Replacement Heifers: How Many, What Kind, and How Do We Manage it All?

Michael Overton, DVM, MPVM
Elanco Animal Health
Advisor – Dairy Analytics
moverton@elanco.com

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Advancements in Dairy Breeding and Selection have Created Both Opportunities and Challenges

- Formerly:
  - Bred everything (conventional)
  - Kept all heifers that did not die
- Currently – options:
  - Sex-sorted semen
  - Beef semen
  - IVF embryos (dairy or beef)
  - Genomic testing
- Many questions to consider:
  - What service sire should I use on each animal?
    - Conventional, sexed, beef, or embryo
    - How many heifers do I need to produce?
    - Which cows should produce my replacements?
  - Which heifers do I keep?
  - When do I cull heifers that I do not need?
  - Should I use genomic testing?
  - How many (and which) cows should I cull?

Common Question that I Get: "How Many Heifers Do I Need?

- "IT DEPENDS…"
- It depends on the question being asked and on the timing:
  - THIS month, need enough heifers to replace cows that need to be culled (or would like to cull)
  - If forecasting into the future…the questions can vary and the answers will vary based upon many factors:
    - How many do pregnancies do I need to produce?
    - How many do I need to place into the hutches?
    - How many do I need in inventory?

Producing More Pregnancies is Just the Start…

- Stillbirths – what percent of births result in dead calves?
- Mortality losses
- Heifer culling due to chronic disease issues
- Growth rate/nutritional management/age at first service
- Fertility – it's a bigger issue than many realize
- Abortions…Pregnancies must survive to term
- Adult herd culling needs
- Herd size plans (expansion, no change, contraction)

To Help Illustrate a Few of These Concepts, We'll Use a Data Set from Our Dairy Data Access System (DDAS)

(Convenience sample of 30 dairy herds from across the US)

- Populations used:
  - 30 herds from across the U.S. (all herds are >90% Holstein)
  - Average milking and dry, total across all herds = 99,955 cows
  - Average youngstock inventory, total across all herds = 104,264 heifers
  - Herd size range of 236 to 13,602, mean of 3,332
  - DairyComp 305® backups were from December 2018

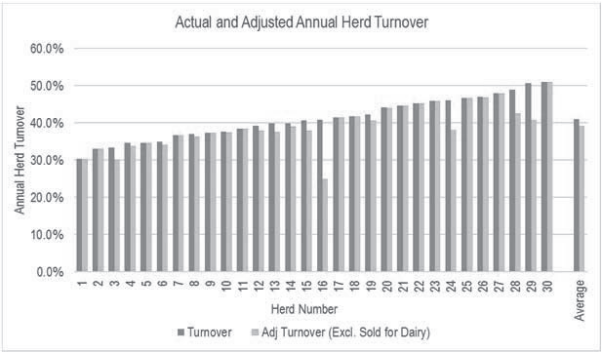
When Considering "How Many Heifers Do I Need?", the Primary Consideration Should be the Anticipated Herd Turnover

Herd Turnover:

$$\frac{\text{\# Cows (milking and dry) that leave the herd}}{\text{Average \# of Cows (milking and dry) for the year}}$$

- Wide range of observed values: < 20% to > 50%
- Very commonly observed (US): 35% to 45%
- Why is there so much variation amongst herds?

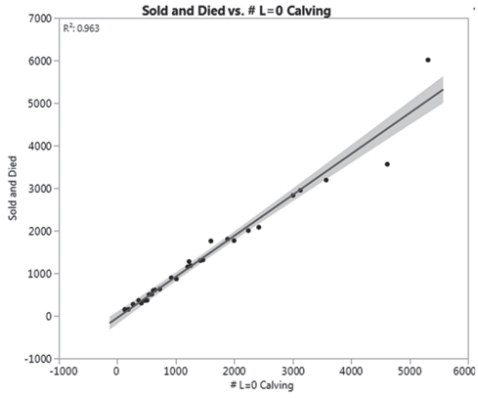
Holstein Data Set from DDAS System



Think of a Dairy as a Closed Production System

- There is a certain capacity of animals (milking and dry)
  - If too many, overcrowded and decreased performance
  - If too few, inefficient dilution of fixed costs
- First priority: improve management in order to reduce the risk of cows losing value prematurely (death, disease, infertility, etc)
- THEN, culling should be driven by economics…
  - Based on what is better for the current and long term profitability of the herd and ***NOT some predetermined benchmark***

Heifer Numbers (or Availability) and Herd Turnover Are Highly Correlated (as expected)



Given the Strong Relationship Between Heifer Numbers and Herd Turnover, What Factors Impact the Number of Heifers Produced?

- Reproductive performance – heifers and cows
- Sires used – conventional, sexed, or beef
- Stillbirth (DOA) risk – heifers and cows
- Heifer losses
  - Early:
    - Birth through weaning
    - Weaning to entrance to breeding pen
    - Breeding
  - Late:
    - Post-breeding to calving

What Factors Impact the Number of Heifers Produced?

- **Reproductive performance – heifers and cows**
- Sires used – conventional, sexed, or beef
- Stillbirth (DOA) risk – heifers and cows
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  - Early:
    - Birth through weaning
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    - Post-breeding to calving

What is the Relationship Between 21-d Pregnancy Rate (PR) and Calves Produced

- In reality, it depends on the pattern (timing) of pregnancy creation along with the herd's 21-d PR
- For this demonstration → our assumptions:
  - Herd with 1200 animals calving/year
  - Average abortion risk = 10%
  - Average culling risk = 34%
  - 10 21-d cycles of breeding eligibility

21-d PR	***16%***	***20%***	***23%***	***26%***	***28%***
% of Cows that Calve Again	*60%*	*63%*	*66%*	*67%*	*68%*
# Calves Produced	720	760	792	807	816
# Heifers Produced	346	365	380	387	392
Difference from lower PR		19	15	7	5

  - So, assuming 48:52% heifers:bulls and a 1000-cow dairy, a 28% PR in THIS demonstration would yield 46 more heifers, assuming all else being equal

What Happens to Herd Turnover if Reproductive Performance Improves?

- If pregnancy creation efficiency improves (more pregnancies and fewer animals culled due to reproductive failure)
- AND assuming replacement heifer management and performance is unchanged
- AND service sires used are similar
- AND if herd size is stable…

Herd Turnover MUST Increase

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About Those Service Sires…

- Traditionally, herds used natural service or AI with conventional semen
  - Expected 45-48% heifer calves
- 10-20 years ago, herds often struggled to reach 18-20% pregnancy rate
- As a result, herd turnover was limited (or producers purchased heifers as needed)
- Now, there are options!

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Potential Sire Options and Expected Fertility

Semen Type	Expected % Heifer Replacements	Fertility Impact
Conventional	46-48%	Baseline
Sex Sorted	Up to 90%	-20 to -25% but animal selection and superior management can result in lower impacts
Beef	0%	None to slight improvement

Karakaya-Bilen, E., et al. (2018). Reproduction in Domestic Animals: 1-8.
Vishwanath, R. and J. F. Moreno (2018). Animal 12(s1): s85-s96.

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Given that Heifer Numbers Typically Drive Herd Turnover, What Drives the Number of Heifers Produced?

- Reproductive performance – heifers and cows
- Sires used – conventional, sexed, or beef
- **Stillbirth (DOA) risk – heifers and cows**
- Heifer losses
  - Early:
    - Birth through weaning
    - Weaning to entrance to breeding pen
    - Breeding
  - Late:
    - Post-breeding to calving

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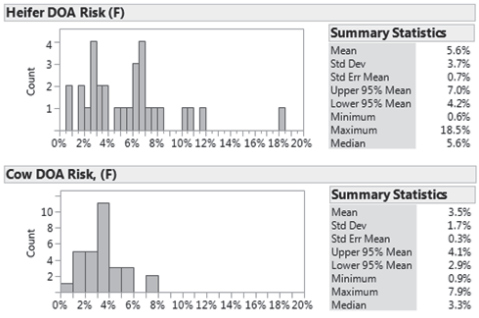
Stillbirth (DOA) Risk (same 30-herd data set)



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What Factors Impact the Number of Heifers Produced?

- Reproductive performance – heifers and cows
- Sires used – conventional, sexed, or beef
- Stillbirth (DOA) risk – heifers and cows
- **Heifer losses**
  - **Early:**
    - **Birth through weaning**
    - **Weaning to entrance to breeding pen**
    - **Breeding**

    "What % become pregnant?"
  - **Late:**
    - **Post-breeding to calving**

    "What % of pregnancies actually calve?"

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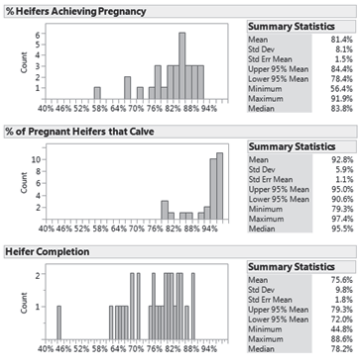
Heifer Dynamics (birth through potential calving)



On average:

- 19% of heifers failed to achieve a pregnancy (but don't confuse this with a fertility issue)
  - Mortality
  - Culling (sold)
  - Repro failure (sold)
- 7% of pregnant heifers failed to calve
  - Abortion losses
  - Late culls
  - Late mortality

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Putting it all together…How Many Heifers Are Needed Annually? (using results of 30-herd data set)

Milking and Dry	1200
Herd Turnover	39.0%
# Cows Culled = # Heifers Needed to Calve	468
% of Heifers Calving	75.5%
% Preg Heifers that Calve	92.8%
% Heifers that Conceive	81.4%
# Live Heifers Born	620
DOA Risk	5.6%
# Heifer Births Needed	656

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How Many Heifers are Needed Annually? (Scenarios for Consideration)

Milking and Dry	1200	1200	1200	1200	1200	1200
Herd Turnover	30.0%	40.0%	50.0%	40.0%	40.0%	39.0%
# Culled = # Heifers Needed to Calve	360	480	600	480	480	468
% of Heifers Calving	83.6%	83.6%	83.6%	83.6%	73.6%	75.5%
% Preg Heifers that Calve	95.0%	95.0%	95.0%	95.0%	92.0%	92.8%
% Heifers that Conceive	88.0%	88.0%	88.0%	88.0%	80.0%	81.4%
# Live Heifers Born	431	574	718	574	652	620
DOA Risk	5.0%	5.0%	5.0%	3.0%	5.0%	5.6%
# Heifer Births Needed	453	604	755	592	686	656

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Different Approaches to Creating Sufficient Number of Heifers: Observations from the Field

- Very common:
  - Use sexed semen for 1-3 services in virgin heifers
- Increasingly common:
  - Also, use sexed semen for 1-2 services in lactation=1 +/- lactation=2
- In herds aggressively using sexed semen, now starting to see increased use of beef semen in lower end cows and heifers
- Some herds are trying to move to all sexed or beef; plan is to use NO conventional semen

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Putting it all together…Selecting Sires

Milking and Dry	1200
Herd Turnover	39.0%
# Culled = # Heifers to Calve	468
% of Heifers Calving	75.5%
% Preg Heifers that Calve	92.8%
% Heifers that Conceive	81.4%
# Live Heifers Born	620
DOA Risk	5.6%
# Heifer Births Needed	656
# Animals Conceiving	1200

		Option 1		Option 2		Option 3	
	%F	% Sires	# Heifers	% Sires	# Heifers	% Sires	# Heifers
% Convent.	48%	83%	480	50%	287	26%	150
% Sexed	88%	17%	175	35%	370	48%	506
% Beef	0%	0%	0	15%	0	26%	0
		100%	656	100%	656	100%	656

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Putting it all together…Selecting Sires

Milking and Dry	1200
Herd Turnover	39.0%
# Culled = # Heifers to Calve	468
% of Heifers Calving	75.5%
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		Option 1		Option 2		Option 3		Option 4	
	%F	% Sires	# Heifers	% Sires	# Heifers	% Sires	# Heifers	% Sires	# Heifers
% Convent.	48%	83%	480	50%	287	26%	150	0%	0
% Sexed	88%	17%	175	35%	370	48%	506	62%	656
% Beef	0%	0%	0	15%	0	26%	0	38%	0
		100%	656	100%	656	100%	656	100%	656

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Producing a Large Excess of Heifers Has Become an Economic Concern

- Due to a combination of excess heifer inventory and low milk prices, replacement heifer values have plummeted and are well below actual cost of production:

	Jan-18	Oct-18	Jan-19
Arizona	$1,700	$1,450	$1,250
California	$1,500	$1,200	$1,100
Florida	$1,530	$1,260	$1,250
Idaho	$1,600	$1,350	$1,120
Michigan	$1,600	$1,400	$1,180
Minnesota	$1,500	$1,200	$1,050
New York	$1,750	$1,450	$1,040
Ohio	$1,450	$1,100	$1,000
Pennsylvannia	$1,440	$1,400	$1,050
Texas	$1,600	$1,450	$1,300
Virginia	$1,370	$1,120	$970
Wisconsin	$1,470	$1,180	$1,120
United States	**$1,520**	**$1,230**	**$1,140**

Source: USDA NASS Ag Prices Report, March 28.2019, p. 21
https://downloads.usda.library.cornell.edu/usda-esmis/files/c821gj76b/f7623m42k/k0698f528/agpr0319.pdf, last accessed on 4/20/2019

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Estimating the Cost per Heifer Raised

Assumptions used in the model:

- Newborn heifer value $60
- Birth weight 88 lbs
- Breeding weight 884 lb (57% of mature weight & 51" WH)
- Labor/ hr $15
- Interest 6%
- AI cost/ service $18
- Large dairy using hutches, 100% milk replacer, outdoor housing, and TMR feeding

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Estimated Cost of Raising Heifers

Hutch	Post Wean	Growing	Breeding	Post-breeding	Close-up	Total	Stage
Birth to 2	2 to 4	4 to 10	10.0-15.3	15.3-20.9	20.9-22.9	22.8	Age in months
3.50%	1.75%	1.00%	0.50%	0.30%	0.25%	7.30%	Mortality
0.0%	0.0%	0.0%	0.0%	7.0%	0.0%	6.5%	Culled (sold)
$16						16	Colostrum*
$164						164	Milk*
$22						22	Starter*
	$71					71	Grain*
	$5					5	Hay*
		$217	$262	$311	$153	943	Feed (TMR)*
$203	$76	$217	$262	$311	$153	$1,296	Total Feed*
$48	$10	$12	$33	$14	$30	$158	Labor*
$18	$5	$8	$3	$3	$15	$55	Vet Med/ Health*
			$35	($61)		($24)	Breeding & Culls*
$30	$19	$12	$11	$13	$7	$100	Housing and Other*
$2	$3	$16	$24	$34	$14	$97	Interest*
$301	$113	$266	$368	$313	$220	$1,682	Total Cost*
$4.78	$1.92	$1.45	$2.11	$1.83	$3.61	$2.37	Cost/ Day
88	198	325	702	1037	1341		Entering Weight (lb)
198	325	702	1037	1341	1443	1443	Exit Weight (lb)
1.75	2.16	2.06	1.92	1.77	1.68		Average daily gain (lb)
1.75	1.95	2.02	1.98	1.93	1.91	1.91	Cumulative ADG (lb)
							Cumulative from birth
$301	$419	$689	$1,061	$1,457	$1,682	$1,682	Total Cost*
$4.78	$3.44	$2.26	$2.22	$2.24	$2.37	$2.37	Cost/ Day*
$364	$484	$756	$1,130	$1,534	$1,760	$1,760	Cost Including Wet Calf*

* Adjusted for death loss

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Estimated Cost of Raising Heifers

Cumulative Cost by End of Each Stage

Hutch	Post Wean	Growing	Breeding	Post-breeding	Close-up
Birth to 2	2 to 4	4 to 10	10.0-15.3	15.3-20.9	20.9-22.9
$364	$484	$756	$1,130	$1,534	**$1,760**

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For the Next Slide, Will Examine the Cost of Extra Culling during the Raising Period

(over and above mortality and reproductive culling)

- Assumptions:
  - Same baseline assumptions as before
  - Same mortality risk by stage
  - Initial heifer population = 1,000
    - 50 culled after weaning
    - 40 culled after the grower
  - Cull values based on projected body weight at time of culling and published market values for slaughter Holstein heifers (4 sources around the US)

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Culling Loss Estimates

Starting age	0.0	2.1	4.1	10.1	15.3	20.9
Ending Age (mos)	2.1	4.0	10.0	15.2	20.8	22.8
Number of performance culls for stage	0	50	40	0	0	0
Median days to cull for stage	63	14	14	30	60	14
Total Cost for heifer completing stage	$364	$498	$786	$1,164	$1,574	$1,802
Weight of cull (lb)		229	354	760	1143	1364
Beef value ($/lb)		$0.71	$0.77	$0.74	$0.69	$0.90
Beef value ($/head)		$162	$273	$562	$789	$1,200
Cost of raising to point of cull		-$413	-$531	-$854	-$1,301	-$1,608
Loss per heifer culled		**-$251**	**-$258**	**-$291**	**-$513**	**-$408**

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Comparison of Baseline vs. Culling Strategy

Baseline							Culling Strategy					
Hutch	Post Wean	Growing	Breeding	Post-breeding	Close-up	Stage	Hutch	Post Wean	Growing	Breeding	Post-breeding	Close-up
Birth to 2	2 to 4	4 to 10	10.0-15.7	15.7-21.4	21.4-23.4	Age in months	Birth to 2	2 to 4	4 to 10	10.0-15.7	15.7-21.4	21.4-23.4
3.50%	1.75%	1.00%	0.50%	0.30%	0.25%	7.3% Mortality 7.1%	3.50%	1.75%	1.00%	0.50%	0.30%	0.25%
0.0%	0.0%	0.0%	0.0%	7.0%	0.0%	6.5% Culled (sold) 14.9%	0.0%	5.2%	4.5%	0.0%	7.0%	0.0%
$16						Colostrum*	$16					
$164						Milk*	$164					
$22						Starter*	$22					
	$71					Grain*	$0	$72				
	$5					Hay*	$0	$5				
		$217	$262	$311	$153	Feed (TMR)*	$0		$218	$262	$311	$153
$203	$76	$217	$262	$311	$153	Total Feed*	$203	$77	$218	$262	$311	$153
$48	$10	$12	$33	$14	$30	Labor*	$48	$10	$13	$35	$15	$32
$18	$5	$8	$3	$3	$15	Vet Med/ Health*	$18	$5	$9	$3	$3	$15
$0	$0	$0	$35	($61)	$0	Breeding & Culls*	$0	($9)	($13)	$35	($62)	$0
$30	$19	$12	$11	$13	$7	Housing and Other*	$30	$20	$13	$12	$14	$8
$2	$3	$16	$24	$34	$14	Interest*	$2	$4	$17	$24	$35	$15
$301	$113	$266	$368	$313	$220	Total Cost*	$301	$107	$256	$371	$316	$222
$4.78	$1.92	$1.45	$2.11	$1.83	$3.61	Cost/ Day	$4.78	$1.82	$1.40	$2.13	$1.84	$3.65
88	198	325	702	1037	1341	Entering Weight (lbs)	88	198	325	702	1037	1341
198	325	702	1037	1341	1443	Exit Weight (lbs)	198	325	702	1037	1341	1443
1.75	2.16	2.06	1.92	1.77	1.68	Average daily gain (lbs)	1.75	2.16	2.06	1.92	1.77	1.68
1.75	1.95	2.02	1.98	1.93	1.91	Cumulative ADG (lbs)	1.75	1.95	2.02	1.98	1.93	1.91
						Cumulative from birth						
$301	$419	$689	$1,061	$1,457	$1,682	Total Cost*	$301	$430	$711	$1,087	$1,489	$1,715
$4.78	$3.44	$2.26	$2.22	$2.24	$2.37	Cost/ Day*	$4.78	$3.53	$2.34	$2.27	$2.29	$2.41
$364	$484	$756	$1,130	$1,534	$1,760	Cost Including Wet Calf*	$364	$498	$786	$1,164	$1,574	$1,802

Comparison of Baseline vs. Culling Strategy

Baseline

Hutch	Post Wean	Growing	Breeding	Post-breeding	Close-up
Birth to 2	2 to 4	4 to 10	10.0-15.7	15.7-21.4	21.4-23.4
$364	$484	$756	$1,130	$1,534	**$1,760**

Culling Strategy

Hutch	Post Wean	Growing	Breeding	Post-breeding	Close-up
Birth to 2	2 to 4	4 to 10	10.0-15.7	15.7-21.4	21.4-23.4
$364	$498	$786	$1,164	$1,574	**$1,802**

What if I Already Have Too Many Heifers in the Pipeline? (current youngstock plus known pregnancies)

- Options:
  - Do nothing now – current cash flow drain…
    - Sell springers later (hope for higher prices…)
    - Cull more cows (possibly for dairy purposes?)
    - Expand the herd
  - Cull some heifers
    - Which should you cull?
    - When should you cull them?
- Plan to breed more selectively moving forward

Can We Use Data Contained In The Record System To Make Improved Culling Decisions?

- What data are useful predictors?
- What impact does culling some heifers have on the cost of the ones that successfully complete the raising process and calve?
- What is the value of using data during the heifer raising period to cull heifers at high risk for poor first lactation performance?

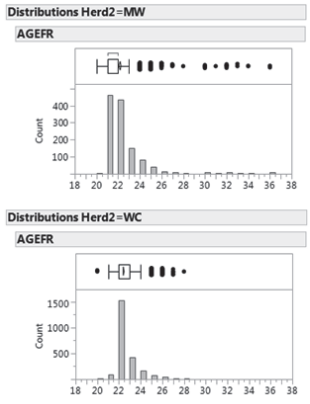
Herd Data Analysis

- Two large dairy herds from two geographically diverse areas of US
- Heifers born during 2013 were evaluated using records from DC305
- Goals:
  - Determine if potential culling candidates can be accurately identified during the heifer rearing process
  - What is the value of using this approach if there are more heifers than needed in the pipeline?

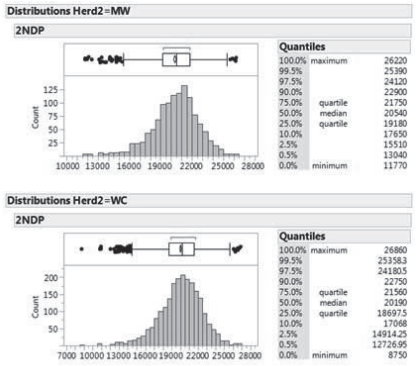
Inclusion Criteria

- Heifers had to have the following information recorded to be included in the project:
  - Current Dairy Gain 2 (CDG2) – daily gain adjusted to a 61-d weaning age
  - Predicted Transmitting Ability – Milk (PTAM)
  - Current Dairy Gain 3 (CDG3) – daily gain adjusted to 91-d of age

Descriptive Information about the Two Herds



Descriptive Information about the Two Herds



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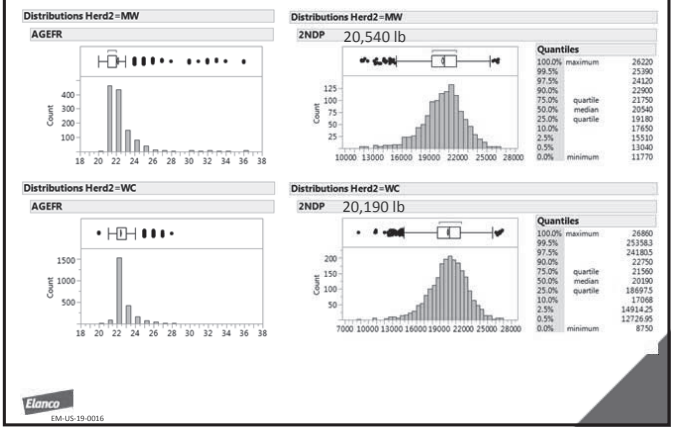
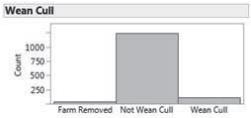


Developed Three Potential Approaches (Models) for Consideration in Selecting the "Wean Culls"

- Original Approach: Select heifers that are below the lower quartile cut points for CDG2 *and* PTAM
- More Selective: Select heifers that are below the lower quartile cut points (CDG2 and PTAM) *and* had Pneumonia recorded by 60 d of age
- Less Selective: Select heifers that are below the lower quartile cut points (CDG2 and PTAM) *or* had Pneumonia recorded by 60 d of age

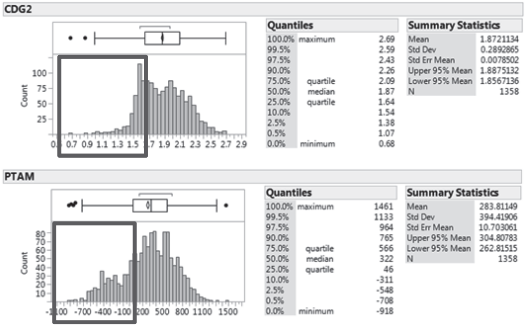
Created Culling Criteria for Post-Weaning Evaluation

- First, eliminated the heifers that died or were sold by the dairy prior to 63 days of age
- Then, if below the lower quartile for both CDG2 (1.64) *and* PTAM (46), identified them as "Wean Cull"

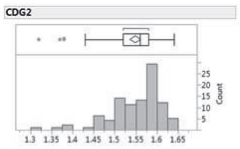


Frequencies		
Level	Count	Prob
Farm Removed	30	0.02209
Not Wean Cull	1229	0.90501
Wean Cull	99	0.07290
Total	1358	1.00000

First Herd: MW



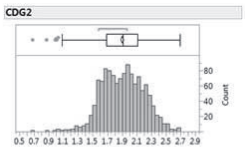
Culled at Weaning



Quantiles		
100.0%	maximum	1.64
99.5%		1.64
97.5%		1.64
90.0%		1.62
75.0%	quartile	1.58
50.0%	median	1.56
25.0%	quartile	1.52
10.0%		1.47
2.5%		1.38
0.5%		1.32
0.0%	minimum	1.32

Summary Statistics	
Mean	1.5491919
Std Dev	0.0601813
Std Err Mean	0.0060484
Upper 95% Mean	1.5611949
Lower 95% Mean	1.537189
N	99

Not Culled at Weaning



Quantiles		
100.0%	maximum	2.69
99.5%		2.60
97.5%		2.44
90.0%		2.27
75.0%	quartile	2.12
50.0%	median	1.91
25.0%	quartile	1.69
10.0%		1.58
2.5%		1.38
0.5%		1.04
0.0%	minimum	0.68

Summary Statistics	
Mean	1.9049634
Std Dev	0.283649
Std Err Mean	0.0080911
Upper 95% Mean	1.9208372
Lower 95% Mean	1.8890896
N	1229

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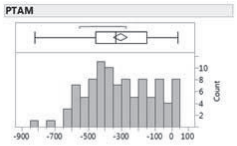
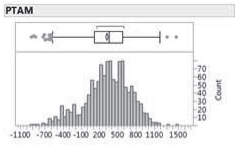
Culled at Weaning



Quantiles		
100.0%	maximum	36
99.5%		36
97.5%		32
90.0%		-12
75.0%	quartile	-149
50.0%	median	-337
25.0%	quartile	-456
10.0%		-553
2.5%		-666
0.5%		-820
0.0%	minimum	-820

Summary Statistics	
Mean	-306.7172
Std Dev	199.28203
Std Err Mean	20.028598
Upper 95% Mean	-266.9711
Lower 95% Mean	-346.4633
N	99

Not Culled at Weaning



Quantiles		
100.0%	maximum	1461
99.5%		1130
97.5%		964
90.0%		778
75.0%	quartile	573
50.0%	median	353
25.0%	quartile	112
10.0%		-220
2.5%		-489
0.5%		-686
0.0%	minimum	-918

Summary Statistics	
Mean	326.77705
Std Dev	367.21187
Std Err Mean	10.47468
Upper 95% Mean	347.32731
Lower 95% Mean	306.2268
N	1229

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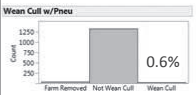
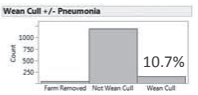
Results of Different Approaches for Selecting "Wean Culls"

	Original Approach	More Selective: Below Cut Points AND Pneumonia by 60 d	Less Selective: Below Cut Points OR Pneumonia by 60 d
Not Wean Cull minus Wean Cull (LS Means)	1249 lb	1421 lb	813 lb
Not Wean Cull minus Full Population (LS Means)	625 lb	711 lb	406 lb

Frequencies			
Level	Count	Prob	
Farm Removed	30	0.02209	
Not Wean Cull	1229	0.90501	
Wean Cull	99	0.07290	
Total	1358	1.00000	



Frequencies			
Level	Count	Prob	
Farm Removed	30	0.02209	
Not Wean Cull	1320	0.97202	
Wean Cull	8	0.00589	
Total	1358	1.00000	



Frequencies			
Level	Count	Prob	
Farm Removed	30	0.02209	
Not Wean Cull	1183	0.87113	
Wean Cull	145	0.10677	
Total	1358	1.00000	

Continued the analysis with the Original Approach

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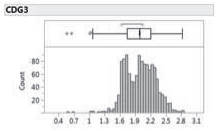
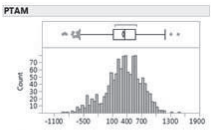
Next, "Removed" the "Wean Cull" Heifers and the Farm-Removed Heifers Prior to 120-d and Re-Evaluated the Performance of the Remaining Heifers at 120 d of Age



Quantiles		
100.0%	maximum	2.82
99.5%		2.70
97.5%		2.52
90.0%		2.35
75.0%	quartile	2.20
50.0%	median	1.99
25.0%	quartile	1.74
10.0%		1.63
2.5%		1.52
0.5%		1.08
0.0%	minimum	0.56

Summary Statistics	
Mean	1.9853621
Std Dev	0.2896054
Std Err Mean	0.008261
Upper 95% Mean	2.0015693
Lower 95% Mean	1.9691549
N	1229



Quantiles		
100.0%	maximum	1461
99.5%		1130
97.5%		964
90.0%		778
75.0%	quartile	573
50.0%	median	353
25.0%	quartile	112
10.0%		-220
2.5%		-489
0.5%		-686
0.0%	minimum	-918

Summary Statistics	
Mean	326.77705
Std Dev	367.21187
Std Err Mean	10.47468
Upper 95% Mean	347.32731
Lower 95% Mean	306.2268
N	1229

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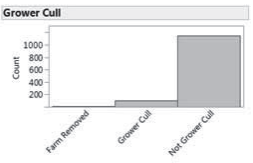
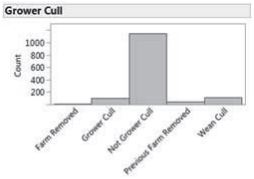
Created Culling Criteria for Grower Evaluation

- If below the lower quartile for CDG3 (1.74) and PTAM (112), identified them as "Grower Cull"



Frequencies		
Level	Count	Prob
Farm Removed	3	0.00244
Grower Cull	91	0.07404
Not Grower Cull	1135	0.92352
Total	1229	1.00000



Frequencies		
Level	Count	Prob
Farm Removed	3	0.00221
Grower Cull	91	0.06701
Not Grower Cull	1135	0.83579
Previous Farm Removed	30	0.02209
Wean Cull	99	0.07290
Total	1358	1.00000

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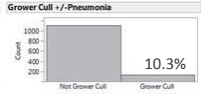
Repeated the Three Different Selective Models as with the Weaning Evaluation

	Original Approach	More Selective: Below Cut Points AND Pneumonia by 120 d	Less Selective: Below Cut Points OR Pneumonia by 120 d
Not Grower Cull minus Grower Cull (LS Means)	561 lb	908 lb	309 lb
Not Grower Cull minus Full Population (LS Means)	281 lb	454 lb	155 lb

Frequencies			
Level	Count	Prob	
Not Grower Cull	1135	0.92577	
Grower Cull	91	0.07423	
Total	1226	1.00000	

Frequencies			
Level	Count	Prob	
Not Grower Cull	1215	0.99103	
Grower Cull	11	0.00897	
Total	1226	1.00000	



Frequencies			
Level	Count	Prob	
Not Grower Cull	1100	0.89723	
Grower Cull	126	0.10277	
Total	1226	1.00000	

Continued the analysis with the Original Approach

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Repeated the Process for Herd WC

Herd Comparisons

CDG2		MW	WC	CDG3		MW	WC
Original Model	% Culled	7.3%	6.9%	Original Model	% Culled	7.4%	3.9%
	Difference	1249 lb	911 lb		Difference	561 lb	1082 lb
	Lift	625 lb	456 lb		Lift	281 lb	541 lb
More Selective	% Culled	0.6%	1.6%	More Selective	% Culled	0.9%	1.0%
	Difference	1421 lb	1280 lb		Difference	908 lb	1136 lb
	Lift	711 lb	640 lb		Lift	454 lb	568 lb
Less Selective	% Culled	10.7%	21.6%	Less Selective	% Culled	10.3%	18.7%
	Difference	813 lb	634 lb		Difference	309 lb	602 lb
	Lift	406 lb	317 lb		Lift	155 lb	300 lb

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Assuming that We Can Predict Which Heifers will be of Lower Value, What is the Impact on the Cost of Raising?

- To examine this question, created three scenarios:
  - Cull selected heifers post-weaning
  - Cull selected heifers post-weaning and post-grower
  - Cull selected heifers post-weaning and at springer stage
- Assumptions used:
  - Housing costs are fixed: i.e., with additional selective culling, cost/remaining heifer for cost of housing increases
  - Labor costs are partially fixed: i.e., with additional selective culling, cost/remaining heifer are treated as 50% fixed, 50% variable based on # of heifers

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Estimated Value Minus Raising Cost for Each Scenario by Herd (using modeled least square means estimates)

Herd MW	Scenario 1: Cull Selected Heifers at Post-Weaning			Scenario 2: Cull Selected Heifers at Post-Weaning and Post-Grower			Scenario 3: Cull Selected Heifers at Post-Weaning and at Springer Stage		
	Baseline	Scenario	Net	Baseline	Scenario	Net	Baseline	Scenario	Net
Total Raising Cost per Heifer Calving	($1,760)	($1,793)	($33)	($1,760)	($1,833)	($73)	($1,760)	($1,840)	($80)
Predicted Value per Heifer Calving	$1,760	$1,934	$174	$1,760	$1,838	$78	$1,760	$1,838	$78
Net Benefit (or Cost) of Scenario			$141			$5			($2)

Herd WC	Scenario 1: Cull Selected Heifers at Post-Weaning			Scenario 2: Cull Selected Heifers at Post-Weaning and Post-Grower			Scenario 3: Cull Selected Heifers at Post-Weaning and at Springer Stage		
	Baseline	Scenario	Net	Baseline	Scenario	Net	Baseline	Scenario	Net
Total Raising Cost per Heifer Calving	($1,760)	($1,793)	($33)	($1,760)	($1,812)	($52)	($1,760)	($1,817)	($57)
Predicted Value per Heifer Calving	$1,760	$1,887	$127	$1,760	$1,911	$151	$1,760	$1,911	$151
Net Benefit (or Cost) of Scenario			$94			$99			$94

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With Good Data and Careful Analyses, Selective Pressure Can Be Applied to Replacement Programs to Improve the Quality of Heifers Calving

- BUT, there MUST be extra heifers for this program to work
  - In these examples, and extra 14.7% or 10.8% of heifers were culled, depending on the herd
  - MUST have good records to make more accurate decisions
- This approach needs to be repeated across herds to validate the process
- Highly unlikely that a single modeling approach will work across all herds
  - Will need to develop customized approaches for each herd

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Summary

- Advancements in dairy breeding and selection have created opportunities and challenges for dairies
- Careful management can promote faster genetic progress and improved cash flow
  - Sexed semen to top animals, beef semen on bottom cows
  - But remember the fertility impacts as well…
- Err on the side of caution in terms of heifer numbers
  - A large excess is costly but not having enough to cull properly might be more costly in the long term
- By using growth performance and genetic information, excess heifers can be culled, leading to better quality heifers at calving (but there are still costs…)
- Finally, strive to reduce the risk of premature loss of value in heifers (and in cows) through improved feeding, housing, and preventive care
  - But, replace animals in a timely manner based on economic decision making

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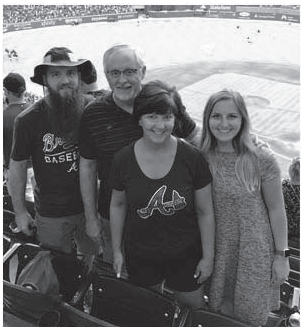
Thanks For Your Attention!



Michael Overton, DVM, MPVM

(706) 248-4664

moverton@elanco.com

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