# Economics of Raising the Right Heifers

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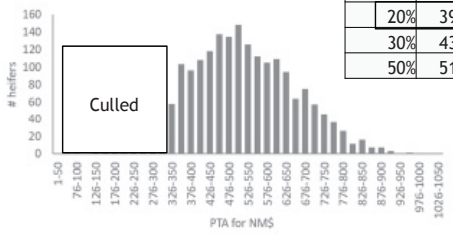
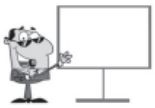
## gPTA Net Merit Dollars for 2000 heifers

| Culled | Min | Average | Gain | StDev |
|---|---|---|---|---|
| 0% | 69 | 512 | 0 | 145 |
| 10% | 318 | 537 | 25 | 126 |
| 20% | 391 | 564 | 52 | 112 |
| 30% | 436 | 585 | 73 | 103 |
| 50% | 510 | 631 | 119 | 88 |




## Overview

1. Culling worst heifers
2. Make more dairy calves than needed? (keep best ones)
3. Keep best dairy calves or crossbred calf premiums?
4. Combining health, growth, genetics to predict first lactation IOFC



## How much is +$52 PTA NM$ worth?

+$52 predicted transmitting ability / life time
= +$104 estimated breeding value / life time (= 3 years)
= +$34 estimated breeding value / year

Keeping the best 80% of heifers increases the genetic level of the herd by $34/cow/year
(but culling, discounting makes final value a little lower)

**Top 50 Net Merit $**

| NAAB Code | Short Name | NM$ | OR | Rel |
|---|---|---|---|---|
| 29HO18960 | ACURA *99-I | 1065 | G | 74 |
| 200HO11500 | MOSALAH | 1056 | G | 73 |
| 551HO03600 | NASHVILLE *99-I | 1051 | G | 75 |
| 29HO18693 | CRIMSON *99-I | 1045 | G | 75 |
| 29HO18868 | DIVERSITY *99-I | 1041 | G | 74 |
| 614HO14226 | ROME *99-I | 1040 | G | 76 |
| 200HO11586 | EINSTEIN | 1040 | G | 73 |
| 29HO17454 | INVICTUS *99-N | 1039 | G | 73 |
| 551HO03800 | DUBAI *99-I | 1036 | G | 74 |
| 29HO18850 | CELTIC *99-I | 1035 | G | 73 |
| 551HO03797 | TAMPA *99-N | 1033 | | |
| 29HO18937 | BUNDLE *99-N | 1032 | | |
| 614HO14453 | ARROWHEAD *99-I | 1031 | | |
| 614HO14065 | SOLUTION *99-I | 1030 | | |
| 29HO18870 | VENTURE *99-I | 1030 | | |
| 551HO03529 | CHARL *99-I | 1029 | | |
| 29HO18906 | BILLY *99-N | 1029 | G | 74 |
| 7HO14703 | HALLMARK *99-N | 1024 | G | 74 |
| 29HO18929 | VALUE *99-N | 1022 | G | 76 |
| 551HO03590 | DEDICATE *99-I | 1017 | G | 77 |

**Top 50 Cheese Merit $**

| NAAB Code | Short Name | CMS | OR | Rel |
|---|---|---|---|---|
| 29HO18960 | ACURA *99-I | 1093 | G | 74 |
| 200HO11500 | MOSALAH | 1085 | G | 73 |
| 551HO03600 | NASHVILLE *99-I | 1096 | G | 75 |
| 200HO11586 | EINSTEIN | 1083 | G | 73 |
| 551HO03800 | DUBAI *99-I | 1081 | G | 74 |
| 29HO17454 | INVICTUS *99-N | 1081 | G | 73 |
| 614HO14226 | ROME *99-I | 1080 | G | 76 |
| 29HO18693 | CRIMSON *99-I | 1080 | G | 75 |
| 29HO18868 | DIVERSITY *99-I | 1079 | G | 74 |
| 29HO18937 | BUNDLE *99-N | 1077 | G | 74 |

**Top 50 TPI**

| NAAB Code | Short Name | TPI | OR |
|---|---|---|---|
| 200HO11586 | EINSTEIN | 2953 | G |
| 551HO03600 | NASHVILLE *99-I | 2932 | G |
| 551HO03800 | DUBAI *99-I | 2927 | G |
| 551HO03797 | TAMPA *99-N | 2919 | G |
| 551HO03812 | IMPERIAL *99-I | 2898 | G |
| 614HO14220 | RIVETING *99-I | 2896 | G |
| 29HO18960 | ACURA *99-I | 2895 | G |
| 200HO11500 | MOSALAH | 2895 | G |
| 200HO11330 | MAESTRO | 2889 | G |
| 551HO03590 | DEDICATE *99-I | 2879 | G |

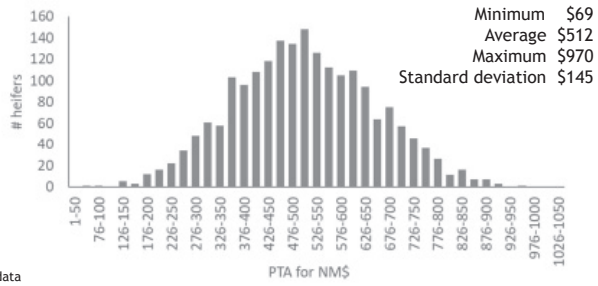
Net Merit $ = Predicted transmitting ability (PTA) of lifetime profit compared to profit of base cow

Hoard's Dairyman Bull List. Genomic Holsteins. April 2019

## Make more dairy heifer calves than needed?

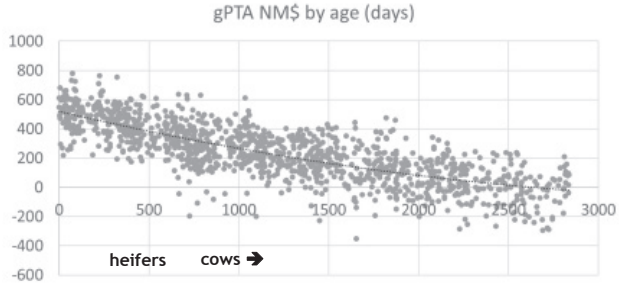
- Use sexed semen
- Higher selection intensity
- Greater selection gain
- Other advantages dairy calves

## gPTA Net Merit Dollars for 2000 heifers



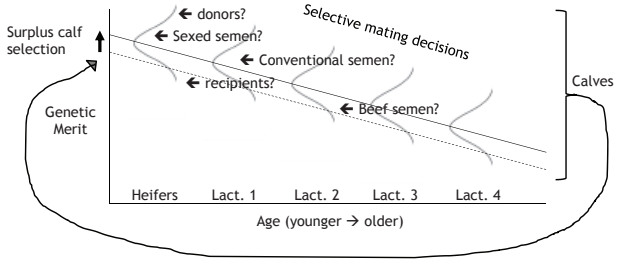

Minimum $69
Average $512
Maximum $970
Standard deviation $145

2013 data



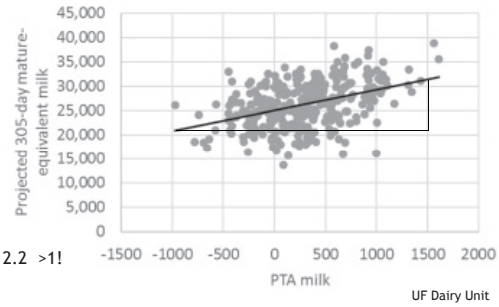

1,247 animals genomic tested at the UF Dairy Unit

## Genetic model




## Response to selection:

**"Traditional" PTA milk of cow vs. phenotype mature equivalent milk of cow**
**Expected response to selection: 1 lb milk / 2 lb PTA = 1**




Observed response to selection =

$$\frac{32{,}000 - 21{,}000}{(1{,}500 - -1{,}000) \times 2} = 2.2 > 1!$$

UF Dairy Unit

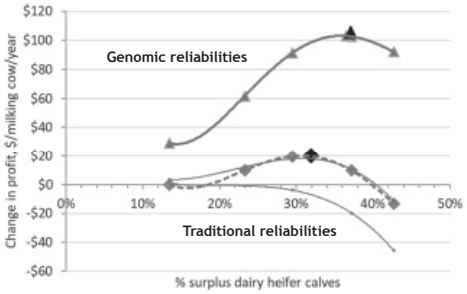
## Herd budget model

Genetics, phenotype, prices, …
1000 milking cows

Bottom line:
Profit per milking cow per year


"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

## Response to selection = 2 x expected




- 35% cull rate

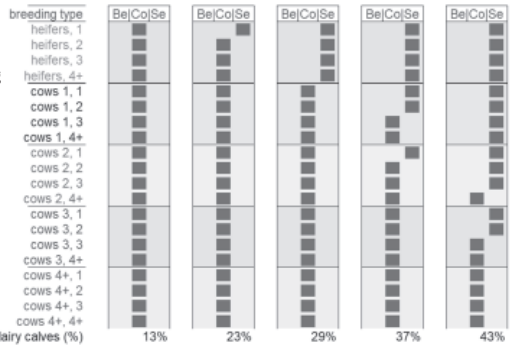
0% → sexed semen use → a lot

0% → sexed semen use → a lot

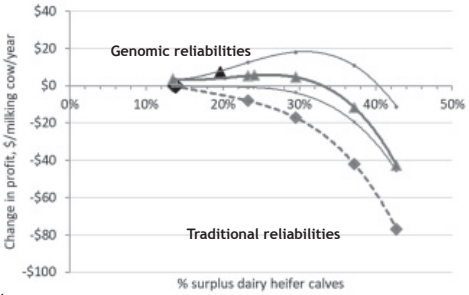
5 breeding policies

No selective mating

35% cow cull rate
Many other inputs
→ surplus calves




## $100 lower dairy calf sale price compared to dairy bull calf

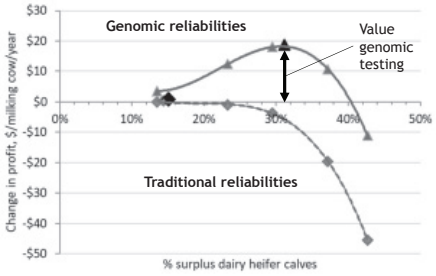



- 35% cull rate

0% → sexed semen use → a lot

## Default = base line inputs

- 35% cull rate
- Vary use of sexed semen
- Complete budget of revenues and costs
- Conclusion: genomic testing pays if willing to make surplus heifers with lots of sexed semen




0% → sexed semen use → a lot

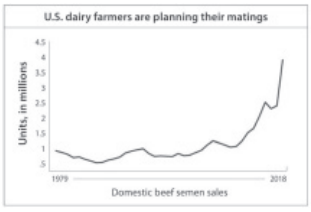
HOARD'S DAIRYMAN INTEL April 29 2019 08:05 AM

15

### Beef-on-dairy semen sales skyrocketed in 2018

BY COREY GEIGER, MANAGING EDITOR

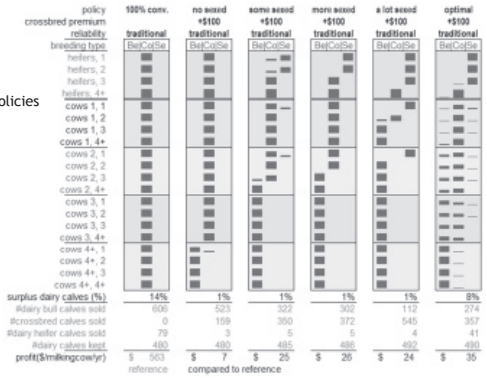
Crossbred premium
or
Dairy heifer calf selection?




https://hoards.com/article-25428-beef-on-dairy-semen-sales-skyrocketed-in-2018.html

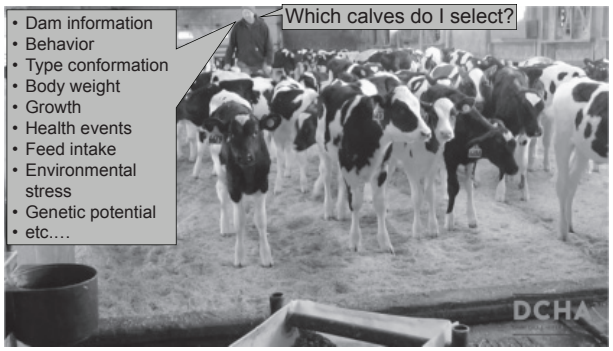
## Scenario A

- 5 user-defined breeding policies
- 1 optimal breeding policy
- +$100 crossbred premium
- No genomic testing
- 35% cow cull rate



| policy | 100% conv. | no sexed +$100 | some sexed +$100 | more sexed +$100 | a lot sexed +$100 | optimal +$100 |
|---|---|---|---|---|---|---|
| crossbred premium | | | | | | |
| reliability | traditional | traditional | traditional | traditional | traditional | traditional |
| breeding type | BeiCoiSe | BeiCoiSe | BeiCoiSe | BeiCoiSe | BeiCoiSe | BeiCoiSe |
| heifers, 1 | | | | | | |
| heifers, 2 | | | | | | |
| heifers, 3 | | | | | | |
| heifers, 4+ | | | | | | |
| cows 1, 1 | | | | | | |
| cows 1, 2 | | | | | | |
| cows 1, 3 | | | | | | |
| cows 1, 4+ | | | | | | |
| cows 2, 1 | | | | | | |
| cows 2, 2 | | | | | | |
| cows 2, 3 | | | | | | |
| cows 2, 4+ | | | | | | |
| cows 3, 1 | | | | | | |
| cows 3, 2 | | | | | | |
| cows 3, 3 | | | | | | |
| cows 3, 4+ | | | | | | |
| cows 4+, 1 | | | | | | |
| cows 4+, 2 | | | | | | |
| cows 4+, 3 | | | | | | |
| cows 4+, 4+ | | | | | | |
| surplus dairy calves (%) | 14% | 1% | 1% | 1% | 1% | 8% |
| #dairy bull calves sold | 606 | 523 | 322 | 302 | 112 | 274 |
| #crossbred calves sold | 0 | 159 | 350 | 372 | 545 | 357 |
| #dairy heifer calves sold | 79 | 3 | 5 | 5 | 4 | 41 |
| #dairy calves kept | 480 | 480 | 485 | 486 | 492 | 490 |
| profit($/milkingcow/yr) | $ 563 reference | $ 7 | $ 25 | $ 26 | $ 24 | $ 35 |

compared to reference




Michael Schmitt, Master's thesis, U of Florida (2019)

## Scenario B

- 1 user-defined breeding policy
- 3 optimal breeding policies
- Increasing crossbred premium
- No genomic testing
- 35% cow cull rate

| crossbred premium | | +$0 | +$100 | +$200 |
|---|---|---|---|---|
| reliability | traditional | traditional | traditional | traditional |
| breeding type | BeiCoiSe | BeiCoiSe | BeiCoiSe | BeiCoiSe |
| heifers, 1 | | | | |
| heifers, 2 | | | | |
| heifers, 3 | | | | |
| heifers, 4+ | | | | |
| cows 1, 1 | | | | |
| cows 1, 2 | | | | |
| cows 1, 3 | | | | |
| cows 1, 4+ | | | | |
| cows 2, 1 | | | | |
| cows 2, 2 | | | | |
| cows 2, 3 | | | | |
| cows 2, 4+ | | | | |
| cows 3, 1 | | | | |
| cows 3, 2 | | | | |
| cows 3, 3 | | | | |
| cows 3, 4+ | | | | |
| cows 4+, 1 | | | | |
| cows 4+, 2 | | | | |
| cows 4+, 3 | | | | |
| cows 4+, 4+ | | | | |
| surplus dairy calves (%) | 14% | 17% | 8% | 0% |
| #dairy bull calves sold | 606 | 442 | 274 | 100 |
| #crossbred calves sold | 0 | 140 | 357 | 558 |
| #dairy heifer calves sold | 79 | 97 | 41 | 0 |
| #dairy calves kept | 480 | 485 | 490 | 494 |

## Questions

- Relative importance of health, growth, genetics on prediction of future milk production.
- How to best combine data sources: linear regression, random forest, gradient boosting
- Does it pay to wait and learn about calves (health, growth) and cull later?


## Scenario B

- 1 user-defined breeding policy
- 3 optimal breeding policies
- Increasing crossbred premium
- No genomic testing
- 35% cow cull rate

| policy | 100% conv. | optimal +$0 | optimal +$100 | optimal +$200 |
|---|---|---|---|---|
| crossbred premium | | | | |
| reliability | traditional | traditional | traditional | traditional |
| breedings type | BeiCoiSe | BeiCoiSe | BeiCoiSe | BeiCoiSe |
| heifers | | | | |
| cows 1 | | | | |
| cows 2 | | | | |
| cows 3 | | | | |
| cows 4+ | | | | |
| surplus dairy calves (%) | 14% | 17% | 8% | 0% |
| operational | $ 420 | $ (15) | $ (26) | $ (42) |
| calf sales | $ 34 | $ (0) | $ 35 | $ 110 |
| Δ kept dairy calf (sire-cow difference) | $ 86 | $ 14 | $ 26 | $ 28 |
| Δ value (due to selection) | $ 22 | $ 8 | $ 0 | $ (10) |
| genomic testing | $ - | $ - | $ - | $ - |
| profit/(milkingcow/yr) | $ 563 reference | $ 7 | $ 35 | $ 87 |

compared to reference

### Calf selection: health growth genetics

- 12,000 calves born on a Florida dairy farm
- Born between 2009 to 2015
- Followed through first lactation
  - Survival and milk production
  - Information value = first lactation marginal milk income minus feed cost (IOFC)
- Data:
  - Health: diarrhea, respiratory, …
  - Growth: birth and weaning weights
  - Genetics: parent average, genomic test
- Combine data methods:
  - Regression, random forests, gradient boosting

## Scenario C

- 1 user-defined breeding policy
- 3 optimal breeding policies
- Increasing crossbred premium
- With genomic testing
- 35% cow cull rate

| policy | 100% conv. | optimal +$0 | optimal +$100 | optimal +$200 |
|---|---|---|---|---|
| crossbred premium | | | | |
| reliability | genomic | genomic | genomic | genomic |
| breedings type | BeiCoiSe | BeiCoiSe | BeiCoiSe | BeiCoiSe |
| heifers | | | | |
| cows 1 | | | | |
| cows 2 | | | | |
| cows 3 | | | | |
| cows 4+ | | | | |
| surplus dairy calves (%) | 14% | 28% | 11% | 9% |
| operational | $ 420 | $ (23) | $ (28) | $ (42) |
| calf sales | $ 34 | $ (1) | $ 32 | $ 92 |
| Δ kept dairy calf (sire-cow difference) | $ 86 | $ 9 | $ 22 | $ 24 |
| Δ value (due to selection) | $ 42 | $ 35 | $ 7 | $ 2 |
| genomic testing | $ (25) | $ (6) | $ 0 | $ 1 |
| profit/(milkingcow/yr) | $ 558 reference | $ 15 | $ 34 | $ 77 |

compared to reference

## Selection time point options: 3 datasets

## Predictor groups

**Phenotype (Pheno)**

| Predictor Variable | Variable Classes | Unit | Day First Available |
|---|---|---|---|
| ET | 2 | Category | Day 0 |
| Weight birth | | Pounds | Day 0 |
| Weight120 | | Pounds | Day 120 |
| Weight380 | | Pounds | Day 380 |
| ADGto120 | | Lbs/day | Day 120 |
| ADG120to380 | | Lbs/day | Day 380 |
| ADGto380 | | Lbs/day | Day 380 |
| RESP | 5 | # treat. | Day 120 |
| DIGT | 5 | # treat. | Day 120 |
| OTITIS | 5 | # treat. | Day 120 |
| OTHER | 5 | # treat. | Day 120 |
| ANY | 5 | # treat. | Day 120 |

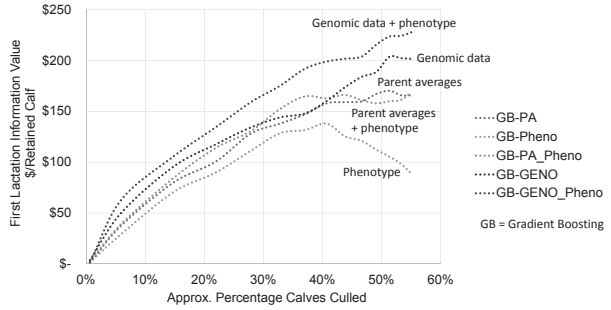
**Parent Average (PA)**

| Predictor Variable | Unit | Day First Available |
|---|---|---|
| Fat.PA | Lbs/lact. | Day 0 |
| Milk.PA | Lbs/lact. | Day 0 |
| NetMerit.PA | Dollars | Day 0 |
| Prot.PA | Lbs/lact. | Day 0 |

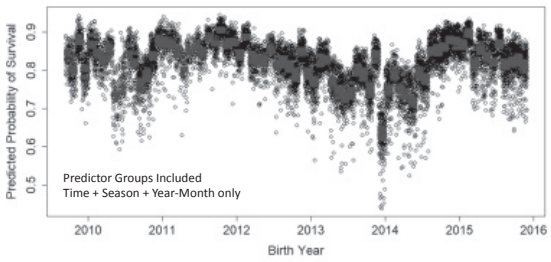
**Genomic (GENO)**

| Predictor Variable | Unit | Day First Available |
|---|---|---|
| BWC.G | Composite | Day 120 |
| CCR.G | Percentage | Day 120 |
| DCE.G | Percentage | Day 120 |
| DPR.G | Percentage | Day 120 |
| DSB.G | Percentage | Day 120 |
| Fat.G | Lbs/lact. | Day 120 |
| FLC.G | Composite | Day 120 |
| HCR.G | Percentage | Day 120 |
| Milk.G | Lbs/lact. | Day 120 |
| NetMerit.G | Dollars | Day 120 |
| PL.G | Months | Day 120 |
| Prot.G | Lbs/lact. | Day 120 |
| PTAT.G | Composite | Day 120 |
| SCE.G | Percentage | Day 120 |
| SCS.G | Log | Day 120 |
| SSB.G | Percentage | Day 120 |
| UDC.G | Composite | Day 120 |
| GnomcInbCo | Percentage | Day 120 |

## First lactation IOFC for selection at day 120

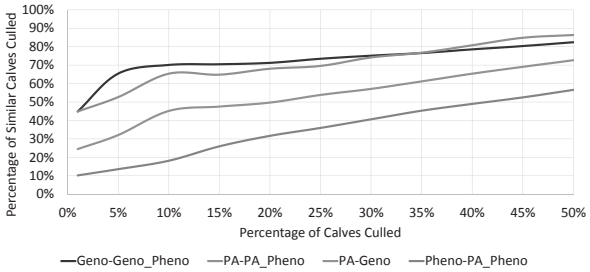



## Survival probabilities to first calving

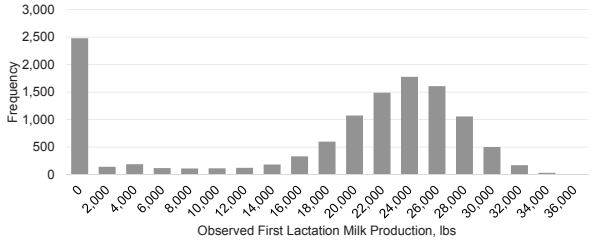



## Different methods of ranking calves: different calves are culled

Day 120 - Gradient Boosting




## Observed first lactation milk production until 305 days in first lactation (all calves)




n = 12,098

## Summary: selection and breeding for heifers

1. Genomic testing is likely profitable when:
   - Make surplus dairy heifer calves (good reproduction, sexed semen)
   - Good response to genetics
2. Best breeding mix:
   - Combination of surplus dairy heifers calves + crossbred calves
   - Simple breeding mix almost as good as optimal breeding mix
3. Genetics data worth more than health and growth data

**Thank you**

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## First lactation IOFC for selection at day 120