Exploring Timing of Pregnancy Impact on Income Over Feed Cost

Jay M. Janowski and Victor E. Cabrera

Overview

Defining the optimal time to get a cow pregnant is a critical management decision, for both physiological and economic reasons. This tool combines novel lactation curve definitions with key economic figures to help dairy producers explore the impact of pregnancy timing on milk Income Over Feed Cost (IOFC). Customizable inputs offer insight as to how changes will influence reproduction, milk production, and consequently, milk income over feed cost for a cow over the course of an average lifespan of three lactations. Results from each change are presented in an interactive format and immediately provide information regarding reproduction management that will positively impact profitability on a dairy. This interactive tool displays the IOFC for a determined time of pregnancy, but also allows the user to maximize the IOFC by adjusting the time of pregnancy for a defined set of economic and biological parameters.

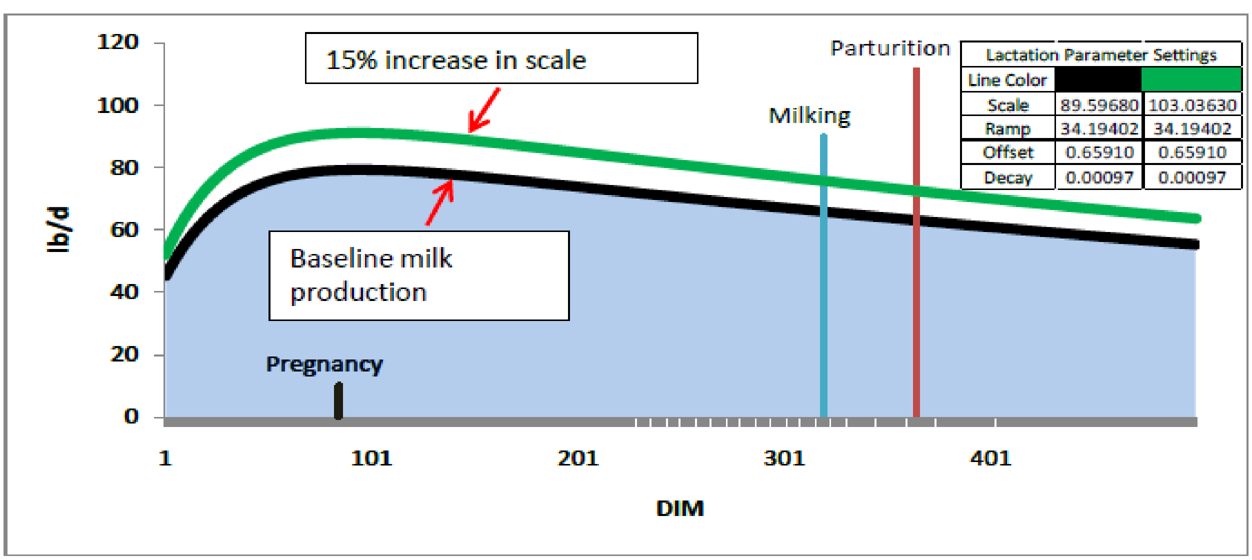
Background Information

The basis for the lactation curve definitions come from Milkbot® (www.milkbot.com), an algorithm that defines lactation curves using four statistical parameters – scale, ramp, offset, and decay. These four descriptors collectively offer a reliable means of benchmarking lactation curve data, identifying deviations from expected production output, and quantifying the impact of each deviation event. Each parameter has a consistent and predictable influence on the shape of the lactation curve – this makes it easier to understand how the curve will respond to changes. Therefore, it is imperative that the user fully understand the specific terminology, as well as how to interpret scale, ramp, offset, and decay to maximize the full capabilities of this tool. A short description and visual representation of each parameter is provided below.

Scale

Measure of a cow's ability to produce milk throughout the lactation. If scale increases by 15%, then production is predicted to increase by 15% each day of the lactation. In Figure 1, the scale has been increased by 15% to highlight this change in overall production.

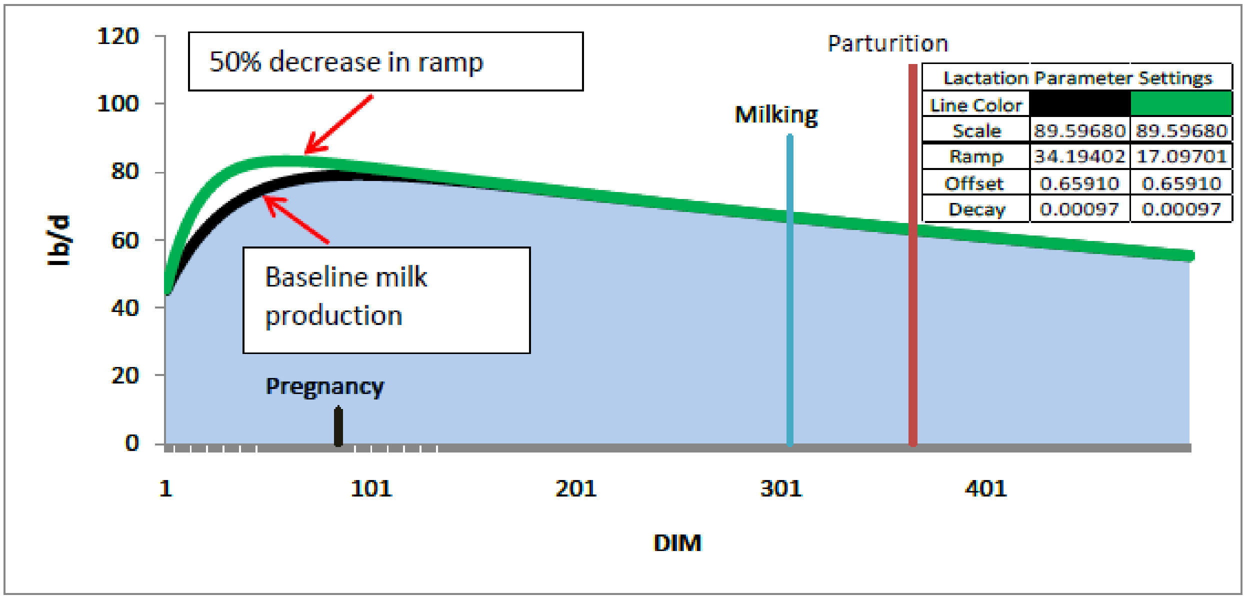
Figure 1. Impact of 15% increase in scale on the lactation curve.



Ramp

Measure of how quickly milk production increases after calving. It is useful for exploring issues related to transition management. A 50% decrease in ramp indicates a sharper rise in production, as shown in Figure 2.

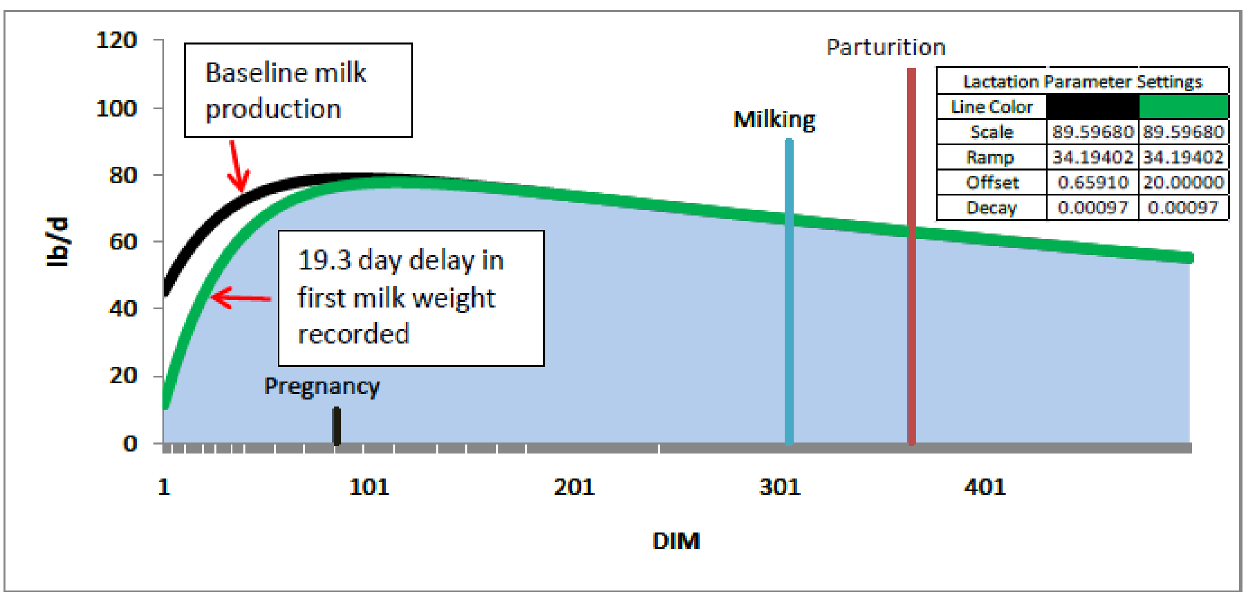
Figure 2. Impact of 50% decrease in ramp on the lactation curve.



Offset

Measure of the time between the day of calving and the first recorded milk weight. Figure 3 shows how changes in offset will shift the lactation curve horizontally. In this case, the beginning of the lactation has been delayed by over 19 days to exaggerate the effect.

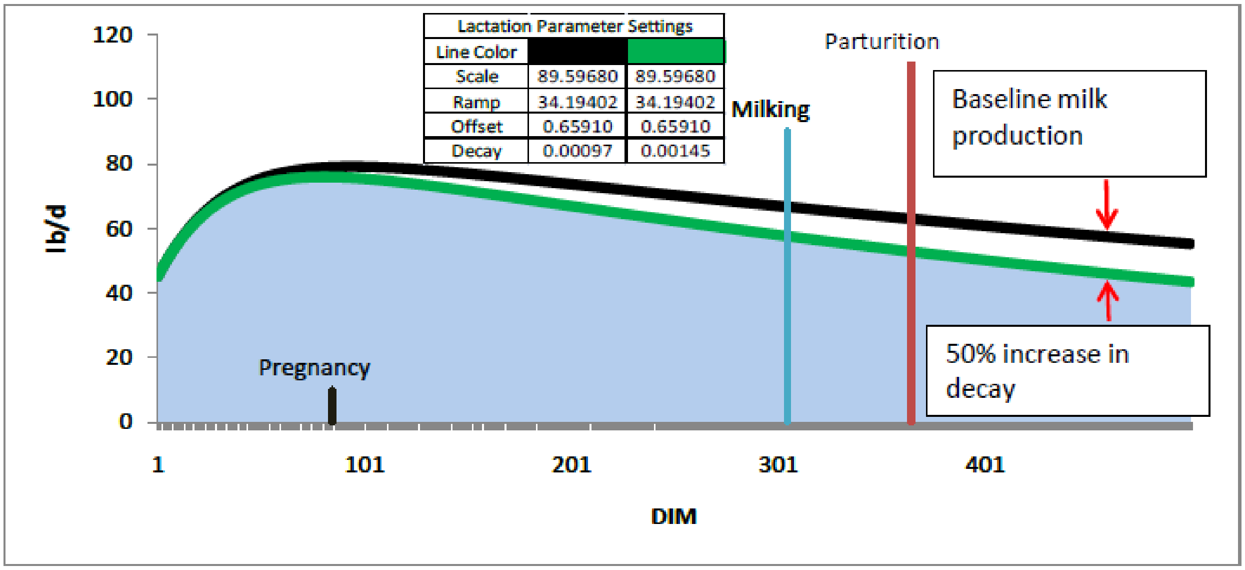
Figure 3. Impact of 19.3 day delay in first milk weight recorded on the lactation curve.



Decay

Measure of the natural decline in production or persistence of the lactation curve. Essentially, decay resembles the half-life of the lactation and has a greater influence on the latter part of the lactation curve. A higher decay value translates to quicker deterioration of the lactation, as illustrated by the green line in Figure 4.

Figure 4. Impact of 50% increase in decay on the lactation curve.



Fitted Lactation Curves

By using these four parameters in the Milkbot® algorithm, it is possible to accurately represent observed lactation curves. The process of "fitting" lactation curves is accomplished by adjusting these four parameters simultaneously to minimize the difference between observed and predicted lactation curves. Lactation curves were fitted using 3.6 million DHI records from AgSource Cooperative Services (www.Agsource.com) for rolling herd averages (RHA) between 18,000 and 30,000 lb/cow per year for first, second, and third parities. Consequently, the user has the opportunity to select pre-defined lactation curves. However, the flexibility of the tool gives the user the opportunity to adjust each lactation curve parameter to better represent particular lactation curves.

General Program Operation

The information contained within this tool is organized to provide easy navigation and interpretation of results. Operation of this tool may be accomplished by providing necessary information in designated input boxes. Collectively, these inputs give the user an opportunity to create original lactation curves for cows in their first, second, or third lactation. Pertinent reproductive and economic data are presented in an interactive format through a series of output boxes and graphs. The combination of output boxes and graphs provide the user with a thorough understanding of the impact of pregnancy timing on IOFC.

In general, drop menus and yellow and orange boxes are fully customizable by the user; blue boxes display results; and red boxes are the results of an optimization algorithm that maximizes the IOFC. Two buttons (Substitute and Maximize IOFC) are also available to perform the indicated actions. The button labeled as Substitute inserts pre-defined lactation parameters for a determined RHA level.

Inputs

Input Boxes

All boxes designated for input information are highlighted in yellow: 90.

Drop Menu

In this area, you may select the rolling herd average (18,000 to 30,000 lb/cow/year) that best represents your specific situation 

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Slider Bars

Slider bars allow for easy customization of pregnancy timing, ramp, scale, offset, and decay in each lactation 

. Use them to accentuate deviations from the benchmark lactation curves generated by this tool. Both yellow and orange boxes may also be edited directly, without having to use the slider bars.

Outputs

Output Boxes

Output information, including IOFC, total milk produced, and the cumulative days in lactation, is shown in light blue boxes 

. Optimized values for timing of pregnancy and maximum IOFC are shown in dark red boxes 

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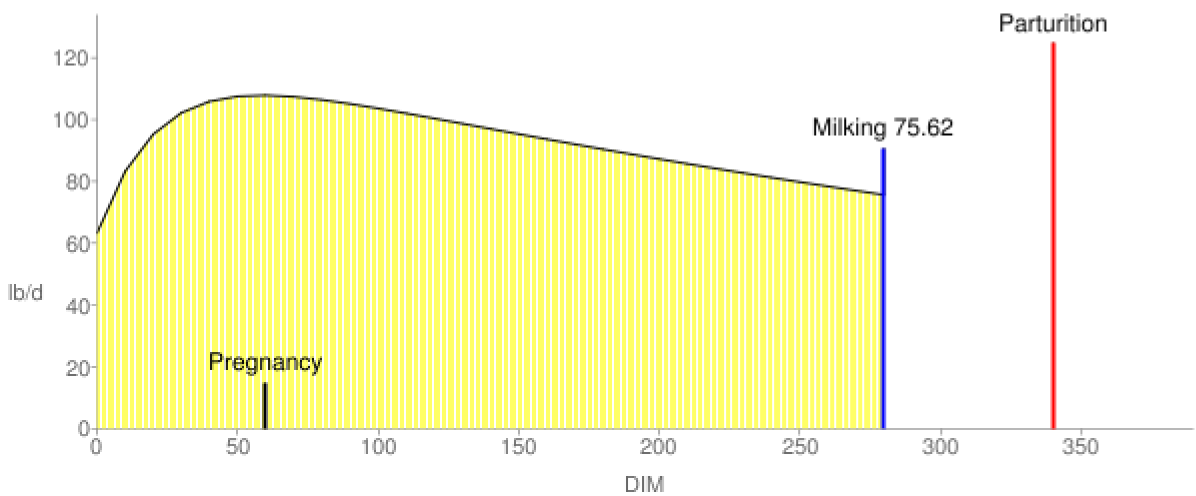
Graphs

Graphs provide a visual representation of the results generated by this tool and enhance the user's understanding of the impact of pregnancy timing on IOFC.



Detailed Program Operation

1. Customize inputs by entering the correct values for your farm in the yellow boxes. Here, you may define the milk price (per lb), feed price (per lb of DM), dry period length (days), and the total gestation length (days). The milk and feed prices will be used to calculate the IOFC according to predicted milk production and dry matter intake, as a function of feed for maintenance and fetal development, and feed for milk production. The dry period and gestation length will determine the duration of the lactation, as influenced by the timing of pregnancy.

Milk $/lb	Feed $/lb	Dry Period d	Gestation d
0.15	0.1	45	280

2. Select the Rolling Herd Average (RHA) from the drop-down menu in the upper right-hand corner of the page *RHA* 24,000. Then click the Substitute button. The scale, ramp, offset, and decay will automatically move to pre-loaded benchmark values based on the information you have provided. Alternatively, you may skip the selection of a benchmark RHA and define your own lactation curves by adjusting these four parameters.

3. At this point, the IOFC that corresponds to the user-defined RHA level and timing of pregnancy is presented individually for each lactation and cumulatively for all three lactations. However, you may wish to find the maximum IOFC. Click the Maximize IOFC button. This will determine the optimal timing of pregnancy in each of the three lactations that will produce the maximum possible IOFC per day.

4. Once the Maximize IOFC button is pressed, the optimal timing of pregnancy that maximizes IOFC will be shown in the "Optimized Values" section.

Optimized Values

Pregnancy Lactation 1 (d)	Pregnancy Lactation 2 (d)	Pregnancy Lactation 3 (d)	Maximum IOFC ($/d)
91	73	81	6.2438

You may input these values in the corresponding input boxes or move the slider bar in each lactation module to maximize IOFC. The other parameters may be adjusted in a similar fashion to reflect deviations from the projected lactation curve. The flexibility and predictable influence of each parameter on the lactation curve allows effective exploration of reproduction protocols, transition period management, herd management, etc. during the lactation.

Lactation Curve Parameters

		Suggested Parameters
Pregnancy	60	
Scale	99.22	99.22
Ramp	42.4013	42.4013
Offset	1.8114	1.8114
Decay	0.00094	0.00094

IOFC($)	1778.045
Total Milk (lb)	22332

Notice

The outputs concerning timing of pregnancy and maximized IOFC are calculated with some assumptions. A number of other variables that may influence reproductive efficiency are not accounted for in this tool. Consequently, the results generated may not fully represent on-farm conditions, but offer a good starting point for discussion. Consult with your reproductive management specialist before making any changes to your reproductive program. More work needs to be done to understand the connection between the timing of pregnancy in one lactation and the possible impact on subsequent lactations.

Additional information, including an instructional video, is available on the UW Dairy Management Website under the "Management Tools" section: DairyMGT.info