

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Optimally Achieving Milk Bulk Tank Somatic Cell Count Thresholds

Jason A. Troendle*, Loren W. Tauer*, and Yrjo T. Grohn+
*Charles H. Dyson School of Applied Economics and Management, College of
Agriculture and Life Sciences, Cornell University + Section of Epidemiology,
College of Veterinary Medicine, Cornell University

Jason Troendle – jat352@cornell.edu, Loren Tauer - lwt1@cornell.edu, and Yrjo
Grohn ytg1@cornell.edu

Selected Poster prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, MA, July 31- Aug. 2

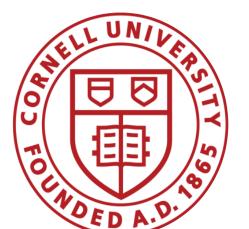
Copyright 2016 by Jason A. Troendle, Loren W. Tauer, and Yrjo T. Grohn. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Optimally Achieving Milk Bulk Tank Somatic Cell Count Thresholds

Jason A. Troendle*, Loren W. Tauer*, and Yrjo T. Grohn+

*Charles H. Dyson School of Applied Economics and Management, College of Agriculture and Life Sciences, Cornell University

+ Section of Epidemiology, College of Veterinary Medicine, Cornell University



The Problem

- High levels of Somatic Cell Count (SCC) in milk reduces shelf life
 of milk and reduces yield of manufactured dairy products such as
 cheese
- As a result farmers are penalized for high SCC or receive a premium for low SCC in the milk they deliver
- Thus farmers often sequentially cull the highest SCC cows to meet the bulk tank SCC threshold, but in the process some high value cows may be culled

What is a Somatic Cell?

- White blood cells known as leukocytes constitute the majority of somatic cells
- The number of somatic cells increases in response to pathogenic bacteria in the mammary gland
- SCC is quantified as cells per ml. of milk
- Cows with SCC less than 200,000 scc/mL are not likely infected with major pathogens.
- Herds with bulk tank SCC above 200,000 scc/mL have varying degrees of subclinical mastitis present.

Study Objective

- To help farmers make optimal decisions attaining somatic cell count (SCC) bulk tank thresholds
- Our approach is to specify the problem as maximize herd milk
 NPV subject to meeting bulk tank SCC thresholds
- The level of SCC is determined by taking a sample of milk from the bulk tank when the milk is collected from the farm, but all cows contribute to the SCC loading
- Thus this is essentially a blending problem
- Data are used from two New York dairy farms

Model

The mathematical programming model is specified as:

$$\max \sum_{i=1}^{n} \sum_{i=1}^{2} NPVcow_{(i)} * cow_{(ij)}$$

subject to:

$$(1)\sum_{i=1}^{n}\sum_{j=1}^{2}cow_{(ij)}+cow_{(ij)}=1$$

(2)
$$\sum_{i=1}^{n} Yield \ cow_{(i1)} = Total \ milk$$

$$(3) \sum_{i=1}^{n} SCC \ cow_{(i1)} = Total \ SCC$$

$$(4)\sum_{i=1}^{n}cow_{(i1)} \ge .33 * \sum_{i=1}^{n}\sum_{j=1}^{2}cow_{(ij)}$$

$$(5) \frac{Total\ SCC}{Total\ milk} \le K_1$$

with:

$$cow_{(ij)} = \begin{cases} cow_{(i1)} & \text{if retained } (j = 1) \\ cow_{(i2)} & \text{if culled } (j = 2) \end{cases}$$

 $NPVcow_{(i)}$ = Net Present Value (dollars) of $cow_{(i)}$ K_1 = somatic cell count (SCC) threshold.

Results from optimizing profit and meeting somatic cell count (SCC) threshold of 200,000 scc/mL with upper culling bound of 33% of total herd, Dairy A - 1/23/2014 test date¹

		Pre-decision herd ²	Post-decision cows retained ³	Post-decision cows culled ⁴
Cow Value (dollars) ⁵		313.61	692.07	-455.05
		(793.96)	(620.95)	(495.78)
Production (1000s mL)		40.94	42.39	37.98
		(13.03)	(12.45)	(13.71)
Total	Tank SCC (1000s)	10,365.76	8,443.35	14,270.19
Concentration		(33,078.26)	(21,355.31)	(48,795.11)
Total	Tank SCC/mL	253,181 scc/ml	199,151 scc/ml	199,151 scc/ml
Cows		391	262	129

¹Optimized using binary linear optimization.

² Pre-decision statistics before culling for profit and SCC, mean and standard deviation.

³Post-decision statistics after culling for profit and SCC, mean and standard deviation for retained cows.

⁴Post-decision statistics after culling for profit and SCC, mean and standard deviation for culled cows.

⁵Values derived from Dairy Comp 305 software.

Results from optimizing profit and meeting somatic cell count (SCC) threshold of 400,000 scc/mL with upper culling bound of 33% of total herd, Dairy B – 10/11/2007 test date¹

	Pre-decision	Post-decision	Post-decision		
	herd ²	cows retained ³	cows culled ⁴		
Cow Value (dollars) ⁵	111.94	503.55	-687.73		
	(777.71)	(608.33)	(361.60)		
Production (1000s mL)	33.59	34.79	31.15		
	(11.06)	(10.52)	(11.77)		
Total Tank SCC (1000s)	16,292.03	13,888.16	21,200.76		
Concentration	(32,156.85)	(27,256.94)	(40,045.89)		
Total Tank SCC/mL	484,958 scc/ml	399,195 scc/ml	399,195 scc/ml		
Cows	362	243	119		

²Pre-decision statistics before culling for profit and SCC, mean and standard deviation.

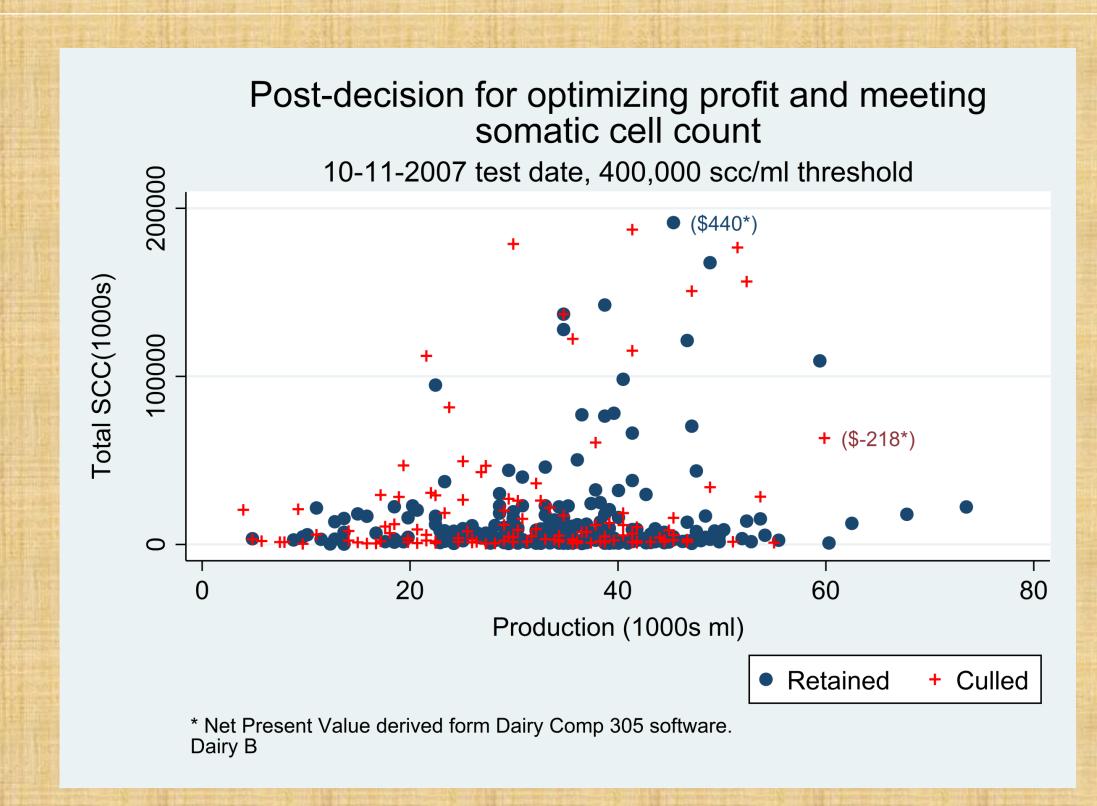
Post-decision statistics after culling for profit and SCC, mean and standard deviation for retained cows Post-decision statistics after culling for profit and SCC, mean and standard deviation for culled cows.

⁵Values derived from Dairy Comp 305 software.

Results from naïve and mathematical optimization culling meeting somatic cell count (SCC) threshold with upper culling bound of 33% of total herd

	Dairy A – 200,000 scc/mL	Dairy B - 200,000 scc/mL
Original SCC (1000s/mL)	253.59	484.96
Mathematically Optimized Culling NPV ¹	\$181,324.00	\$122,363.00
Naïve Culling NPV ²	\$180,597.00	\$117.664.00
Increased Profit from Optimal Culling 1 Optimized using binary linear optimization	\$727.00	\$4,699.00

otimized using binary linear optimization. ws culled naively (first, high SCC cows to reach threshold, second lowest value cows while still meeting threshold) until herd size equal to herd size under mathematicall imized model.



Conclusions

- NPV from optimization is greater than NPV from naively culling cows beginning with the highest SCC cow
- Increase in NPV might be only a few percentages but the model can be incorporated into current dairy data software where NPV and SCC per cow is currently collected.