Improving Dairy Farm Sustainability through Strategic Alternatives to Corn Grain Feeding

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Introduction

- The dairy industry is struggling to remain economically viable because of skyrocketing corn grain feed prices and uncertain milk price fluctuations
- Dairy farmers and extension faculty have indicated a need to improve dairy cattle feed efficiency in order for the dairy industry to remain economically sustainable

Hypothesis

- Effective feeding strategies that include corn grain substitution will improve economic net return in many farm and market situations in Wisconsin. These substitutions will additionally decrease dairy farm environmental impacts and promote more ecologically sustainable production systems.

Materials and Methods

- Integration of four major components into a bio-economic decision support system, the corn-replacer:

1. Compilation and analyses of data from extensive field research of corn/forage substitution, Tessmann et al. (1991);

2. Development of corn/forage substitution production models, Earleywine (2001);

Materials and Methods

3. Integration of grazing concentrate supplementation, Soder and Rotz (2001); Bargo et al. (2003); and

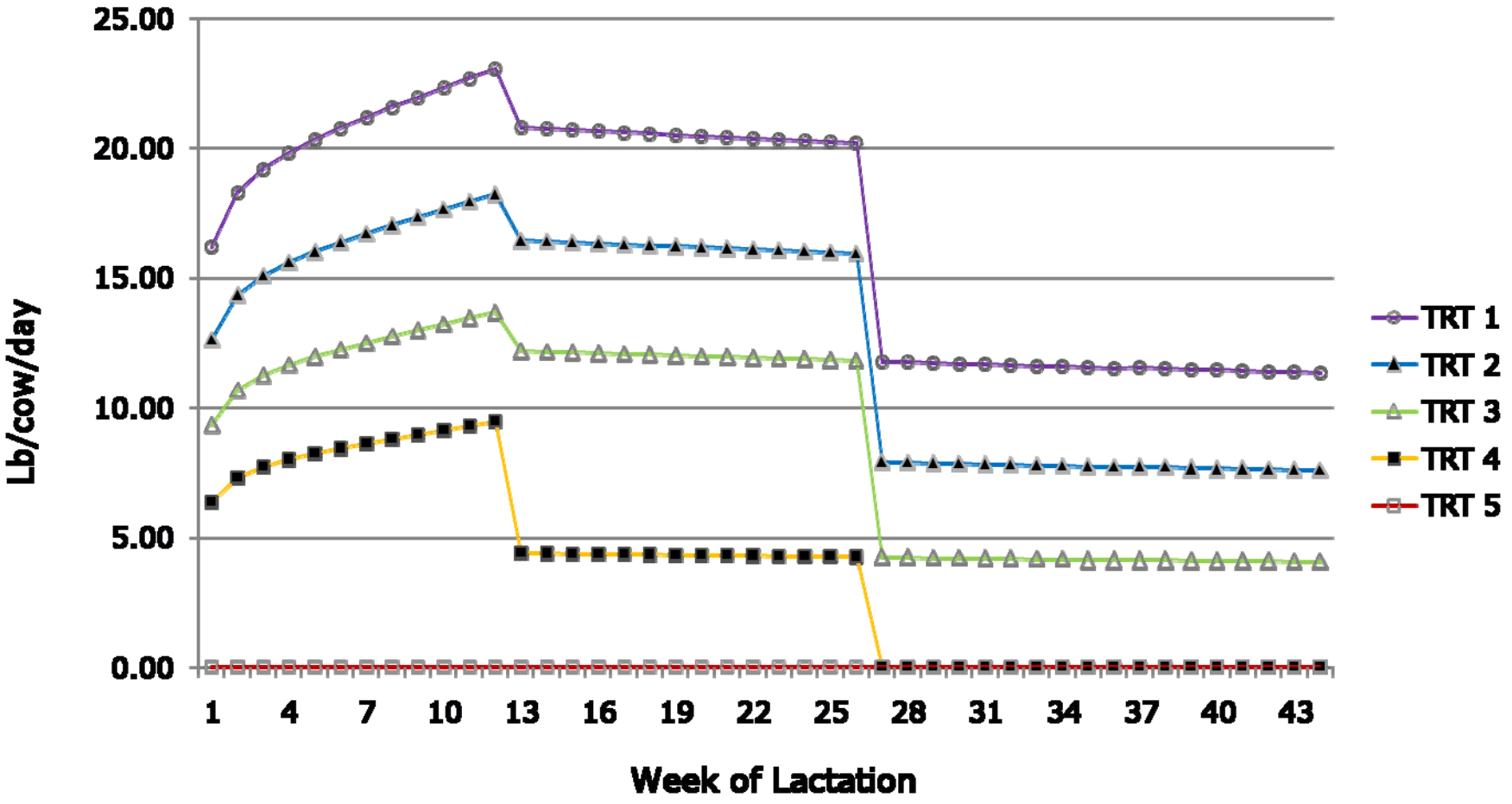
4. Development of a Markov-chain, stochastic, dynamic herd simulation model to portray real-life dairy cattle conditions, (Cabrera et al., 2006; 2008)

Milk Production to Different Diets

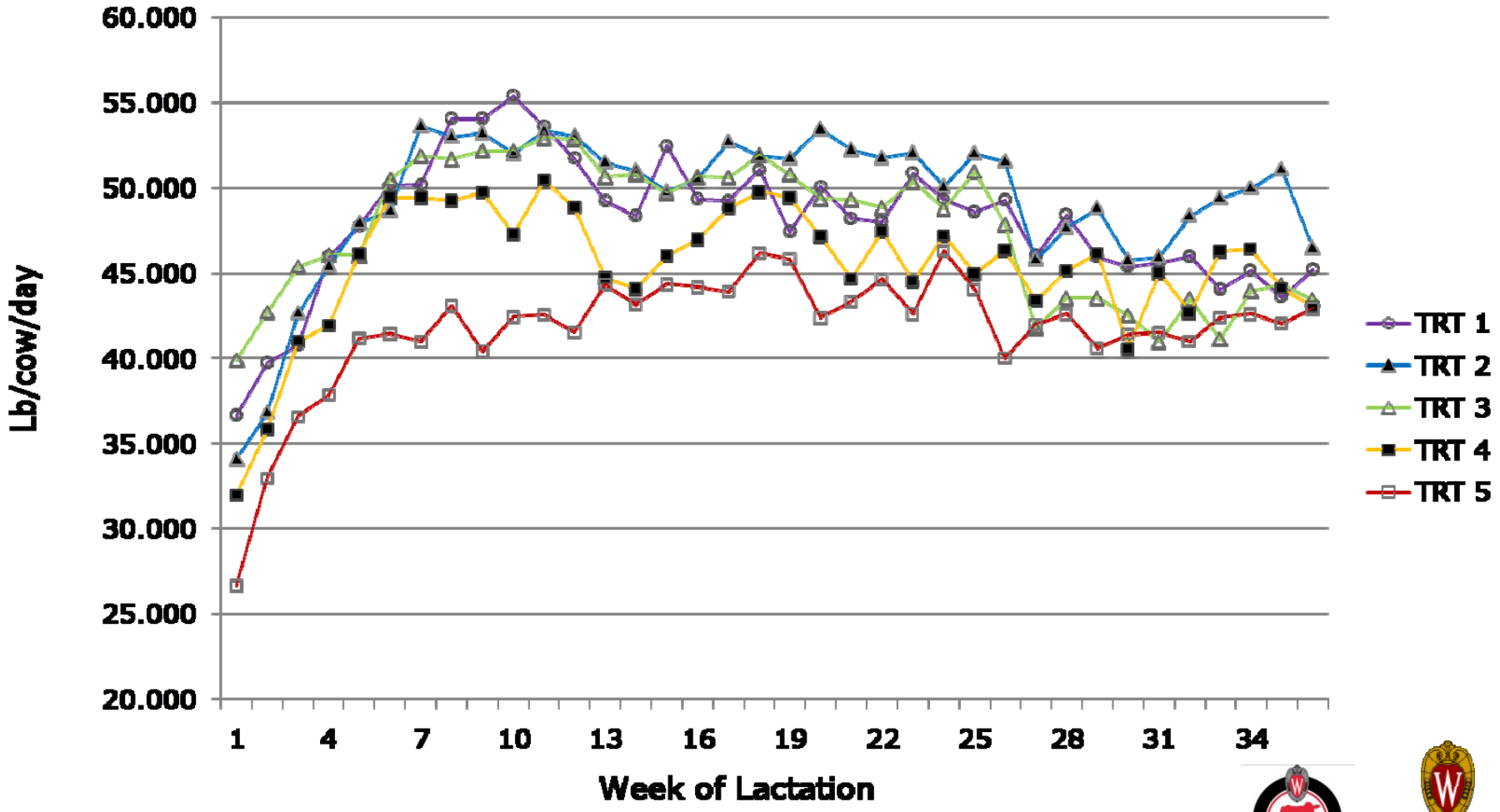
Diet (TRT)	Alfalfa hay	Corn grain (HMEC)	Soybean meal
Lactation Stage	Early-Mid-Late	Early-Mid-Late	Early-Mid-Late
Week	(0-12)-(13-26)-(27-44)	(0-12)-(13-26)-(27-44)	(0-12)-(13-26)-(27-44)
1	38-48-68%	42-40-25%	18-10-05%
2	48-58-78%	34-33-17%	16-07-03%
3	58-68-88%	27-25-09%	13-05-01%
4	68-88-98%	19-09-00%	11-01-00%
5	98-98-98%	00-00-00%	00-00-00%

Source: Tessmann et al. (1991)

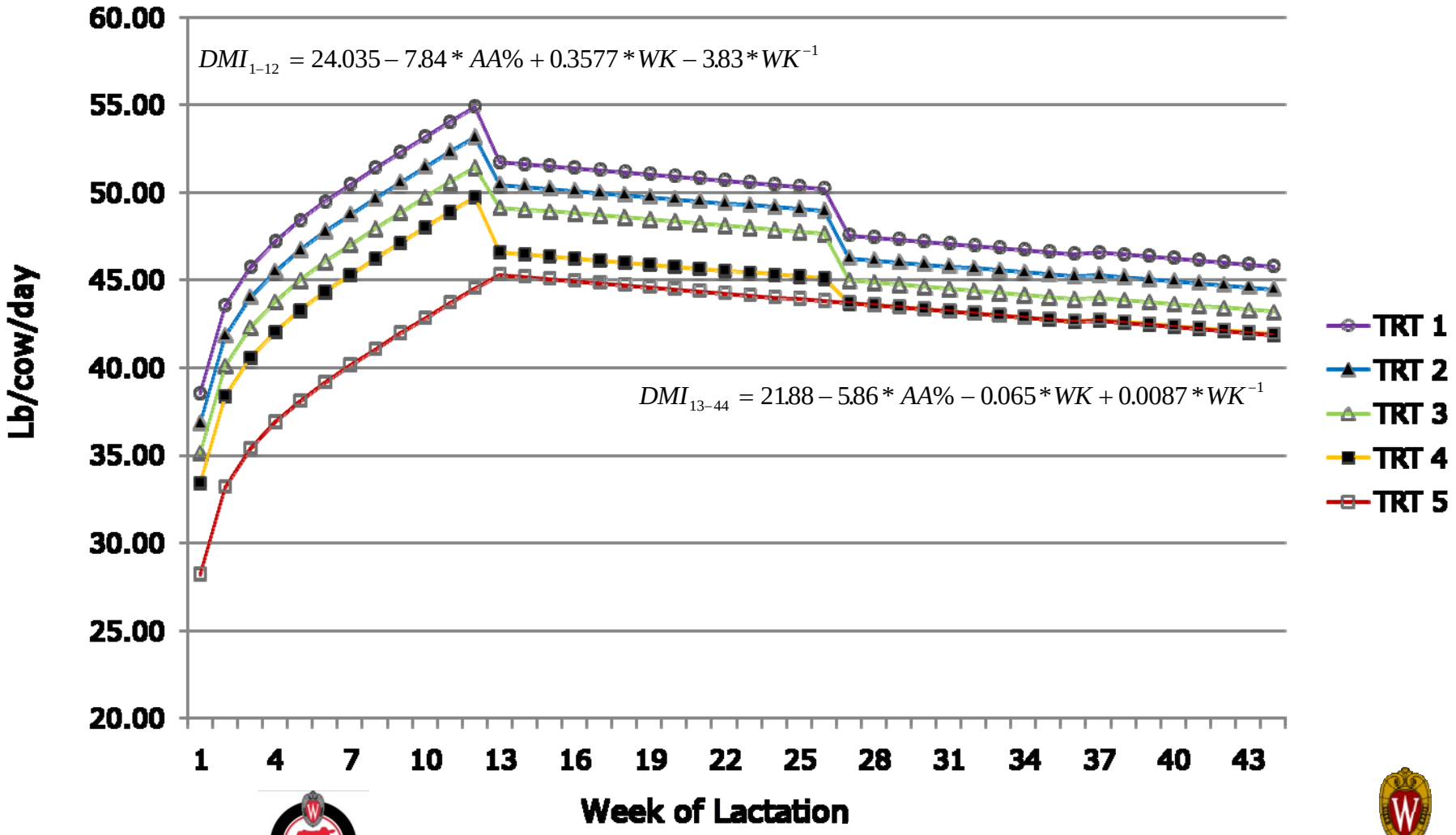
Corn in diet


25.00
20.00
15.00
10.00
5.00
0.00
Lb/cow/day
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
Week of Lactation
TRT 1
TRT 2
TRT 3
TRT 4
TRT 5

Dry Matter Intake (actual)

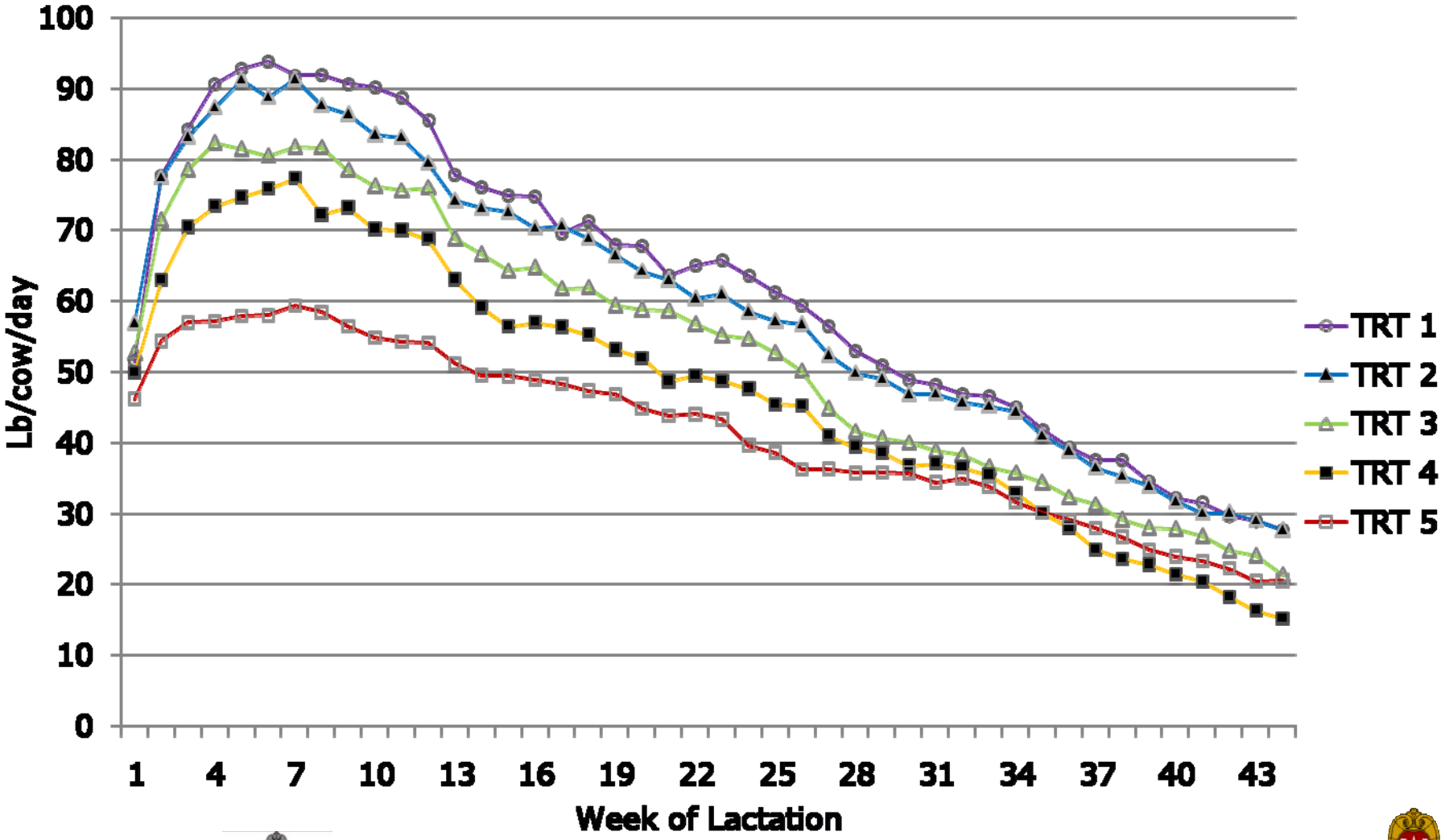


Dry Matter Intake (Predicted)



Source: Earleywine (2001)

Milk Production to Different Diets (actual)



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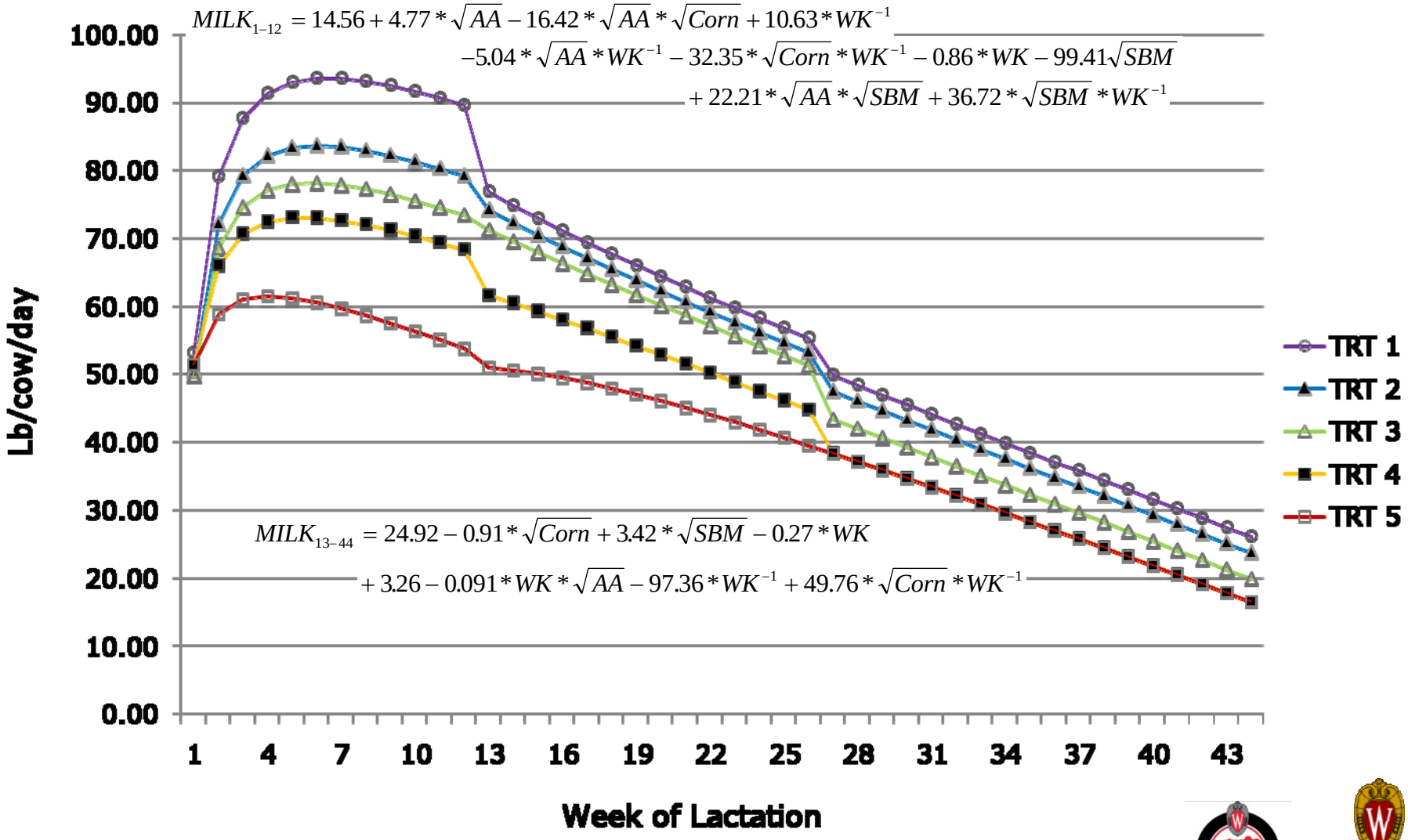
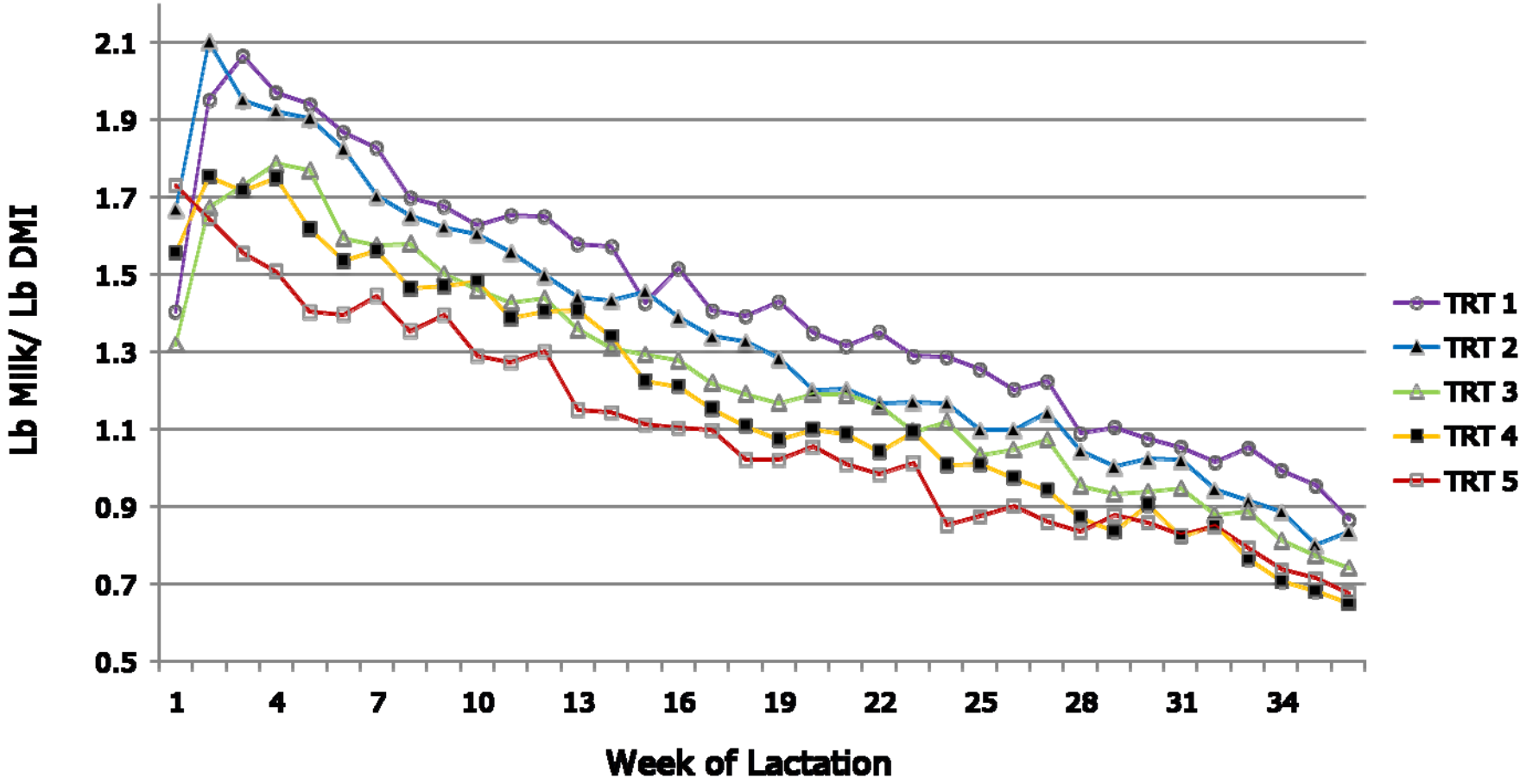
Milk Production to Different Diets (Pred.)

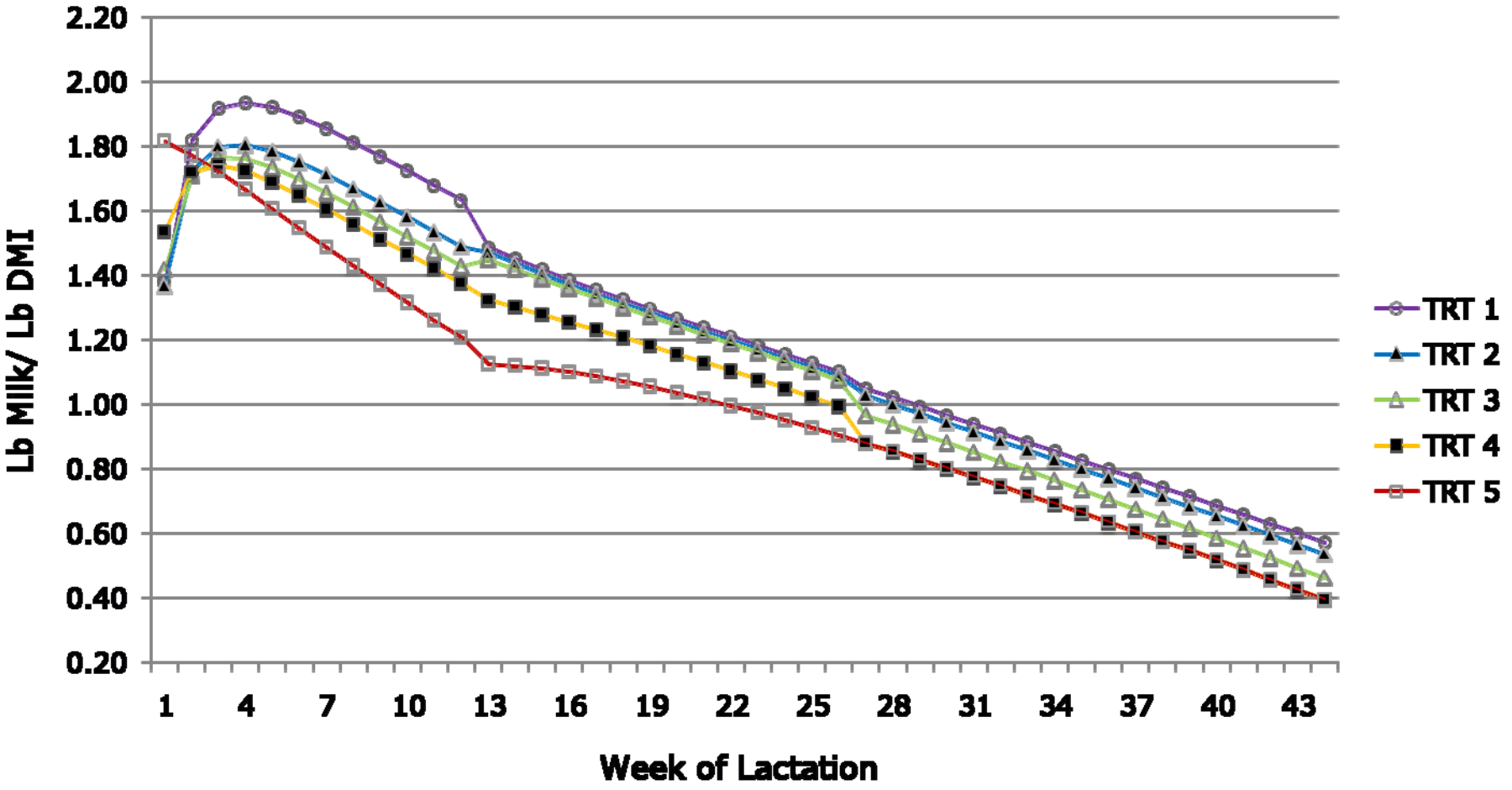


Source: Earleywine (2001)

Feed Efficiency (actual)



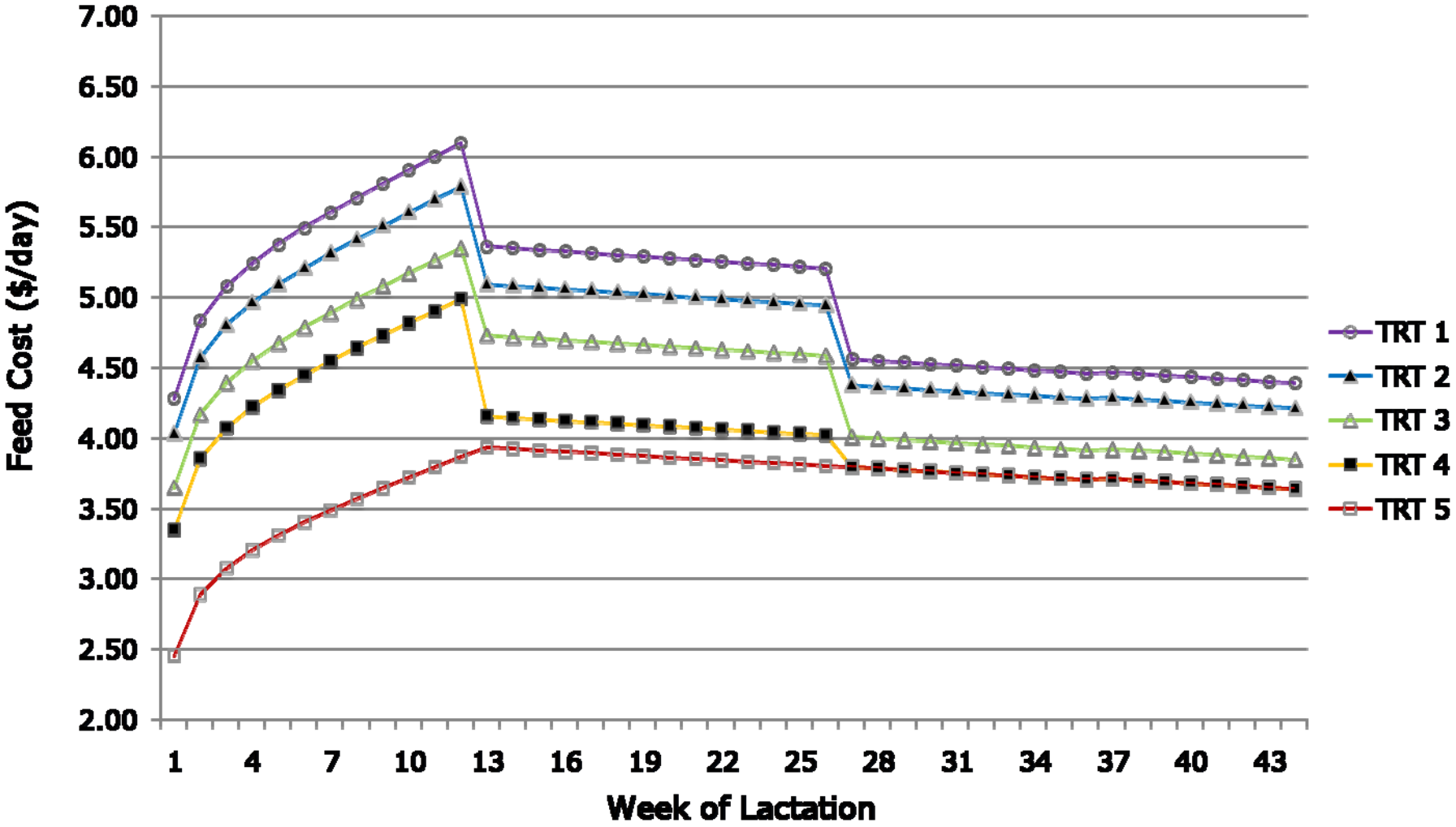
Feed Efficiency (Predicted)



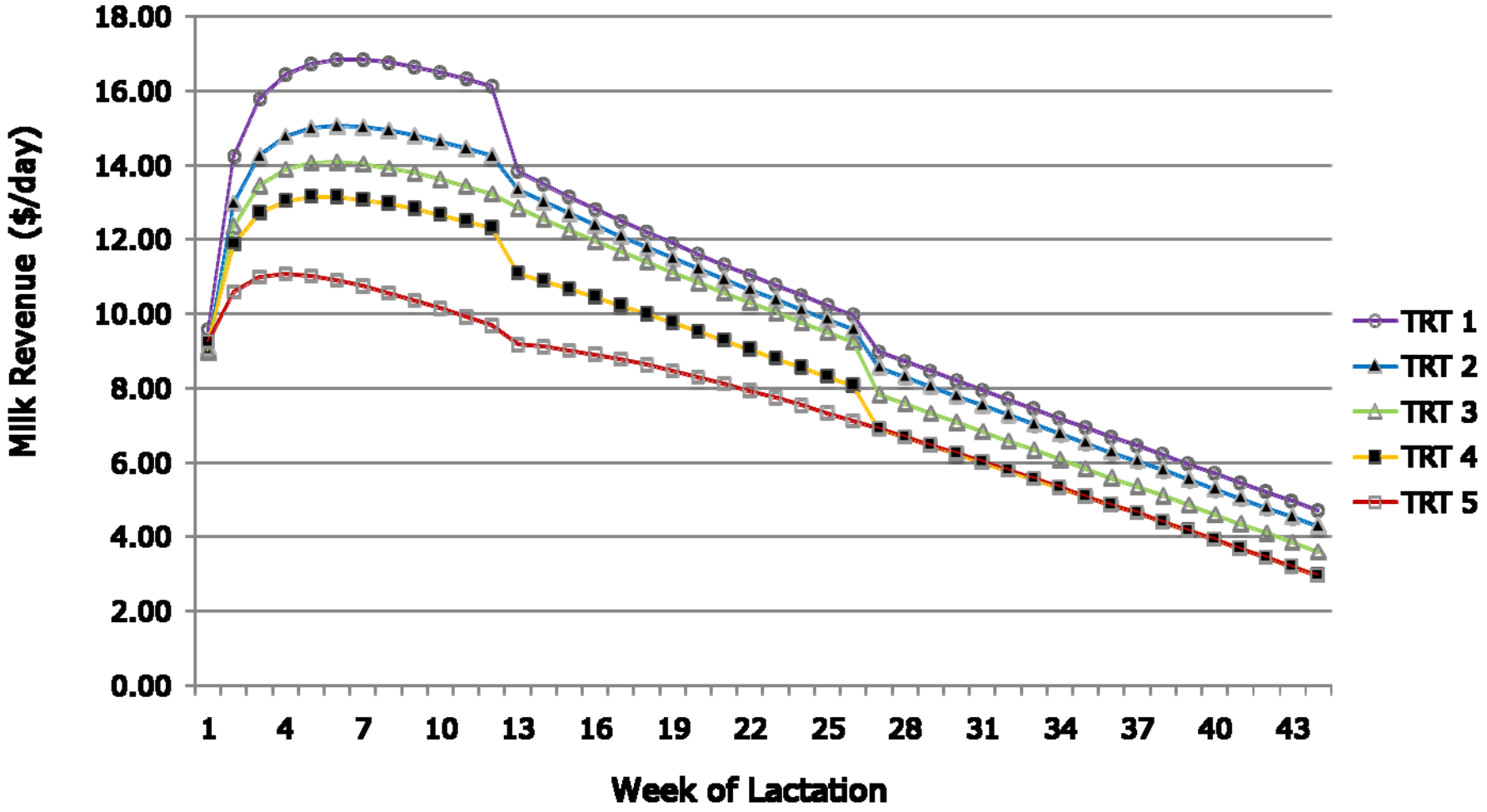
Income Over Feed Cost

Feed Ingredient	Price (June 08)
Alfalfa hay	$177/ton
Corn grain	$6/bu
SBM	$358/ton
Milk	$18/cwt

Feed Cost



Milk Revenue



Income Over Feed Cost

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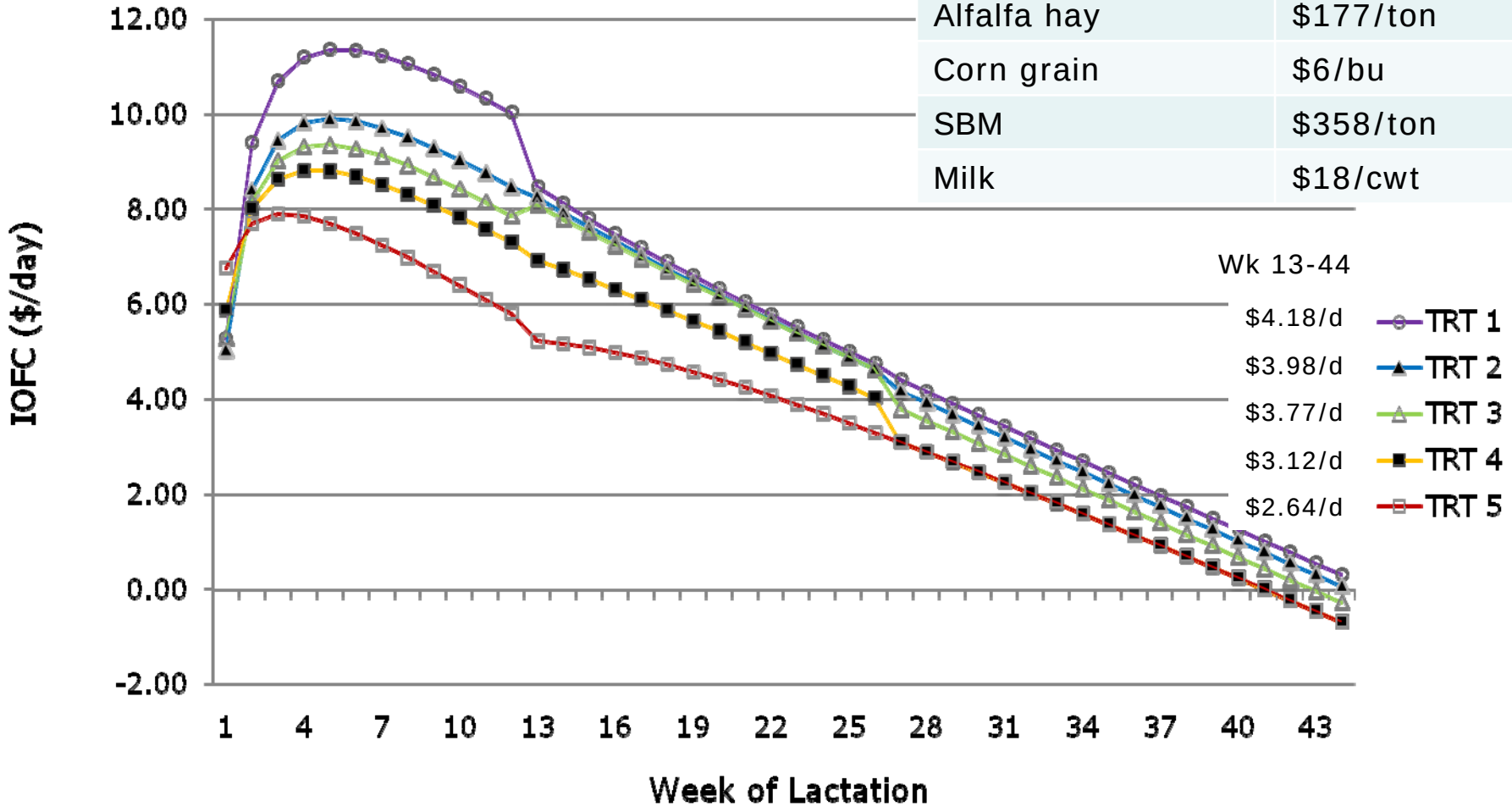

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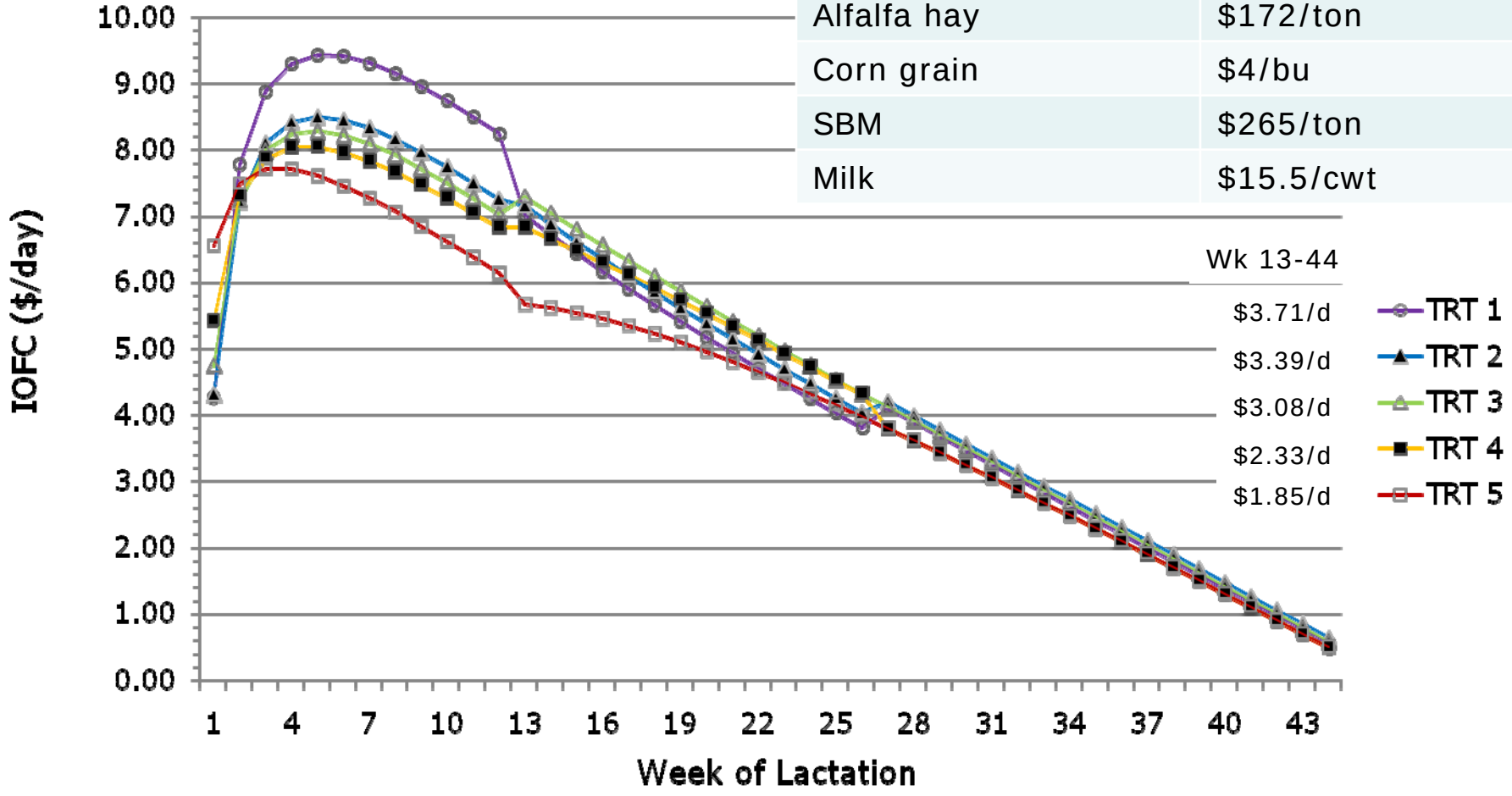
Income Over Feed Cost

Feed Ingredient	Price
Alfalfa hay	$172/ton
Corn grain	$4/bu
SBM	$265/ton
Milk	$15.5/cwt



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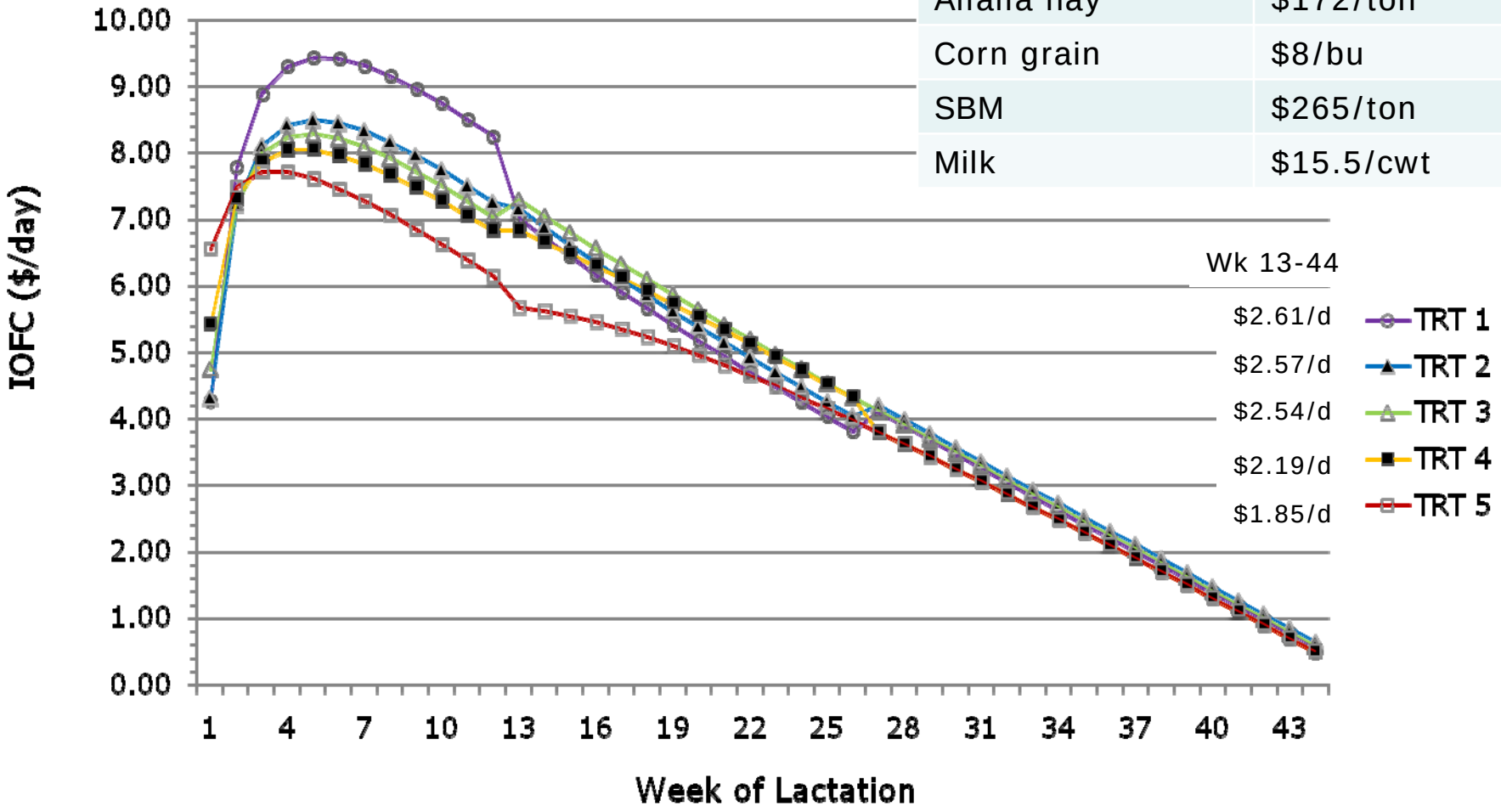
Income Over Feed Cost

Feed Ingredient	Price (Oct 08)
Alfalfa hay	$172/ton
Corn grain	$8/bu
SBM	$265/ton
Milk	$15.5/cwt



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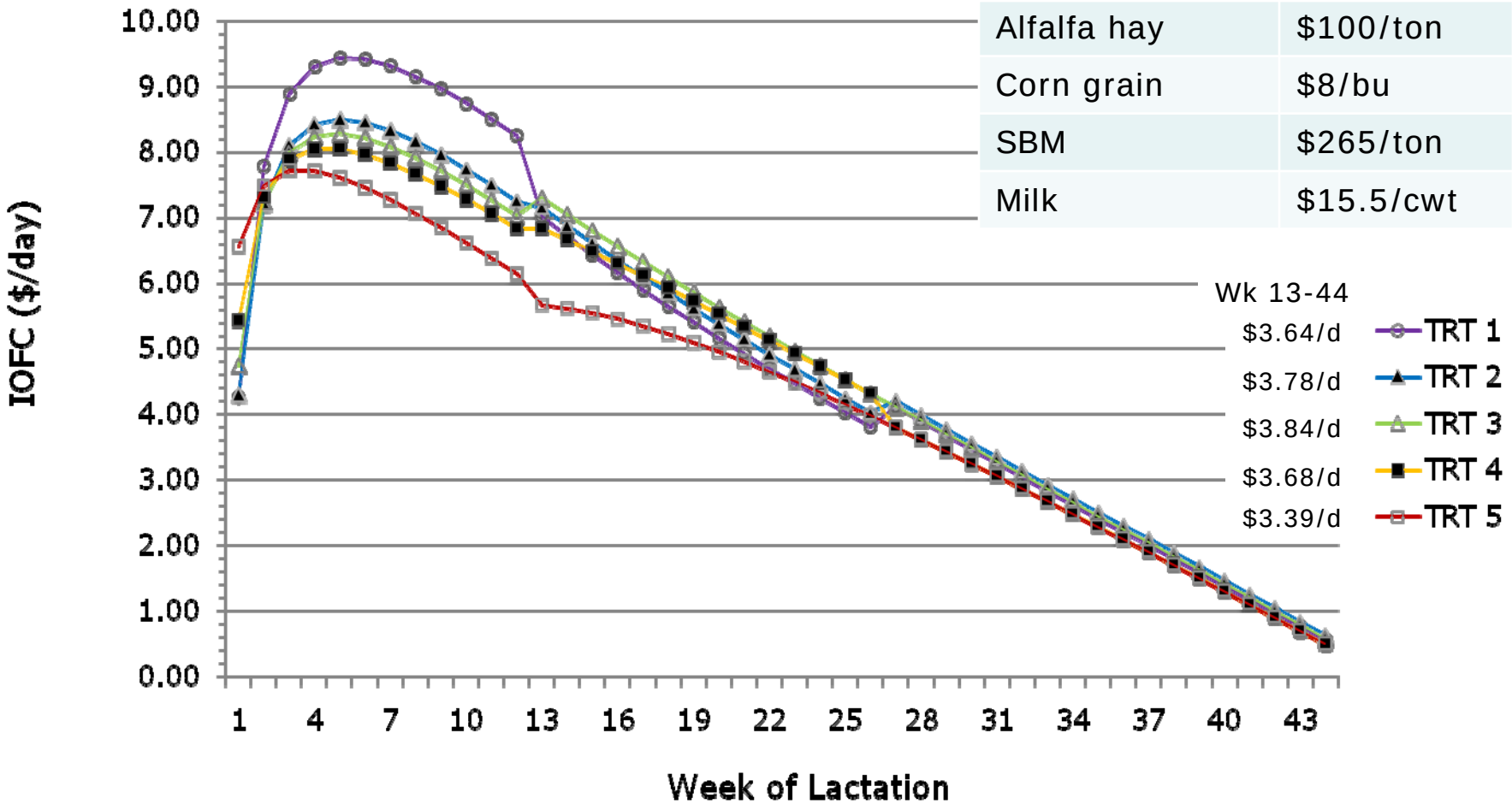
Income Over Feed Cost

Feed Ingredient	Price
Alfalfa hay	$100/ton
Corn grain	$8/bu
SBM	$265/ton
Milk	$15.5/cwt



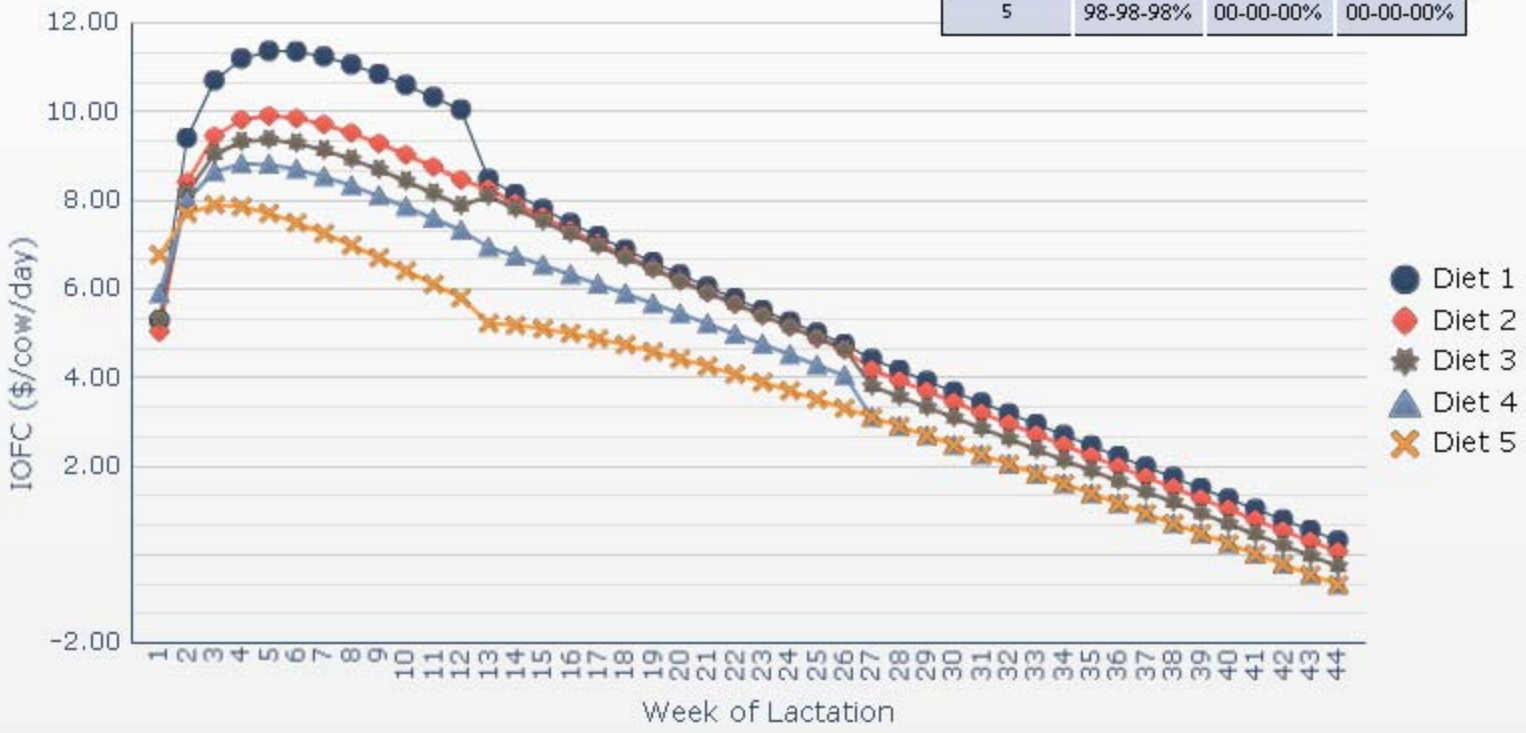
Income Over Feed Cost

Income Over Feed Cost

Victor E. Cabrera, vcabrera@wisc.edu, 608-265-8506

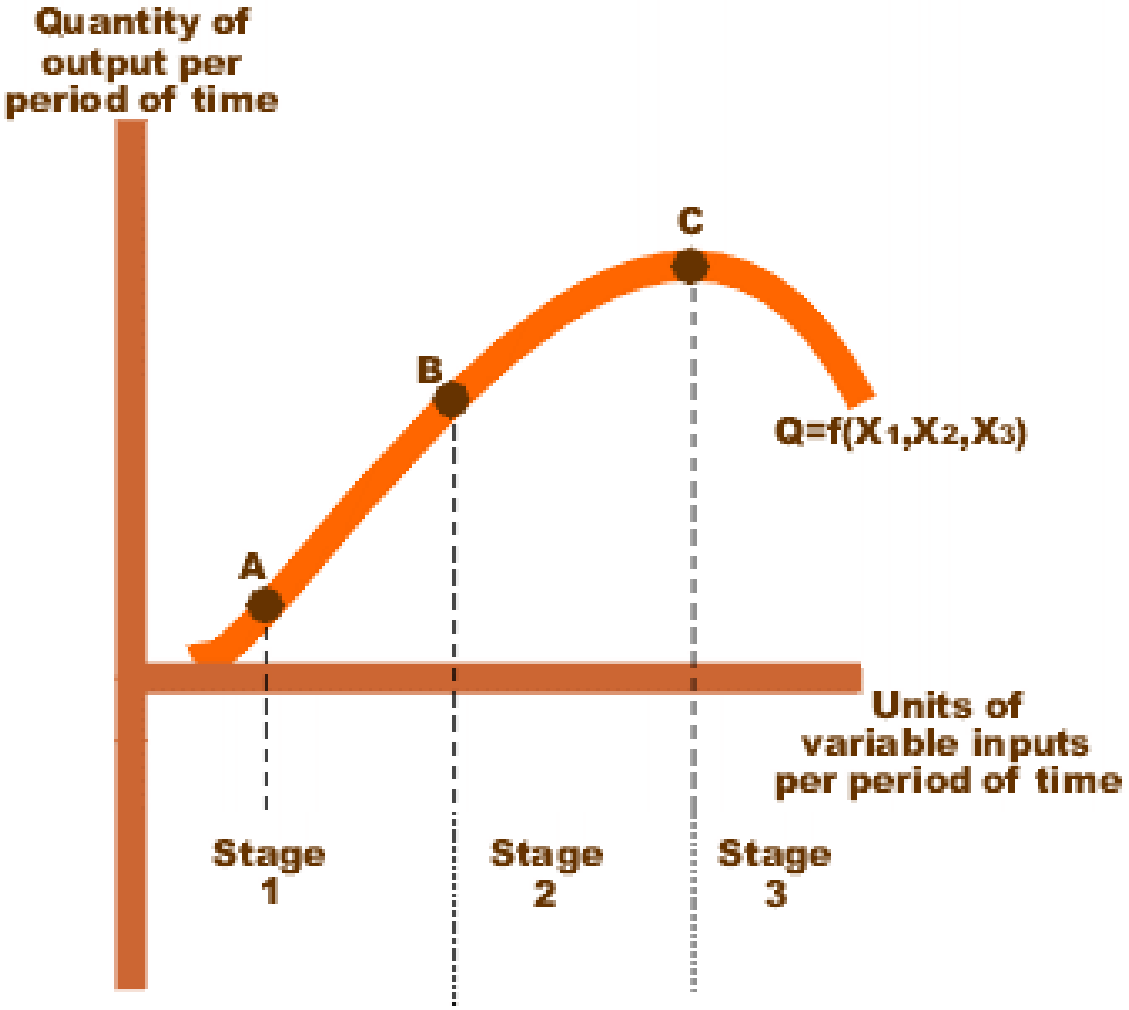
Milk ($/cwt)	18
Alfalfa ($//ton)	177
Corn ($/bu)	6
SBM ($/ton)	358

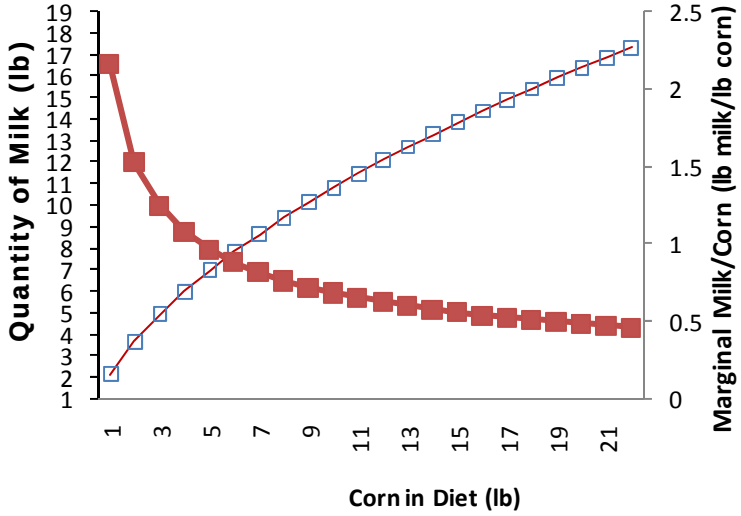
Diet	Alfalfa hay	Corn grain	Soybean meal
1	38-48-68%	42-40-25%	18-10-05%
2	48-58-78%	34-33-17%	16-7-3%
3	58-68-88%	27-25-9%	13-05-01%
4	68-88-98%	19-09-00%	11-01-00%
5	98-98-98%	00-00-00%	00-00-00%



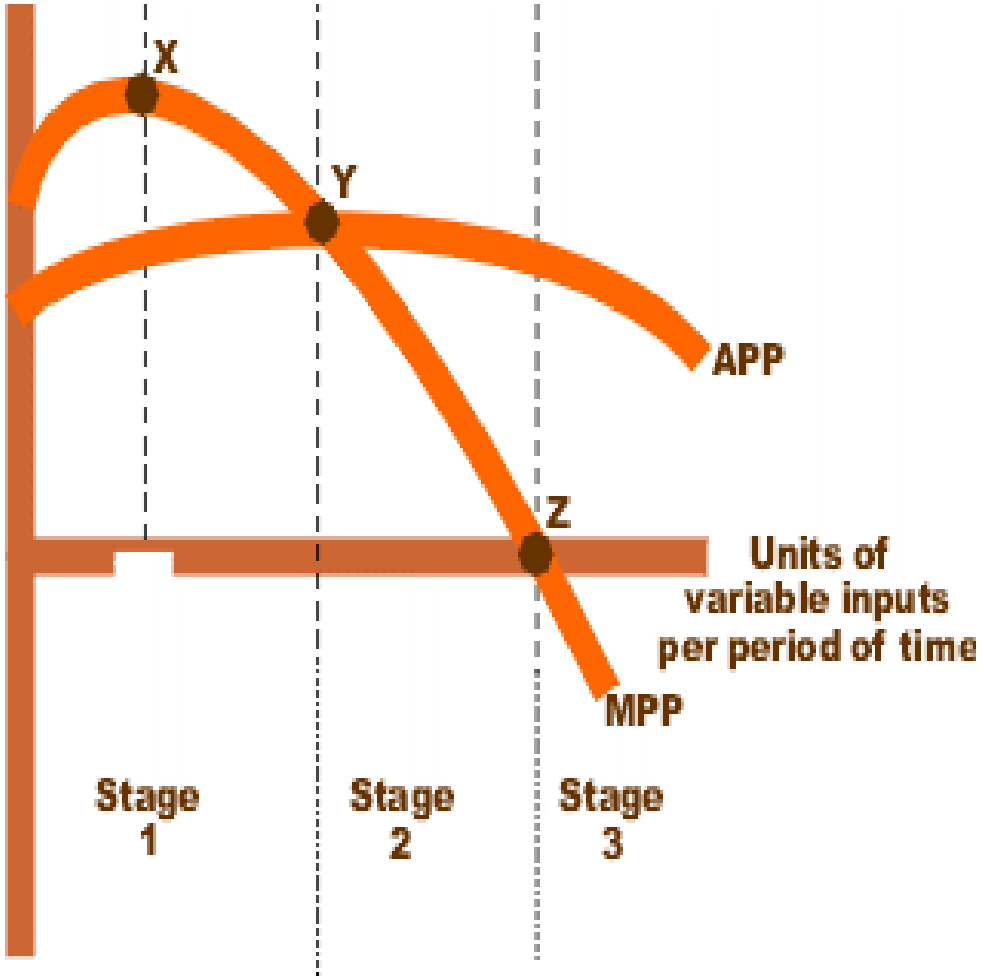
http://www.uwex.edu/ces/dairymgt/

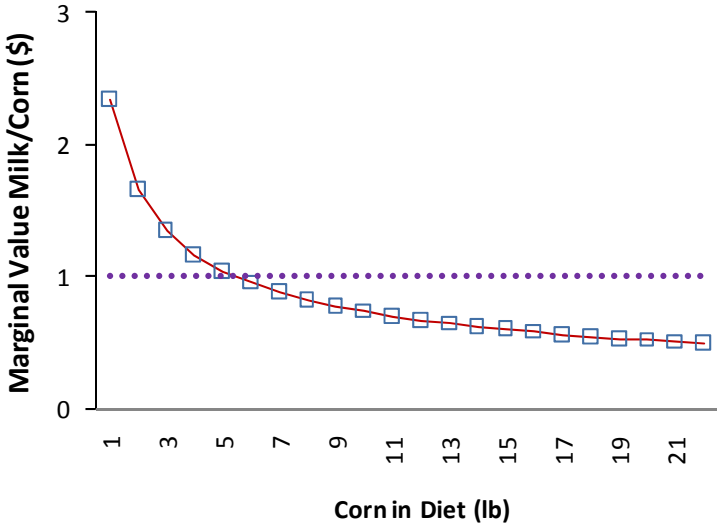
Optimal Corn Usage (Diminishing returns)



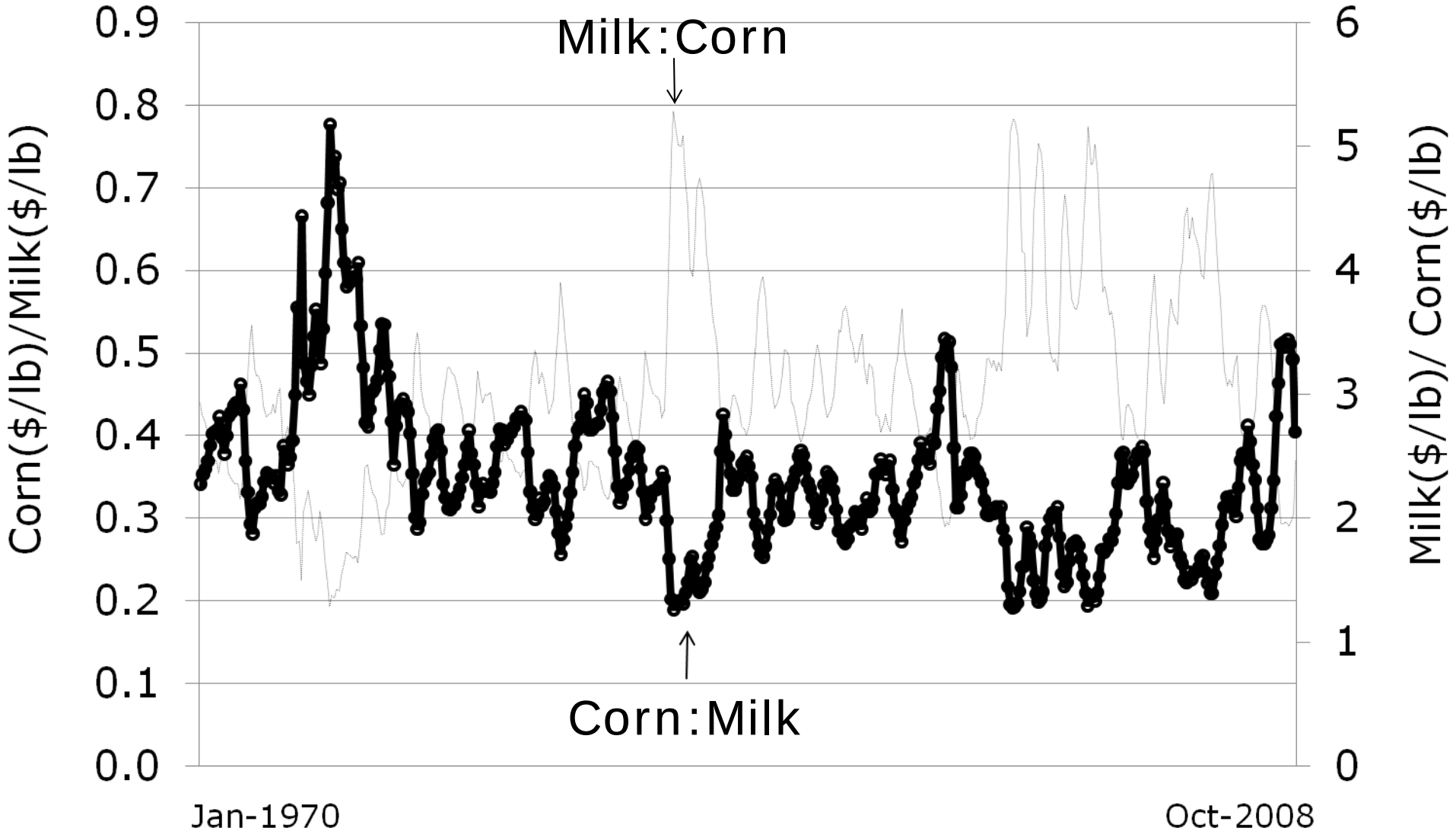


Optimal Corn Usage (Break-even)



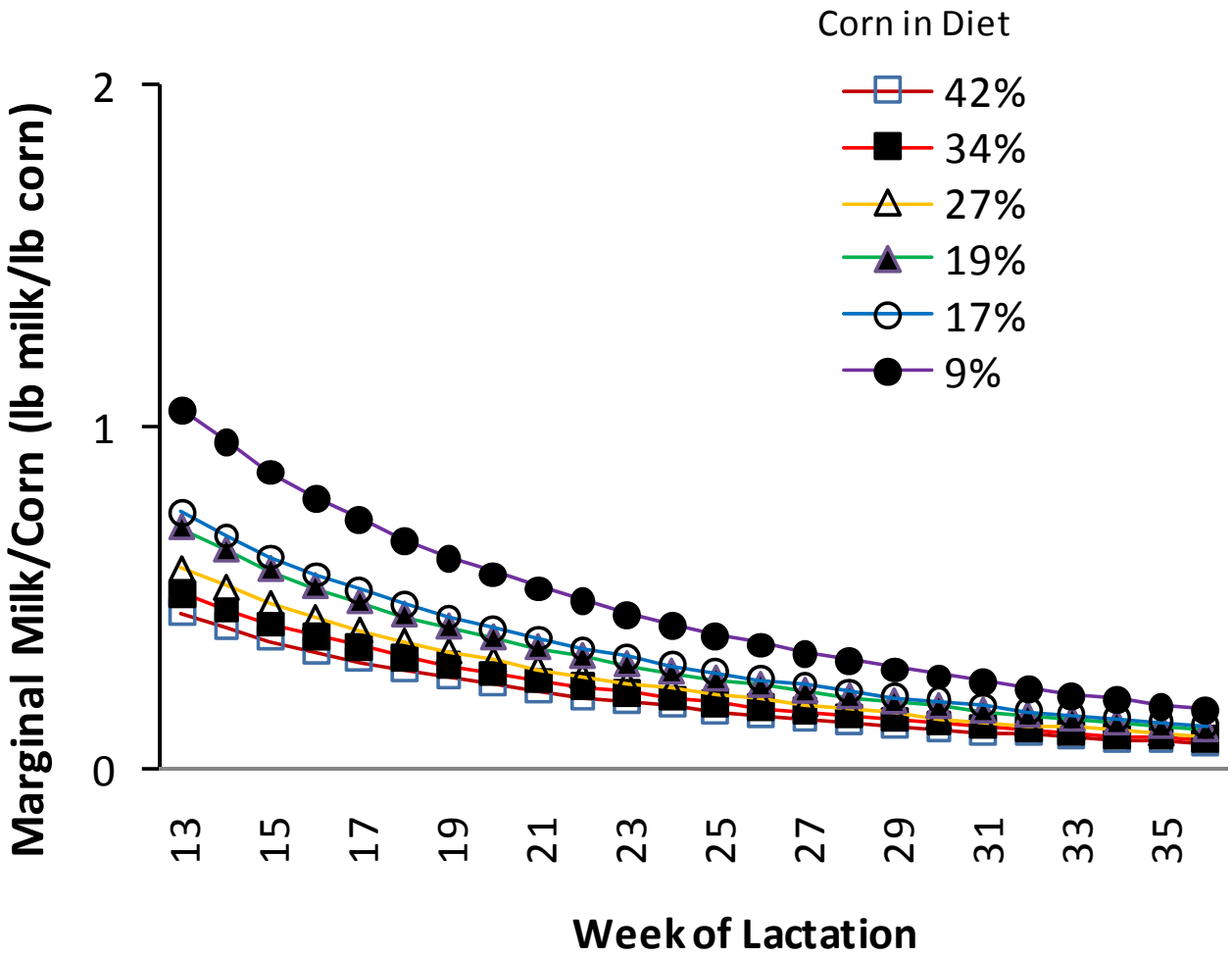


Corn:Milk Price Ratio

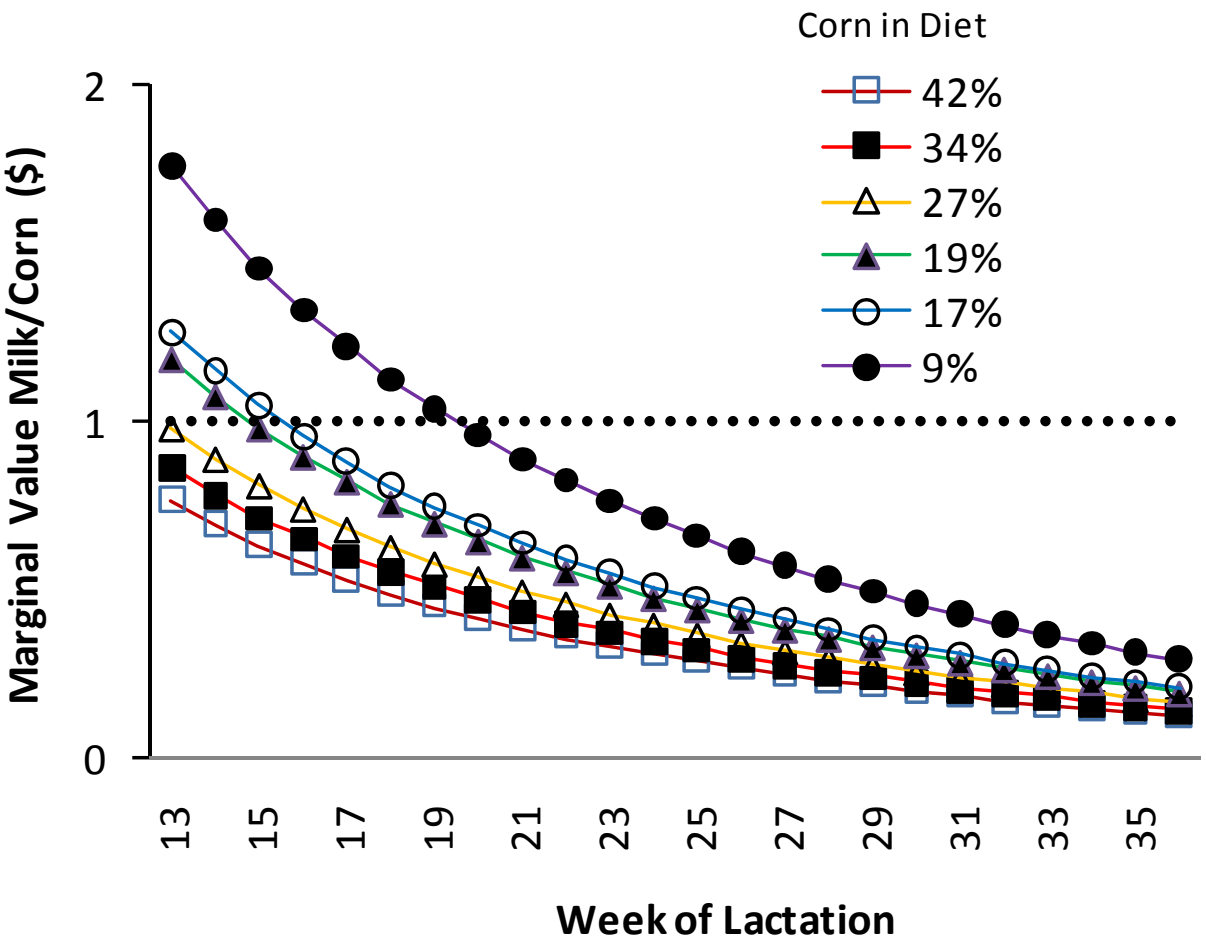


Milk Production Because of Corn

$$MPMILK / Corn = (-0.46 * Corn^{-0.5} + 24.88 * WK^{-1} * Corn^{-0.5}) / 0.454$$

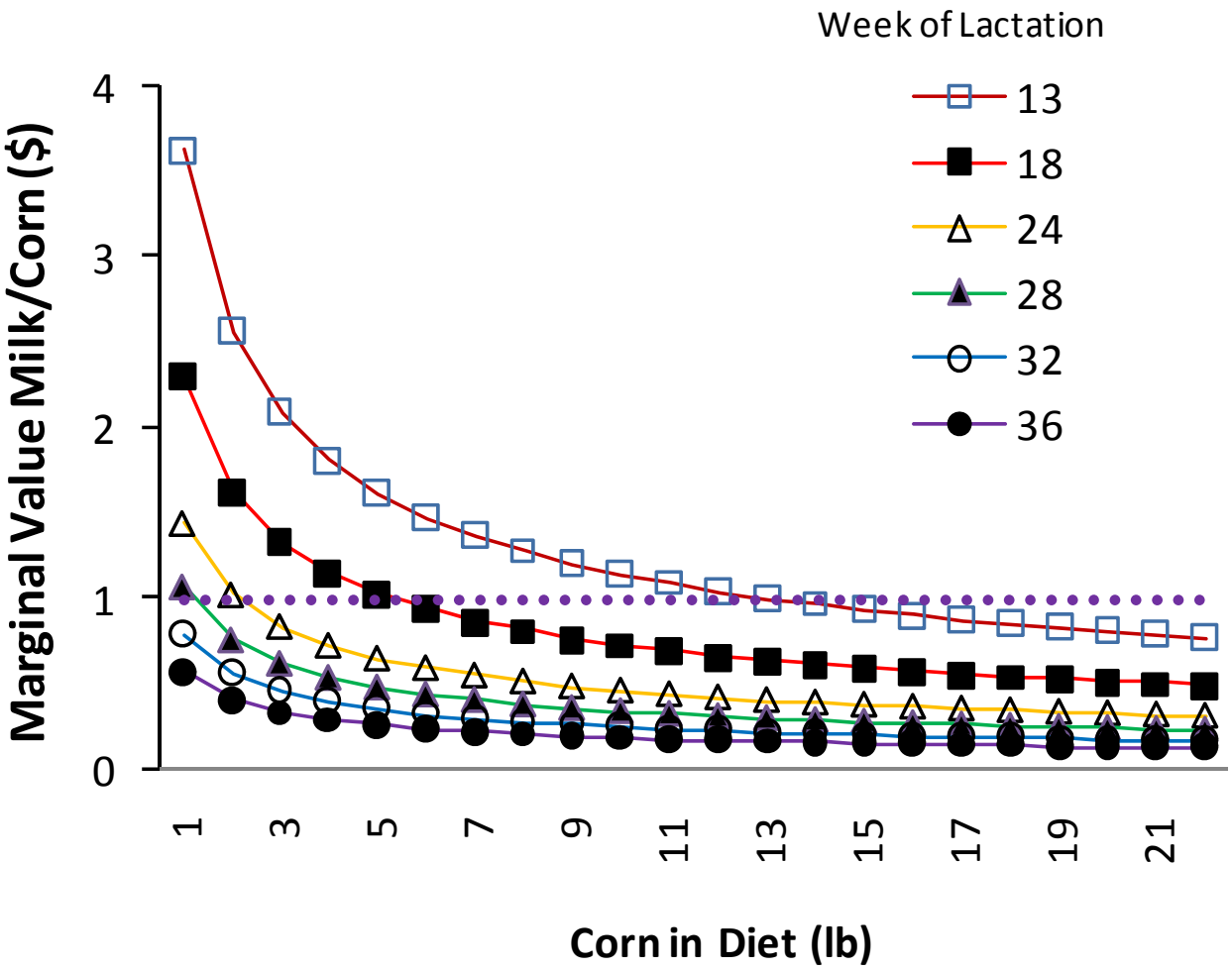


Optimal Corn Usage



Feed	Price
Corn grain	$6/bu
Milk	$18/cwt

Optimal Corn Usage



Feed	Price
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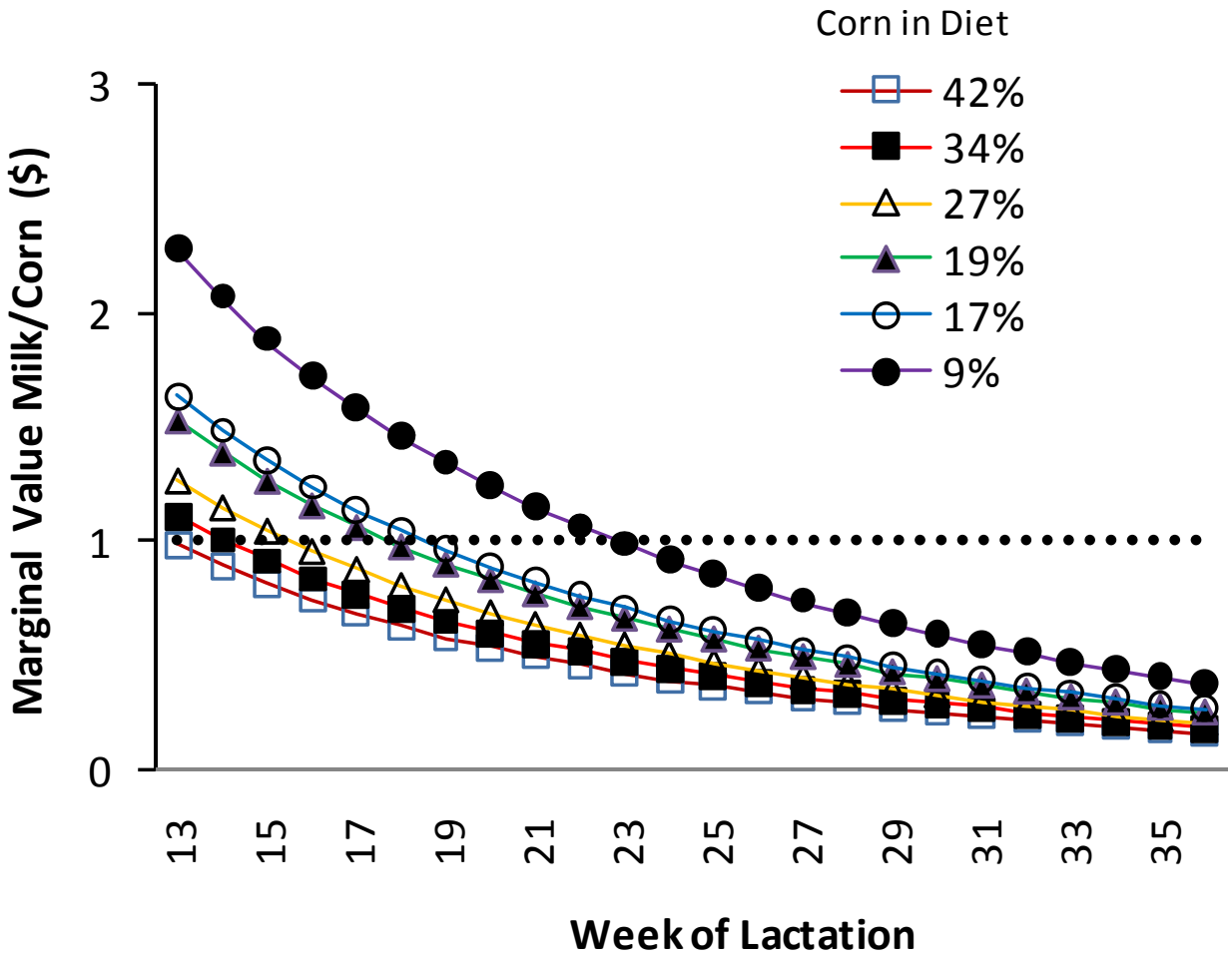
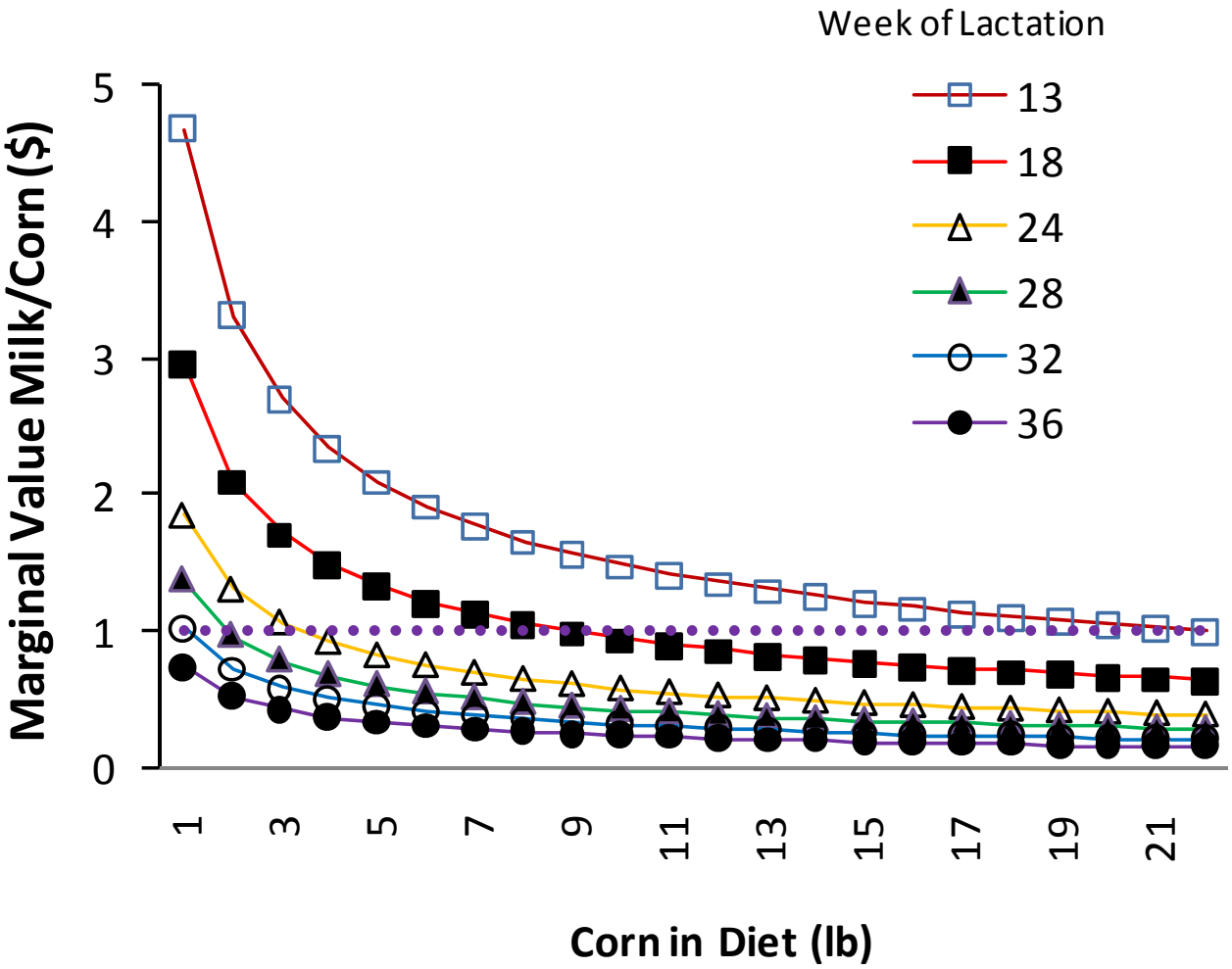
Optimal Corn Usage



Feed	Price
Corn grain	$4/bu
Milk	$15.5/cwt

Optimal Corn Usage



Feed	Price
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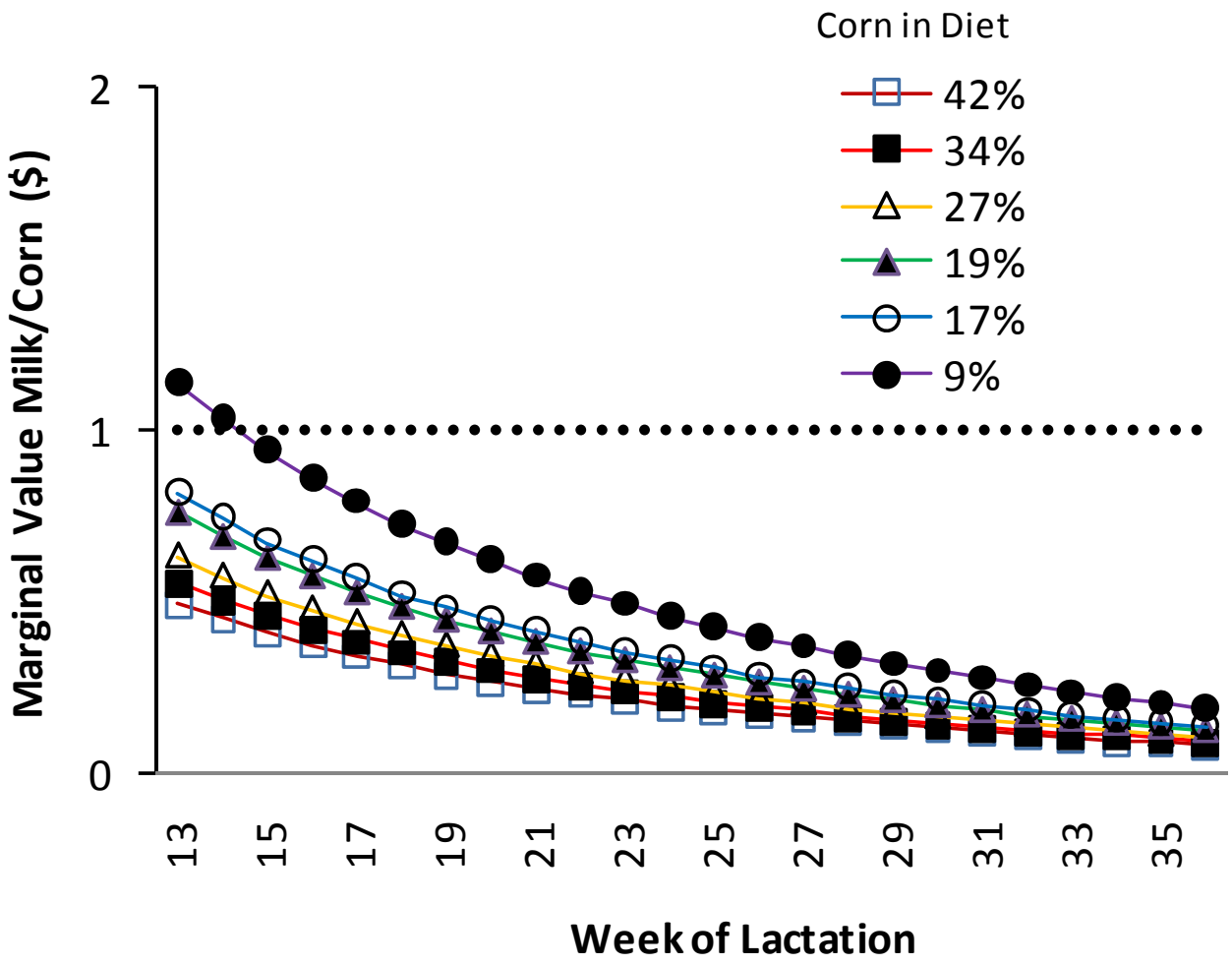
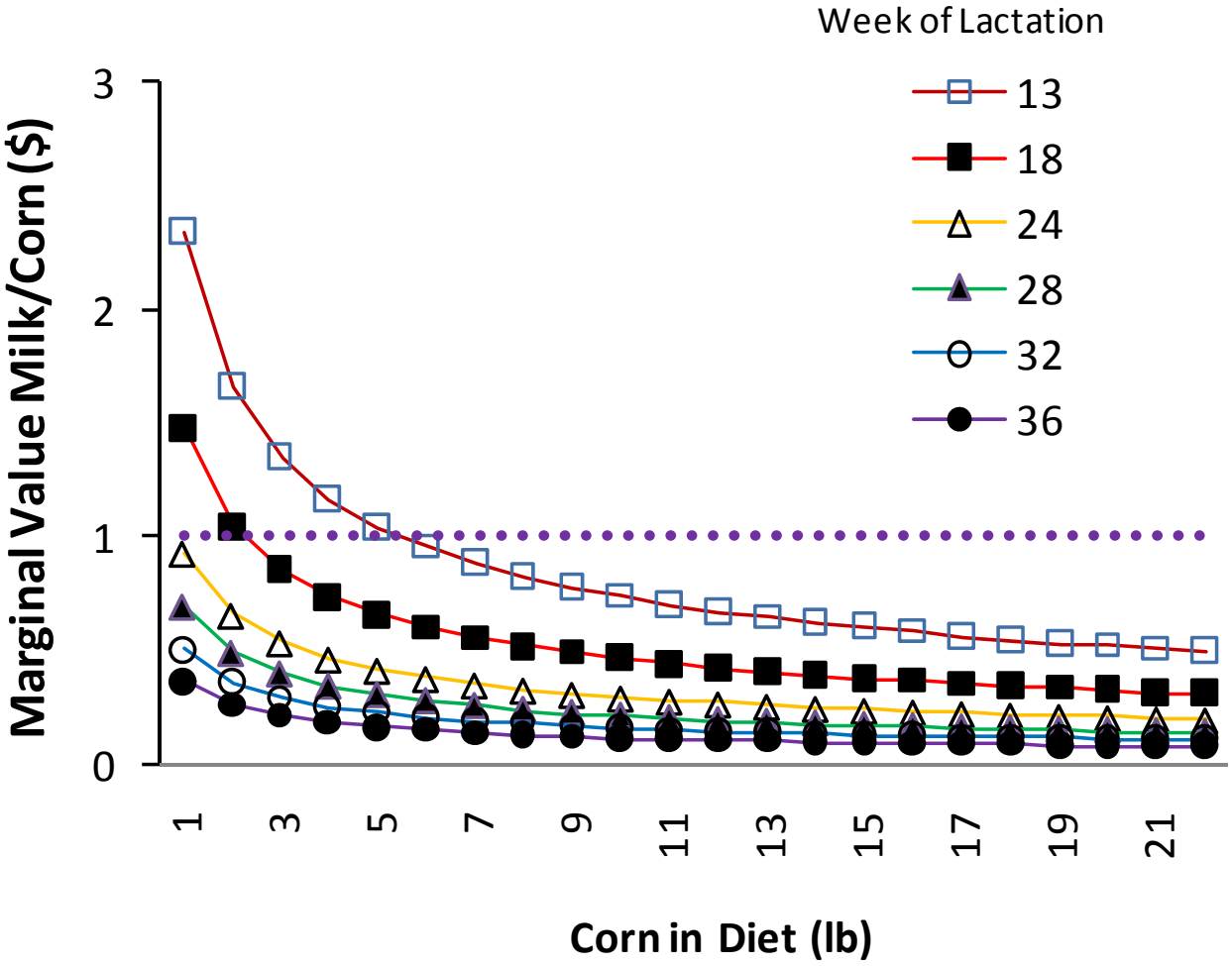
Milk	$15.5/cwt

Optimal Corn Usage



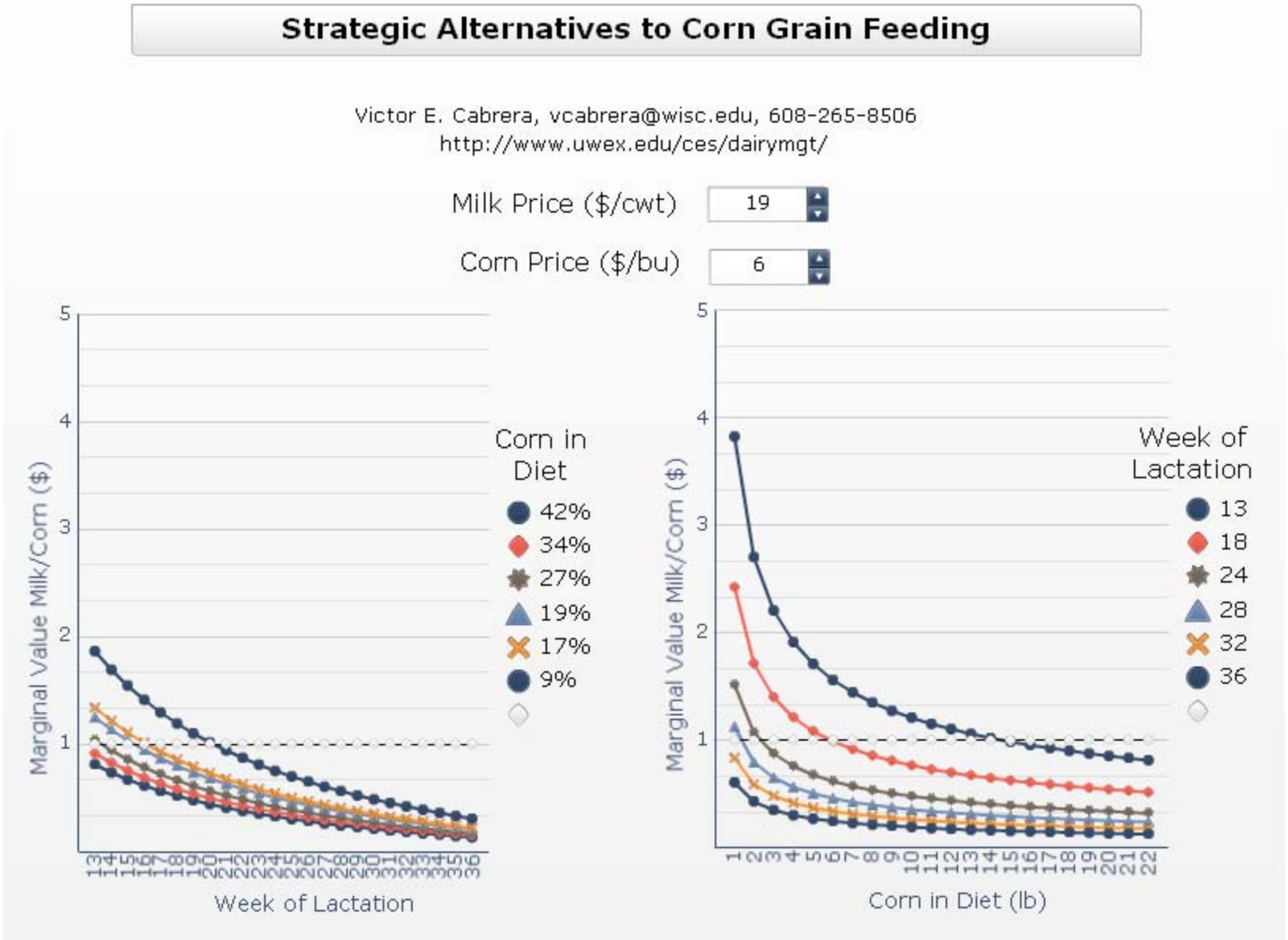
Feed	Price
Corn grain	$8/bu
Milk	$15.5/cwt

Optimal Corn Usage



Feed	Price
Corn grain	$8/bu
Milk	$15.5/cwt

Optimal Corn Usage



Markov-Chains

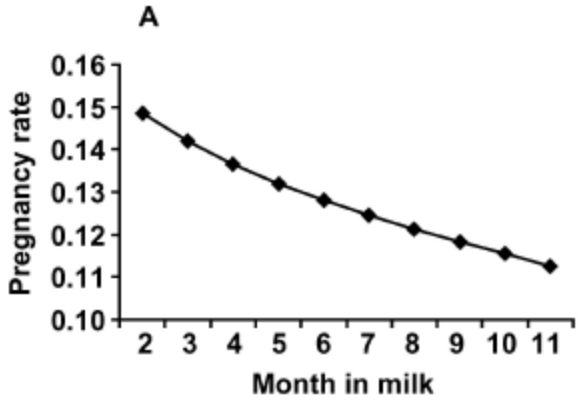
- **Stage** = Time
- **State** = Characteristics of cow or group of cows
- **Transition** = Probabilities that determine the flow from one state to another state

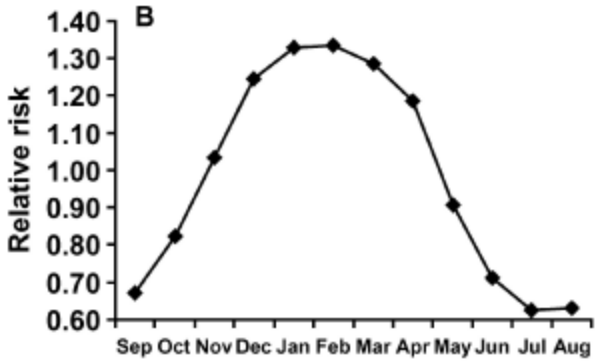
Markov-Chains

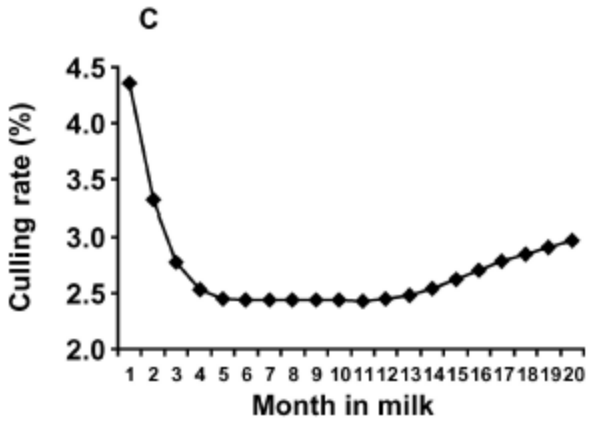
- All potential **states** a cow (or group of cows) can be in a specific **stage**
- Example: (5,400 states)
  - 9 parities
  - 20 month in milk
  - 10 pregnancy (0-non-preg., 1-9 preg.)
  - 3 production levels
  - 12 months in a year

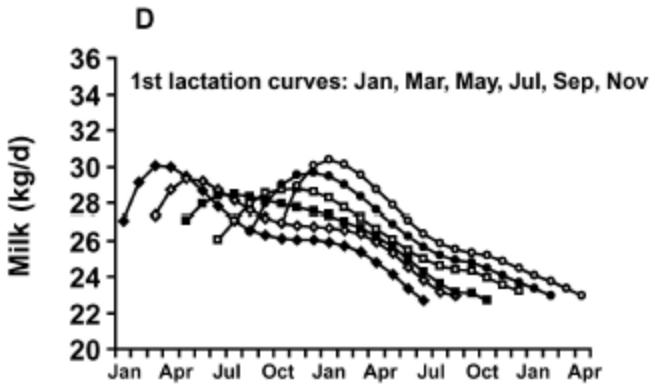
Markov-Chains

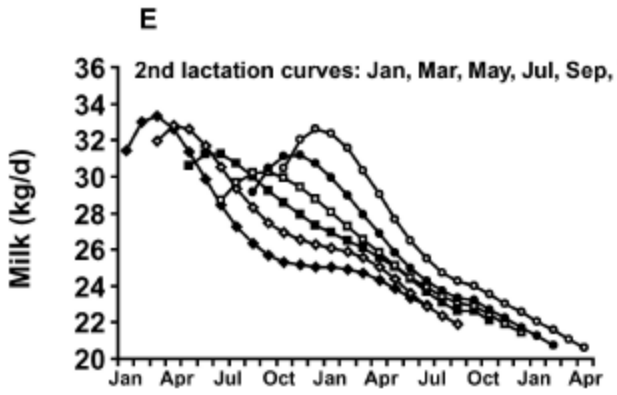
Some Biological Data Needs

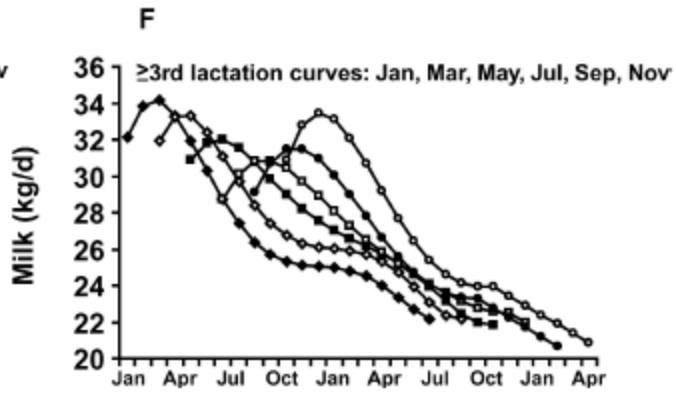












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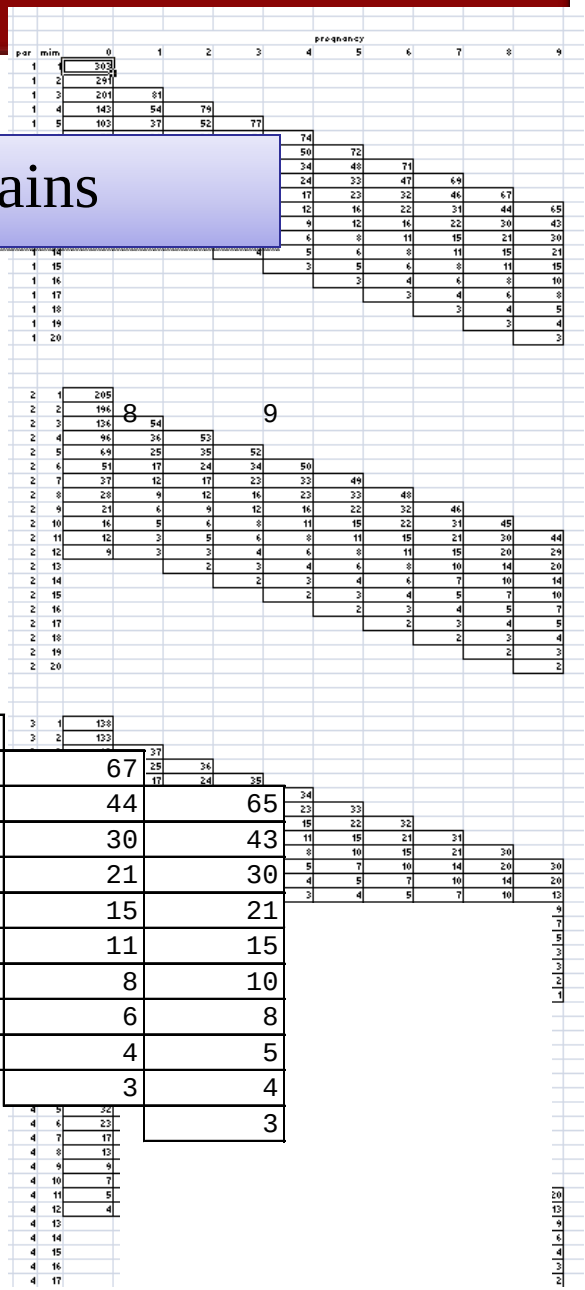
Markov-Chains

Forecast of a dairy herd using Markov Chains



		pregnancy									
par	mim	0	1	2	3	4	5	6	7	8	9
1	1	303									
1	2	291									
1	3	201	81								
1	4	143	54	79							
1	5	103	37	52	77						
1	6	75	26	36	51	74					
1	7	55	18	25	35	50	72				
1	8	41	13	18	24	34	48	71			
1	9	31	9	13	17	24	33	47	69		
1	10	23	7	9	12	17	23	32	46	67	
1	11	18	5	7	9	12	16	22	31	44	65
1	12	14	4	5	7	9	12	16	22	30	43
1	13			4	5	6	8	11	15	21	30
1	14				4	5	6	8	11	15	21
1	15					3	5	6	8	11	15
1	16						3	4	6	8	10
1	17							3	4	6	8
1	18								3	4	5
1	19									3	4
1	20										3

Optimal IOFC Using Herd Structure

	Price
Alfalfa hay	$177/ton
Corn grain	$7/bu
SBM	$350/ton
Milk	$18/cwt
Milking cows	1000
Culling rate	30%

Diet	Lactation Weeks
5	1
1	2-20
3	21-26
1	27-44
Total IOFC	$35,463/wk

Diet	Lactation Weeks
5	1-44
Total IOFC	$24,642/wk

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The Corn-replacer DSS

http://www.uwex.edu/ces/dairymgt/

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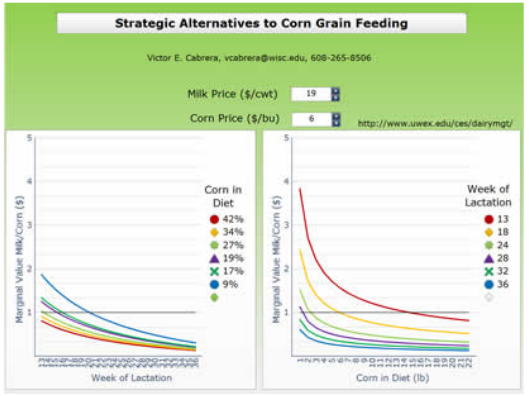
Improving dairy farm sustainability through strategic alternatives to corn grain feeding

Feeding Strategies (3 pages,740 KB)

This spreadsheet applicaation calculates the income over feed cost (IOFC), the marginal value of milk to corn, and the optimal level of corn usage for defined milk price, feed costs, and stage of lactation.



Optimal Alternative Corn Grain Feeding (8 pages, 309 KB)

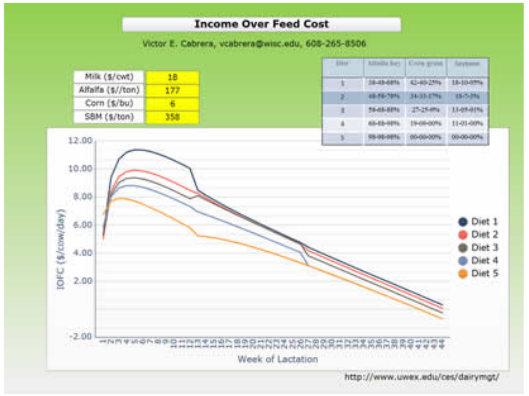
This PDF document describes the analyses of replacing corn grain by alternative feed strategies.

Optimal Feeding Strategies (SWF file, 782 KB)

This Macromedia Flash application performs analyses in real time directly in the web browser.

Income Over Feed Costs Analyses (SWF file, 918 KB)

This Macromedia Flash application performs analyses in real time directly in the web browser.



Improving Feeding Sustainability (Poster, 329 KB)

This PDF document gives a background of more efficient feeding practices for economic and environmental sustainability..

Victor E. Cabrera, PhD, Assistant Professor and Extension Specialist in Dairy Management, is available to contact for more information.

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Limitations and Continued Work

1) Incorporate milk fat and protein,
2) Study and integrate grazing field observations,
3) Incorporate other forages, especially corn silage,
4) Incorporate herd and group feed analyses,
5) Distinction of cow's parity,
6) Incorporate high producing herds, and
7) Account for unintended impacts

Improving Dairy Farm Sustainability through Strategic Alternatives to Corn Grain Feeding

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Acknowledgements

Ken Bolton
Randy Shaver
Bruce Jones
Jim Leverich

http://www.uwex.edu/ces/dairymgt/