

University of Wisconsin Dairy Management

The Economic Value of Improving Reproductive Efficiency

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Department of
Agriculture

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of Food and
Agriculture



Introduction

→ Producers do not know the economic value of reproductive efficiency



Introduction

→ Economic value's calculation is complex

MILK CALVES CULLING COSTS

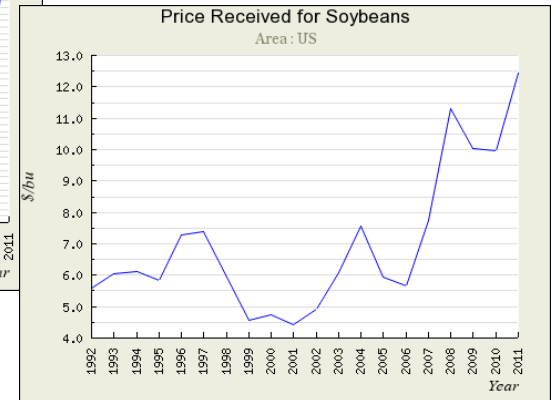
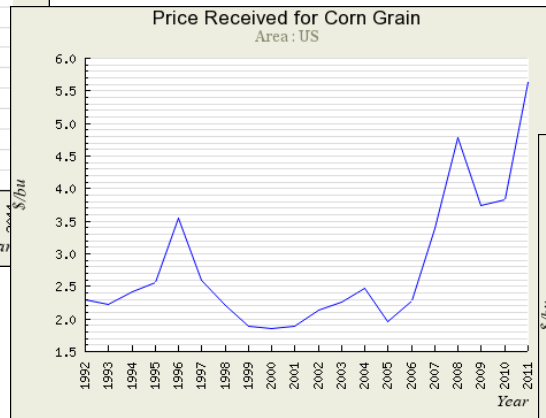
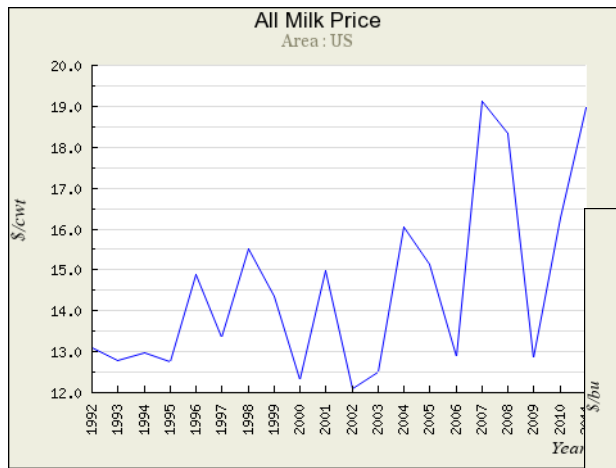
Introduction

→ Economic value is farm specific



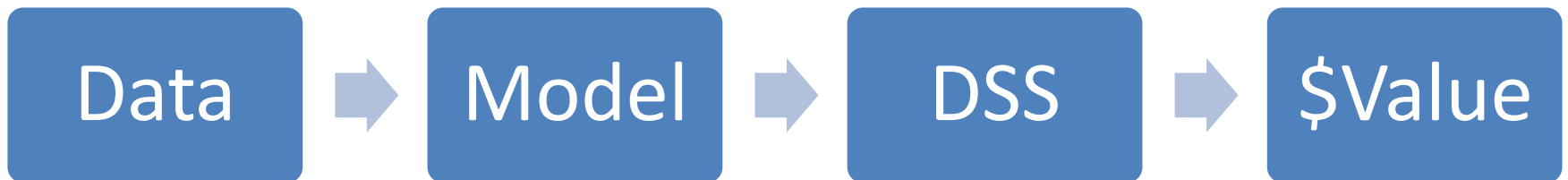
Introduction

→ Economic value is market dependent



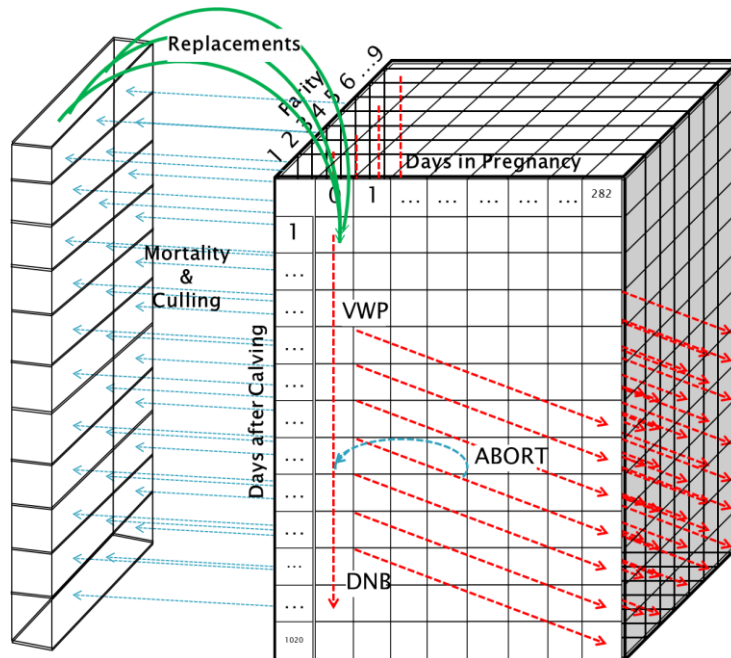
Objective

→ Develop a decision support tool to assess the economic value of reproductive programs



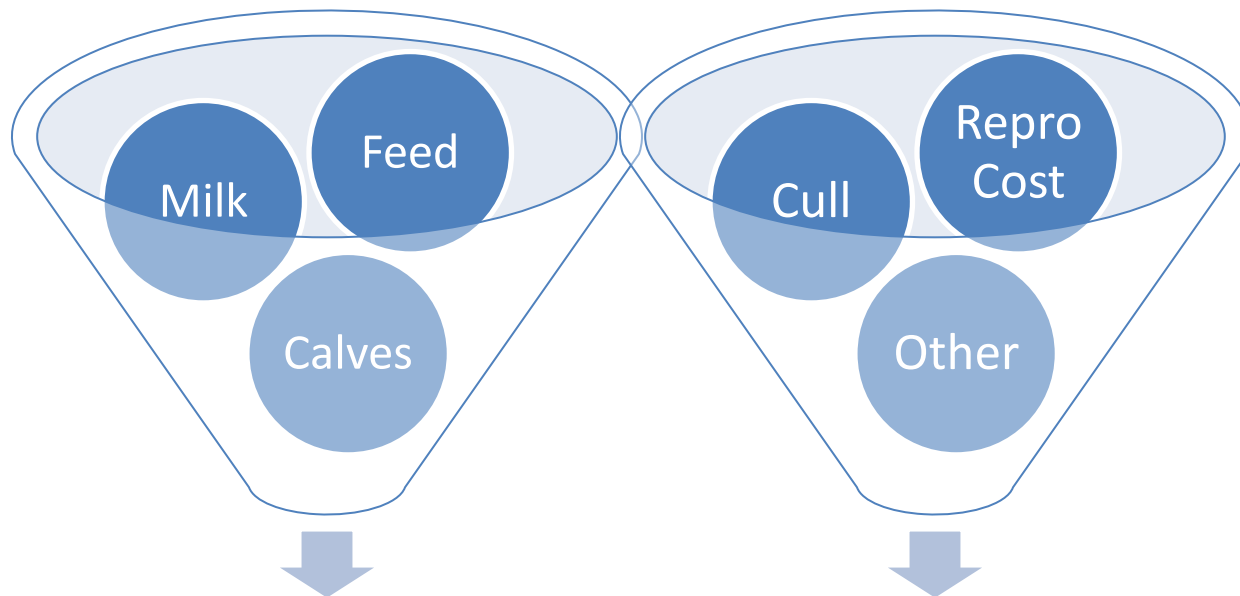
Approach

→ Predict herd structure resulting from a reproductive program



Approach

→ Aggregate the economic value of all animals in the herd



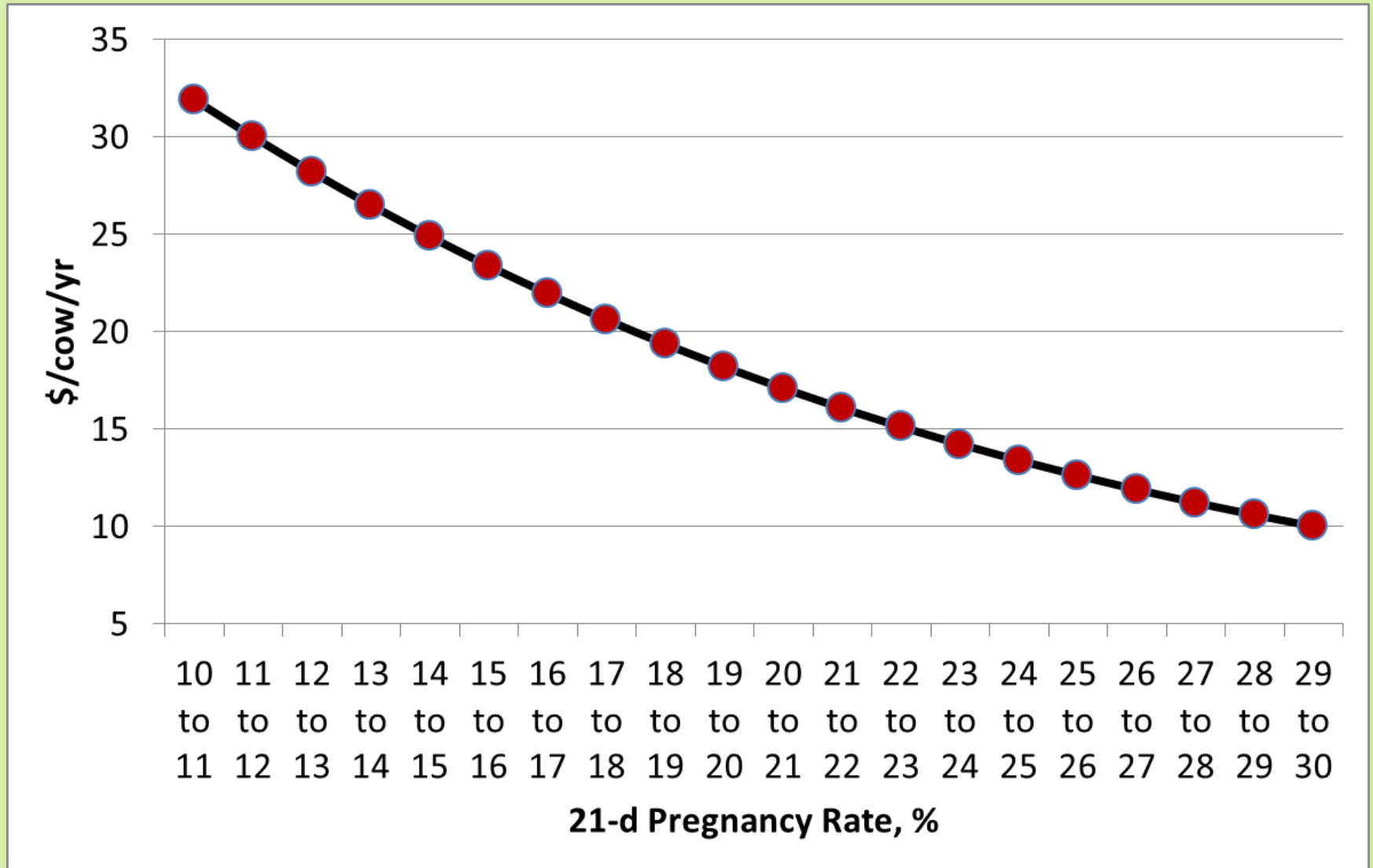
\$ Economic Value Repro Programs

Results

		Current 21-d PR (%)																				
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Goal 21-d PR (%)	11	32																				
	12	62	30																			
	13	90	58	28																		
	14	117	85	55	26																	
	15	141	110	80	51	25																
	16	165	133	103	75	48	23															
	17	187	155	125	97	70	45	22														
	18	207	176	145	117	91	66	43	21													
	19	227	195	165	137	110	85	62	40	19												
	20	245	213	183	155	128	103	80	58	38	18											
	21	262	230	200	172	145	121	97	75	55	35	17										
	22	278	246	216	188	162	137	113	91	71	51	33	16									
	23	293	261	231	203	177	152	128	106	86	66	48	31	15								
	24	307	276	246	217	191	166	143	121	100	81	62	45	29	14							
	25	321	289	259	231	204	179	156	134	113	94	76	59	43	28	13						
	26	333	302	272	243	217	192	169	147	126	107	89	71	55	40	26	13					
	27	345	313	283	255	229	204	181	159	138	119	100	83	67	52	38	25	12				
	28	357	325	295	266	240	215	192	170	149	130	112	95	78	63	49	36	23	11			
	29	367	335	305	277	251	226	202	180	160	140	122	105	89	74	60	46	34	22	11		
	30	377	345	315	287	261	236	212	190	170	150	132	115	99	84	70	56	44	32	21	10	

Value (\$/cow/yr) of improving 21-d PR

Results



Decision Support System

Dairy Reproductive Economic Analysis



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Overview Upload Repro Abort Cull Milk Economics Run Model Results Analyze

This is a Markov-chain model that simulates a dairy herd and their replacements for nine lactations: from the moment of the first calving to the ninth parturition. The model follows monthly probabilistic events of aging, culling, mortality, becoming pregnant, having an abortion, calving, and starting a next lactation. A defined lactation curve determines the milk production depending on lactation number, month in milk, and reproductive status. Cows being culled and dying are replaced the next month, so the herd population remains constant. The model performs a number of iterations until the herd population reaches a "steady state." Steady state of the herd population occurs when the proportion of cows in each specific state (lactation, month in milk, reproductive status) do not change from one iteration (month) to the next.

The model uses pre-defined (or user-defined) probabilities of reproduction, abortion, culling, and mortality to simulate a proportion of cows from one state to the next. For instance, a nonpregnant cow could become pregnant, be culled, or die and a pregnant cow could abort, be culled, die, or calve at the end of gestation. These events occur monthly for each cow in the herd. The value of a reproductive program is then calculated every month for each cow in the herd as the sum of five factors: milk income over feed cost (IOFC), culling cost, mortality cost, income from newborns (calves), and cost of the reproductive program:

Value of Reproductive Program = Income Over Feed Cost + Culling Cost + Mortality Cost + Income from Newborn + Reproductive Program Cost

Once the herd population reaches steady state, the value of the studied reproductive program is calculated as the sum product of the value of the reproductive program in each cow state times the proportion of cows in each state. Different reproductive programs yield different herd structures and consequently different economic values.

Following the tabs in this application you can define a reproductive program, edit the expected probabilities of abortion, culling, and mortality, and define other managerial and economic parameters. An option to download and manipulate these values in a spreadsheet format and then to upload it is also available.

Once you have defined the input parameters you could run the model. The results will be displayed as a "snapshot" of the expected herd at "steady state" and the monthly and total value of the reproductive program based on the five parameters defined above.

DairyMGT.info



Tools



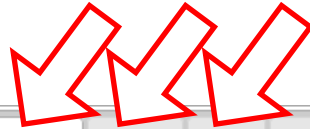
Reproduction

Decision Support System

The screenshot shows a web-based interface for a Decision Support System. At the top, there is a navigation bar with tabs: Overview, Upload, Repro, Abort, Milk, Economics, Run Model, Results, and Analyze. The 'Upload' tab is currently selected. Below the navigation bar, there are three main sections:

- Download Parameter Excel File:** This section contains a button labeled "Download Parameters File". A red arrow points to the "Abort" tab in the navigation bar.
- Upload Parameters as Excel File:** This section contains the text "Upload the Excel File:" followed by a "Choose File" button, the text "No file chosen", and an "Upload" button. A red arrow points to the "Choose File" button, and another red arrow points to the "Upload" button.
- Current File/Data Status:** This section displays the text "Using Data from Default Parameters File on Server".

Decision Support System



Overview	Upload	Repro	Abort	Cull	Milk	Economics	Run Model	Results	Analyze
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Month in Milk	Lactation 1		Lactation 2		Lactation 3		Lactation 4		Lactation 5		Lactation 6		Lactation 7		Lactation 8		Lactation 9	
	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo	Preg Per Month (%/mo)	Cost Per Month \$/cow/mo
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
3	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
4	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
5	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
6	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
7	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
8	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
9	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
10	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
11	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25	18	25
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Decision Criteria for Reproductive Failure Culling

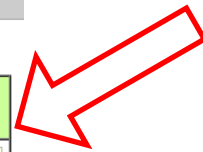
Month in lactation (threshold) to stop reproductive services (MIM)	11
Minimum amount of milk (threshold) produced (lb/cow/day)	50

Decision Support System

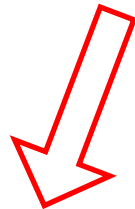
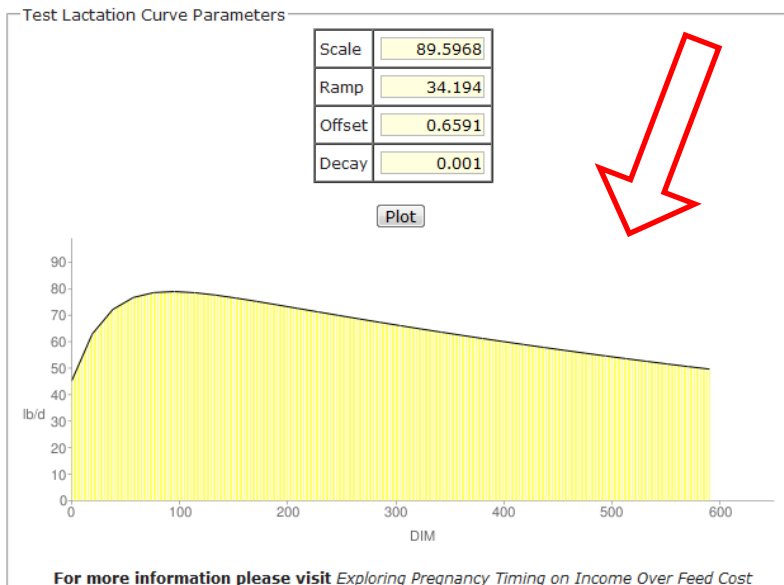
Overview Upload Repro Abort Cull Milk Economics Run Model Results Analyze



MilkBot Lactation Curves Parameters by Lactation <i>Milkbot</i>				
	a=Scale	b=Ramp	c=Offset	d=Decay
Lactation 1	66.4242290	14.6841	-2.4854	0.001005
Lactation 2	107.669823	16.2648	0.0147	0.001757
Lactation 3	132.005066	23.2079	2.5848	0.001922
Lactation 4	132.005066	23.2079	2.5848	0.001922
Lactation 5	132.005066	23.2079	2.5848	0.001922
Lactation 6	132.005066	23.2079	2.5848	0.001922
Lactation 7	132.005066	23.2079	2.5848	0.001922
Lactation 8	132.005066	23.2079	2.5848	0.001922
Lactation 9	132.005066	23.2079	2.5848	0.001922

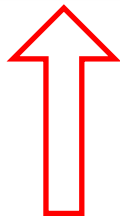


Month in Pregnancy	Decrease in Milk
1	0
2	0
3	0
4	0
5	5
6	10
7	15
8	30
9	45



Decision Support System

Overview	Upload	Repro	Abort	Cull	Milk	Economics	Run Model	Results	Analyze
Parameters									
Body Weight of Lactating Cows	<input type="text" value="1400"/>	lb/animal	<i>Average Weight of Lactating Animals</i>						
Milk FAT Content	<input type="text" value="3.5"/>	%	<i>Average Butterfat on Milk</i>						
Milk Price	<input type="text" value="0.15"/>	\$/lb milk	<i>Average Price Received</i>						
Feed Price	<input type="text" value="0.1"/>	\$/lb feed	<i>Average Price Received</i>						
Heifer Replacement Value	<input type="text" value="1200"/>	\$/heifer	<i>Average Price paid for Pregnant Heifer</i>						
Salvage Value of Culling Animal	<input type="text" value="600"/>	\$/cow	<i>Average Value Received for culled cow</i>						
Born Calf Price	<input type="text" value="200"/>	\$/animal	<i>Average Value of Newborn</i>						
Time for Dry-Off	<input type="text" value="7"/>	months	<i>Cow will not produce after N months</i>						



Decision Support System

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Overview

Upload

Repro

Abort

Cull

Milk

Economics

Run Model

Results

Analyze

Number of Cows *Lactating & Dry*

Run Model

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Decision Support System

Overview

Upload

Repro

Abort

Cull

Milk

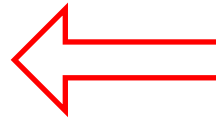
Economics

Run Model

Results

Analyze

Total Number of Cows	100
Iterations Performed	737
Reached Steady State	YES

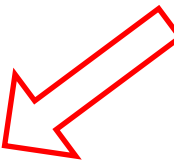
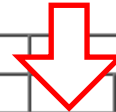


	Total Revenues & Costs				
	IOFC	Cull	Repro	Calves	Net Return
\$/herd/month	15128.81	-1353.02	-932.8	1048.08	13891.07
\$/herd/day	504.29	-45.1	-31.09	34.94	463.04
\$/cow/year	1840.67	-164.62	-113.49	127.52	1690.08



Decision Support System

Month in Milk	Month in Pregnancy										Revenues & Costs (\$)				
	0	1	2	3	4	5	6	7	8	9	Cull Cows	IOFC	Cull	Repro	Calves
	Lactation 1														
1	3.54										0.14	422.47	-69.93	0.00	0.00
2	3.39										0.09	489.30	-45.44	84.80	0.00
3	2.70	0.59									0.06	466.27	-27.96	67.62	0.00
4	2.17	0.48	0.59								0.05	438.04	-24.08	54.34	0.00
5	1.77	0.38	0.47	0.57							0.04	410.78	-20.87	44.17	0.00
6	1.45	0.31	0.38	0.46	0.55						0.04	385.40	-19.18	36.26	0.00
7	1.20	0.26	0.31	0.37	0.44	0.54					0.04	358.39	-18.42	29.94	0.00
8	0.99	0.21	0.25	0.30	0.35	0.43	0.53				0.04	330.60	-17.73	24.73	0.00
9	0.82	0.17	0.21	0.24	0.29	0.35	0.43	0.53			0.04	302.77	-17.76	20.42	0.00
10	0.67	0.14	0.17	0.20	0.24	0.28	0.34	0.42	0.52		0.04	190.20	-18.69	16.84	0.00
11	0.55	0.12	0.14	0.17	0.20	0.23	0.28	0.34	0.42	0.52	0.58	102.51	-20.39	13.84	103.04
12	0.01		0.12	0.14	0.16	0.19	0.23	0.28	0.34	0.41	0.03	29.79	-8.72	0.00	82.79
13	0.01			0.11	0.13	0.16	0.19	0.23	0.27	0.33	0.03	13.03	-6.91	0.00	66.52
14	0.01				0.11	0.13	0.16	0.19	0.22	0.27	0.02	0.47	-5.37	0.00	54.08
15	0.00					0.11	0.13	0.15	0.19	0.22	0.01	-8.44	-4.10	0.00	44.37
16	0.00						0.11	0.13	0.15	0.18	0.01	-14.17	-3.05	0.00	36.57
17	0.00							0.10	0.13	0.15	0.00	-17.51	-2.18	0.00	30.16
18	0.00								0.10	0.12	0.00	-19.11	-1.41	0.00	24.85
19	0.00									0.10	0.00	-8.57	-0.68	0.00	20.41
20											0.00	0.00	0.00	0.00	0.00
21											0.00	0.00	0.00	0.00	0.00
22											0.00	0.00	0.00	0.00	0.00
23											0.00	0.00	0.00	0.00	0.00
24											0.00	0.00	0.00	0.00	0.00
25											0.00	0.00	0.00	0.00	0.00



Decision Support System

Overview

Upload

Repro

Abort

Cull

Milk

Economics

Run Model

Results

Analyze

Find the economic value of improving reproductive performance

	21-d Preg Risk (%)	Repro Cost (\$/cow/mo)
Current Repro Program	18	25
Goal Repro Program	21	25

Analyze

Analysis Results

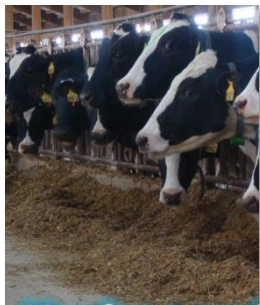
Program	21-d Preg Risk (%)	Repro Cost (\$/cow/mo)	IOFC (\$/cow/year)	Cull (\$/cow/year)	Repro (\$/cow/year)	Calves (\$/cow/year)	Net Return (\$/cow/year)
Current Repro Program	18	25	1840.67	-164.62	-113.49	127.52	1690.08
Goal Repro Program	21	25	1873.33	-160.64	-103.79	135.83	1744.72

Economic value of improving pregnancy risk from 18% to 21% is \$54.64/cow/year.



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