk prices and milk prices with premiums, and the other charts revenues and expenses.

Graph 1. Milk Price with and without Premiums

The importance of Graph 1 is to compare the benefits of having high quality milk with high butterfat and protein content, as well as low somatic cell count. The other graph will help the producer track his or her revenue and expenses on a monthly basis. As the producer enters his or her data the graphs update automatically and add the respective year and month across the horizontal axis. Hyperlinks are built into the four text boxes at the top of the Analysis.
worksheet. A convenient click brings the producer to the respective table or graph. There are
hyperlinks located on each table and graph to bring the producer back to the main Analysis
screen.

The model then uses At-Risk as a way to generate changes in monthly prices paid and
received. These changes can then be used to project future revenues and expenses. To generate
these projected changes, historical data was collected from 2003-2008 on monthly per
hundredweight prices. The change in price was calculated from month to month and fit to a
proper distribution using At-Risk. The change in prices best fit a BetaGeneral type of statistical
distribution, which helped generate random projected changes in price. The production figures
were generated in a similar fashion. Monthly data was gathered from 2003-2008 on average
milk production in Minnesota. The change from month to month was then calculated to fit the
distribution. The change in production was best fit by a Triangle distribution, which was used to
generate random changes in projected production. Feed costs were simulated using the
commonly used Milk/Feed ratio. This ratio is the price of one pound of milk divided by the price
of one pound of feed. Since milk is priced in 100 lbs units, it is easier to price feed in 100 lbs
increments. Monthly data was collected from 2003-2008 on the Milk/Feed ratio, the difference
between months was then calculated and fit to a distribution (RiskLogistic), and the distribution
was used to project changes in the future Milk/Feed ratio.

The original model ran a projection using distributions fit to monthly prices, productions,
and Milk/Feed ratios. One of the problems was an extreme amount of variation in the values
from month to month that are not common. For example, milk prices would change from $20
one month to $13 the next. Free market prices tend to move in a smoother trend, so the model
uses monthly changes to reduce variability. There are still $2-$3 changes in milk prices from
month to month, which is still highly unlikely. However, since the model varies feed prices and
production, large changes in any of the projections can be somewhat negated. When looking at
the changes in projected monthly profits, there are some large unexpected swings from month to
month. Year-to-year changes appear to be much more realistic, meaning the monthly projections
average out to produce a realistic yearly profit.

A producer using the model would need to look up the most recent Milk/Feed Price ratio
from the button placed in the At-Risk section. After entering it in the input box the model will
project future profits or losses and the producer can plan accordingly. The monthly price
projections for milk and feed vary around the most recent price input and Milk/Feed ratio. This projection doesn’t have any typical uptrend and it is not realistic to assume that milk prices won’t get higher than, say $12, in the next 2 years. However, our model is focused on determining how long producers can survive if the current market conditions continue.

**Example**

All the figures used in the model are obtained from FINBIN and are the average of 575 Minnesota dairy farms in 2007. The assumed figures demonstrate the usefulness of the model, in the results it provides. The model is on a cash basis only. Based on 2007 figures, the average Minnesota dairy producer generated $136,796.01. This is assuming the herd size is 135 head, which was the average dairy herd size in Minnesota in 2007. Holding all expenses constant and changing the price for 2009 to the current market price of $10.76, dairy farmers will incur a loss of $78,707. Under these circumstances, total variable costs will need to decrease from $1,965 to $1,382 while holding production constant to break even for the year.

Using the model and the figures provided by FINBIN, one can interpret the data tables and sensitivity analysis of the model. Exhibit 4 compares annual feed cost per cow to the annual production per cow.

**Exhibit 4.**

<table>
<thead>
<tr>
<th>Annual Production Per Cow</th>
<th>Annual Feed Cost Per Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,200.00</td>
</tr>
<tr>
<td>26,000</td>
<td>$36,952.20</td>
</tr>
<tr>
<td>25,500</td>
<td>$29,689.20</td>
</tr>
<tr>
<td>25,000</td>
<td>$22,426.20</td>
</tr>
</tbody>
</table>

Holding everything constant and assuming a dairy operation with a rolling herd average of 25,000 lbs. of milk per cow (with 135 cows) and feed costs of $1,400 per cow, the net income will be negative $4,574. If the same firm were to increase production by 1,000 lbs./cow/year,
they would increase their net income to $9,952 assuming everything else is held constant. If the firm were to maintain production while cutting annual feed costs/cow to $1,200, net income would increase to $22,426. We can infer that feed costs are a large component of total expenses. In fact, they are the largest component. Increasing the efficiency of feeding is essential to limiting costs in a dairy operation. Many producers do and should focus on feed efficiency. One way to measure feed efficiency is through the ratio of lbs. of feed/ lbs. of milk. Many producers try different feed rations to determine which will produce the most milk, while keeping costs in check. In tough times, there are substitutes that can be made in a feed ration to minimize costs.

In Exhibit 5 we compare annual production per cow to the annual non-feed costs per cow. This data table was chosen because non-feed variable costs have a large impact on a dairy operation. These costs affect production and are easily changed in the short run to help withstand low milk prices. All of these costs can be changed more easily. Some of the costs that can be reduced include veterinary expenses, supplies, breeding fees, marketing, and use of BST. Eliminating the use of BST will noticeably reduce production. A reduction in breeding fees will lower conception and pregnancy rates, which results in lower milk production if a cow is open for too long of a period and not bred back. However, an increase in efficiency and better management can lead to a more profitable firm.

Exhibit 5.

<table>
<thead>
<tr>
<th>Annual Production Per Cow</th>
<th>Annual Non-Feed Variable Costs Per Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$400.00</td>
</tr>
<tr>
<td>26,000</td>
<td>$21,724.20</td>
</tr>
<tr>
<td>25,500</td>
<td>$14,461.20</td>
</tr>
<tr>
<td>25,000</td>
<td>$7,198.20</td>
</tr>
</tbody>
</table>

For example, according to exhibit 5, if production is at 25,000 and annual non-feed variable costs are at $500 per cow, the firm will be losing $6,301.80 per year. If management can keep costs constant and increase production to 26,000 lbs./cow/year, net income will increase to $8,224, bringing it into positive territory. Furthermore, if non-feed variable costs are reduced to $400
per cow, net income will increase to $7,198. With that said, the better the management, the lower the costs and the greater the production.

Exhibit 6 compares dry cow treatment and bedding costs to somatic cell count premium. IN this table we show the relationship of two determinants (dry cow treatment and bedding costs) to SCC levels and their premiums. The greater the investment in bedding and dry cow treatment the lower the SCC will be. According to Seitzer Farms Inc., dry cow treatment reduced their SCC from 300,000 to 150,000, increasing their premiums from $0.25 to $0.70 per hundredweight.

Exhibit 6.

<table>
<thead>
<tr>
<th>Somatic Cell Count Premium</th>
<th>Dry Cow Treatment and Bedding Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$40.00</td>
</tr>
<tr>
<td>$0.70</td>
<td>($54,999.43)</td>
</tr>
<tr>
<td>$0.55</td>
<td>($59,101.68)</td>
</tr>
<tr>
<td>$0.40</td>
<td>($63,203.92)</td>
</tr>
<tr>
<td>$0.25</td>
<td>($67,306.17)</td>
</tr>
</tbody>
</table>

According to the model, exhibit 6 shows that increasing the premium from $0.25 to $0.70 will reduce annual losses by $12,306.74, assuming the milk price in $10.76 and the dry cow treatment and bedding costs are $50/cow/year. By reducing bedding costs by $10/cow/year and maintaining the same SCC, the producer can save $1,350 a year. As one can infer, from this data, as well as the other two, management plays a huge role in reducing costs and increasing profits or limiting losses.

The @Risk simulation of future profits uses the same input data from the analysis tab. The example used a price of $10.76, average yearly production of 20,258 lbs, and a Milk/Feed Price ratio of 1.51. This data comes from the analysis page that the producer previously filled in, however he or she must fill in the Milk/Feed Price ratio. In January 2009 the predicted milk price was $10.88 and Milk/Feed Price ratio was 1.36. The Milk/Feed Price ratio is used to project the feed cost, which is ultimately used to calculate the expected net income for the
The January 2009 projected feed price was $7.81 and the revenue per 100 lbs of milk was $10.66, assuming there was no premium for low SCC and high butterfat and protein.

The model projects production by varying the average production of each cow in the herd on a monthly basis. This figure is then used to calculate total revenues per month. Included in the total revenues are all other revenues, such as the sale of bull calves, which is obtained from the analysis portion of the model. For January 2009, projected production was 2,090 hundredweights of milk and revenue per hundredweight was $10.66. Therefore total farm revenue (including all other revenues) was $24,514.

The model uses the project production to calculate the total feed cost. Non-feed variable costs and overhead costs are gathered from the analysis portion of the model. The three types of expenses are used to calculate net income for each month, as well as year-end net income for 2009 and 2010. The example reveals a net income of negative $8,939 for January 2009 and projects a loss of $72,284 for 2009 and a loss of $79,728 for 2010. This is a testament to the very tough market conditions of low milk prices and high feed costs dairy farmers are currently facing. From this projection one can see that if the current market conditions continue, dairy farmers will be required to seek outside financing to stay in business until conditions become profitable.

**Conclusion**

This paper reports on a model that was developed to help dairy producers realize their cost of production and identify areas in which they can minimize costs. The simplicity of the model makes it user-friendly and understandable. The layout of the model enables the producer to enter his or her known data. The model combines this data with relevant market variables to help the producer make management decisions. Tables and graphs help the producer understand the relationship between certain variables. The model also uses real-time information to project future earnings based on current market conditions. Knowing this information, the producer can take the process one step further to determine whether or not he or she will need additional financing in the months to come.
References

Chicago Mercantile Exchange: http://www.cmegroup.com/

FINBIN: http://www.finbin.umn.edu/

University of Wisconsin Dairy Marketing and Risk Management Program:
  http://future.aae.wisc.edu/

USDA’s NASS: http://www.nass.usda.gov/