USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

# AGIL REPORT 2024

## Milking Speed, Herd-Level Sustainability Metrics & Other AGIL News

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# MILKING SPEED:

## Data Trends, Udder Health, & Preliminary PTAs

**Asha Miles, Robert Fourdraine, Kristen Parker Gaddis, Steven Sievert, Jeffrey Bewley, Sophie Eaglen, Jay Weiker, Jana Hutchison, and Joao Dürr**

U.S. Registered Holsteins FOR MAXIMUM PROFIT
HOLSTEIN ASSOCIATION USA, INC.

NATIONAL DHIA

CDCB
COUNCIL ON DAIRY CATTLE BREEDING

USDA Agricultural Research Service
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NAAB

DRMS
DAIRY RECORDS MANAGEMENT SYSTEMS

# PROPOSED RESEARCH

**OBJ. 1:** Assemble a **high-resolution dataset pertinent to MS** representing different dairy breeds, equipment manufacturers, parlor types, and milking management strategies

**OBJ. 2:** Characterize MS for herds grouped by equipment manufacturer and parlor type and assess the impact of additional **system effects** on the phenotype

**OBJ. 3:** Characterize any **biological effects** that impact MS, especially concerning udder health

**OBJ. 4:** **Standardize** MS trait definition and estimate heritability to determine its suitability for selection

# AVAILABLE DATA

DRMS DAIRY RECORDS MANAGEMENT SYSTEMS

## Demographics

~300 herds
>230,000 cows
>300,000 lactations
>40 million observations

31 States
6+ Breeds
11 OEMs

| | |
|---|---|
| DeLaval | 80 |
| GEA | 75 |
| Lely | 47 |
| Boumatic | 46 |
| AfiMilk | 45 |
| SCR | 13 |
| DairyMaster | 10 |
| AIC Waikato | 5 |
| AMS Galaxy | 3 |
| Jantec | 2 |
| Universal | 2 |

*Special thanks to Robert Fourdraine & John Clay*

# PRELIMINARY PTAS

## Different Trait Definitions

1. **Average MS (lbs/min) over all available data**
   a) ***Fixed effects: breed, parity, lactation length, OEM***
   b) ***n = 20,000 cows with complete lactations (1 year)***

**PRELIMINARY RESULTS**

$h^2 = 0.37$

**Genetic Correlations**

| | |
|---|---|
| SCS | 0.39 |
| Milk Yield | 0.14 |
| NM$ | 0.08 |

| | |
|---|---|
| Mean REL | 0.67 |

*Special thanks to Paul VanRaden and Sajjad Toghiani for their contributions to this research*

# PRELIMINARY PTAS

## Different Trait Definitions

1. **Average MS (lbs/min) over all available data**
   a) ***Fixed effects: breed, parity, lactation length, OEM***
   b) ***n = 20,000 cows with complete lactations (1 year)***

2. Average MS (lbs/min) from test-days only
3. Primiparous cows only



***A hypothetical 3X cow would have 3 * 305 = 915 phenotype records***

# PRELIMINARY PTAS

## Different Trait Definitions

1. Average MS (lbs/min) over all available data
   a) *Fixed effects: breed, parity, lactation length, OEM*
   b) *n = 20,000 cows with complete lactations (1 year)*
2. **Average MS (lbs/min) from test-days only**
3. Primiparous cows only

***A hypothetical 3X cow would have 3 * 10 = 30 phenotype records***

***(97% reduction in data!)***

# PRELIMINARY PTAS

## Different Trait Definitions

1. Average MS (lbs/min) over all available data
   a) *Fixed effects: breed, parity, lactation length, OEM*
   b) *n = 20,000 cows with complete lactations (1 year)*
2. **Average MS (lbs/min) from test-days only**
3. Primiparous cows only



**PRELIMINARY RESULTS**

**$h^2$ = 0.28**

**Genetic Correlations**

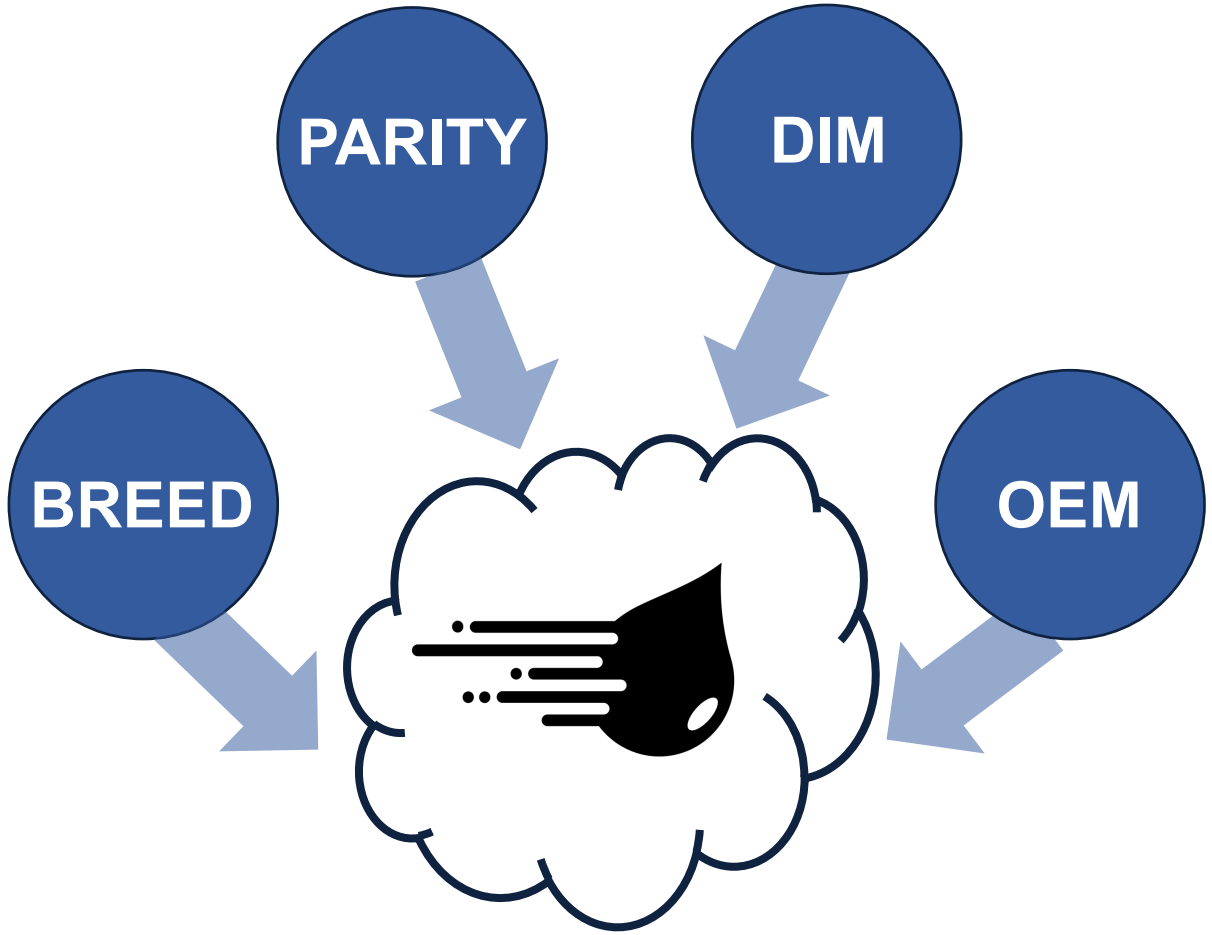
| | |
|---|---|
| **SCS** | **0.43** |
| **Milk Yield** | **0.16** |
| **NM$** | **0.06** |

**Mean REL** **0.64**

# PRELIMINARY PTAS

## Genetic Correlations (upper diagonal)
## Phenotypic Correlations (lower diagonal)

| | Avg_all | Avg_TD | Avg_all_P1 | Avg_TD_P1 |
|---|---|---|---|---|
| Avg_all | | 0.968 | 0.916 | 0.976 |
| Avg_TD | 0.821 | | 0.944 | 0.991 |
| Avg_all_P1 | 1.000 | 0.819 | | 0.924 |
| Avg_TD_P1 | 0.820 | 1.000 | 0.819 | |




**Many factors influence quantitative MSPD measurements**

# THE BOTTOM LINE

- Genetic and genomic prediction methodology for milking speed has been developed
- We are targeting delivery of a new trait in December 2024
- Routine data flow is a key hurdle; a new Format has been proposed and will be discussed at the DRPC meeting in May

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# HERD SUSTAINABILITY METRICS

## Proof of Concept & Discussion

Kristen Parker Gaddis, Asha Miles, Robert Fourdraine

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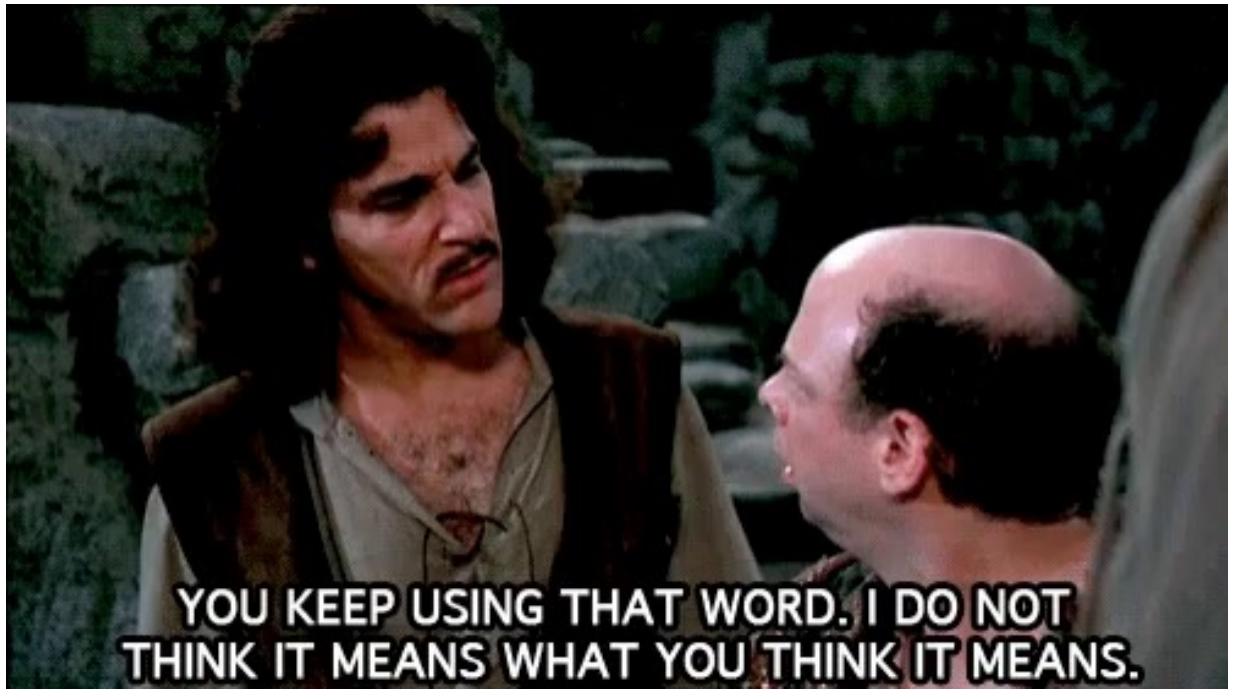
DRMS
DAIRY RECORDS MANAGEMENT SYSTEMS

# WHAT IS SUSTAINABILITY?

> "the ability to be **maintained** at a certain rate or level"
>
> *-Oxford Languages*




***The Princess Bride (1987)***

# WHAT IS SUSTAINABILITY?

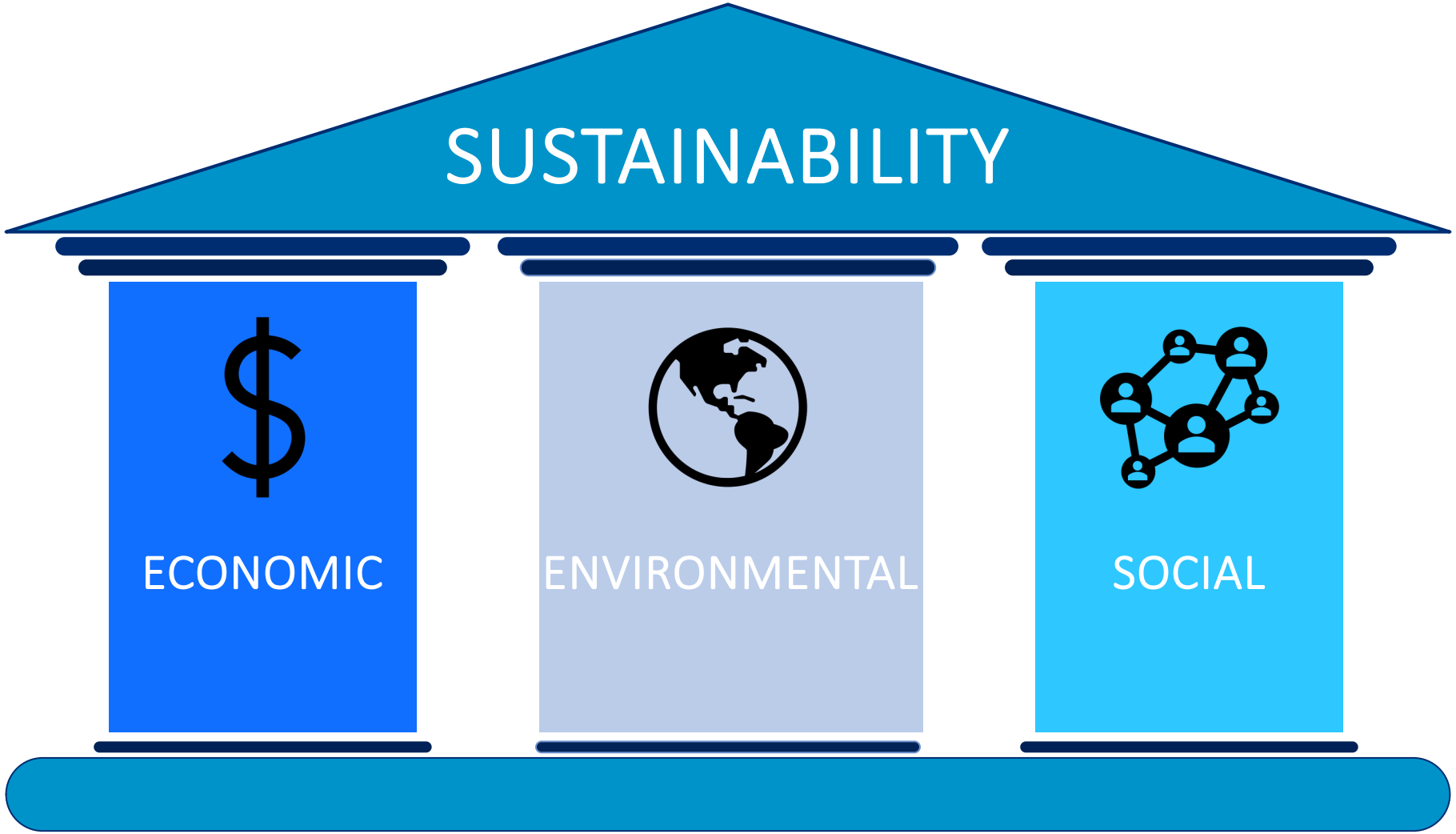
## Farm Bill

[Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA), Public Law 101-624, Title XVI, Subtitle A, Section 1603 (Government Printing Office, Washington, DC, 1990) NAL Call # KF1692.A31 1990]

"**sustainable agriculture** [is] an integrated system of plant and animal production practices… that will, over the long term:

- Satisfy **human** food and fiber needs;
- Enhance **environmental quality** and the **natural resource** base upon which the agricultural **economy** depends;
- Make the most efficient use of **nonrenewable resources** and on-farm resources and integrate, where appropriate, **natural biological cycles** and controls;
- Sustain the **economic viability** of farm operations; and
- Enhance the quality of life for **farmers** and **society** as a whole"

# WHAT IS SUSTAINABILITY?

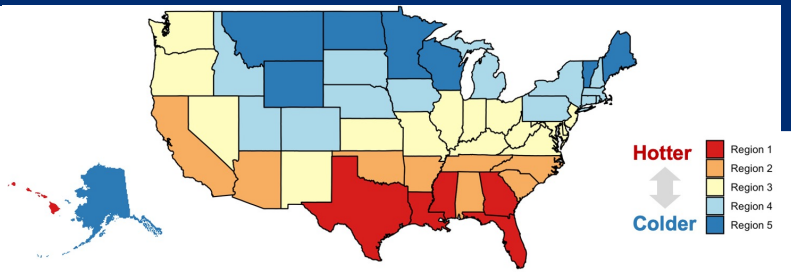


# PROOF OF CONCEPT

## Preliminary Data from All 4 DRPCs

| ICAR SUSTAINABILITY TASK FORCE TRAIT CATEGORIES | | | | |
|---|---|---|---|---|
| FEEDING & PRODUCTION | FERTILITY | HEALTH | LONGEVITY | YOUNG STOCK |
| **AVG DIM** | **AVG CALVING INTERVAL** | **AVG SCC** | **AVG CULLING AGE** | **AVG AGE FIRST CALVING** |
| **N = 10,003** | **N = 9,905** | **N = 9,830** | **N = 10,041** | **N = 10,095** |

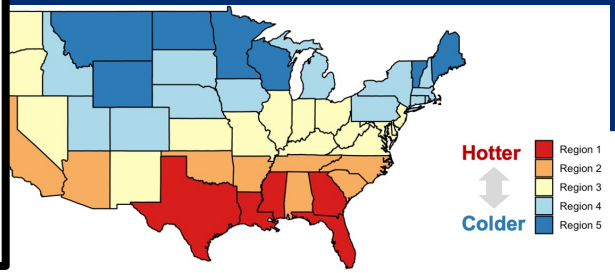
**S** < 250
**M** 250 – 999
**L** 1000+



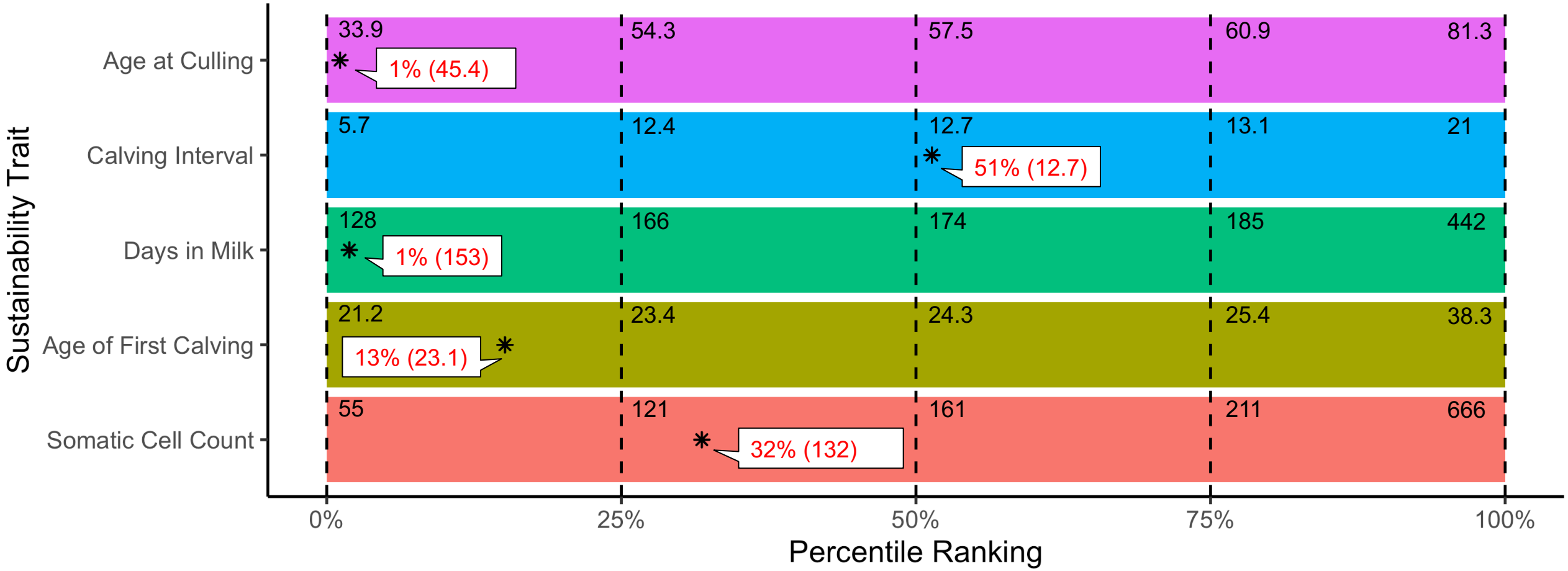

# HERD DEMOGRAPHICS

| | R1 | | | R2 | | | R3 | | | R4 | | | R5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | M | L | S | M | L | S | M | L | S | M | L | S | M | L |
| AY | | | | | | | 7 | | | 22 | | | 14 | | |
| BS | | | | 4 | | | 30 | | | 23 | 3 | | 33 | 4 | |
| DL | | | | | | | | | | 2 | | | | | |
| FL | | | | | | | | | | | | | 1 | 2 | |
| GU | 1 | | | | | | 7 | | | 17 | 1 | | 26 | 2 | |
| HO | 46 | 34 | 19 | 61 | 68 | 206 | 900 | 193 | 55 | 3248 | **443** | 213 | 1938 | 629 | 165 |
| JE | 6 | 2 | 3 | 28 | 18 | 34 | 108 | 18 | 3 | 131 | 18 | 7 | 105 | 15 | 4 |
| MS | | | | 1 | | | 1 | | | 2 | | | 4 | | |
| WW | | | | | | | | | | | | | 3 | | |
| XB | | | | | | | 1 | | | | | | | | |
| XD | | | | | | 4 | | | | 1 | | | 1 | | |
| XX | 20 | 17 | 14 | 34 | 8 | 24 | 208 | 26 | 11 | 407 | 51 | 18 | 302 | 41 | 11 |

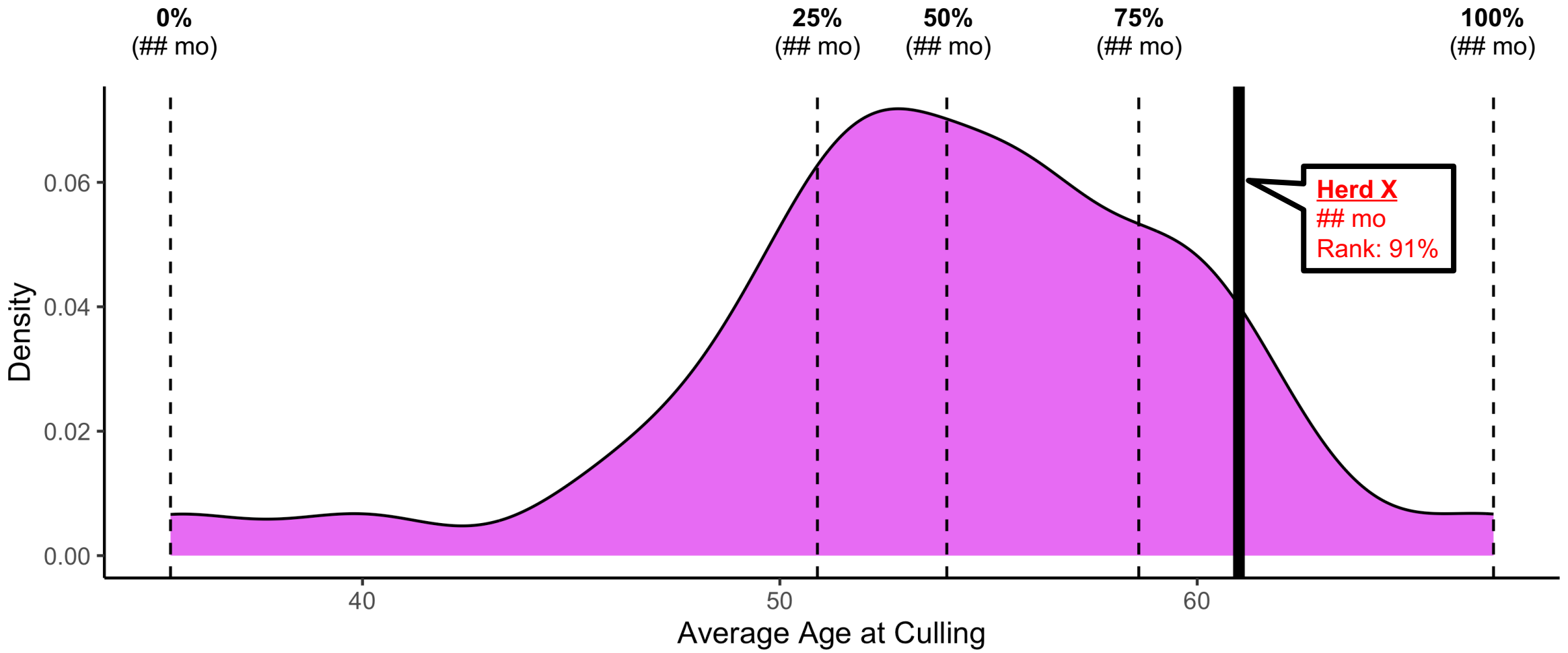
**Example Herd:**
**Holstein**
**Medium (250 – 999)**
**Region 4**
**Peer Group = 443 herds**




# EXAMPLE: PERCENTILES



# EXAMPLE: DENSITY PLOTS



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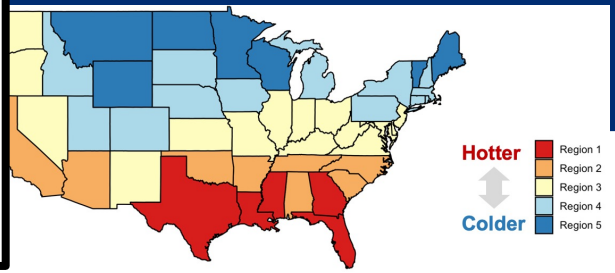
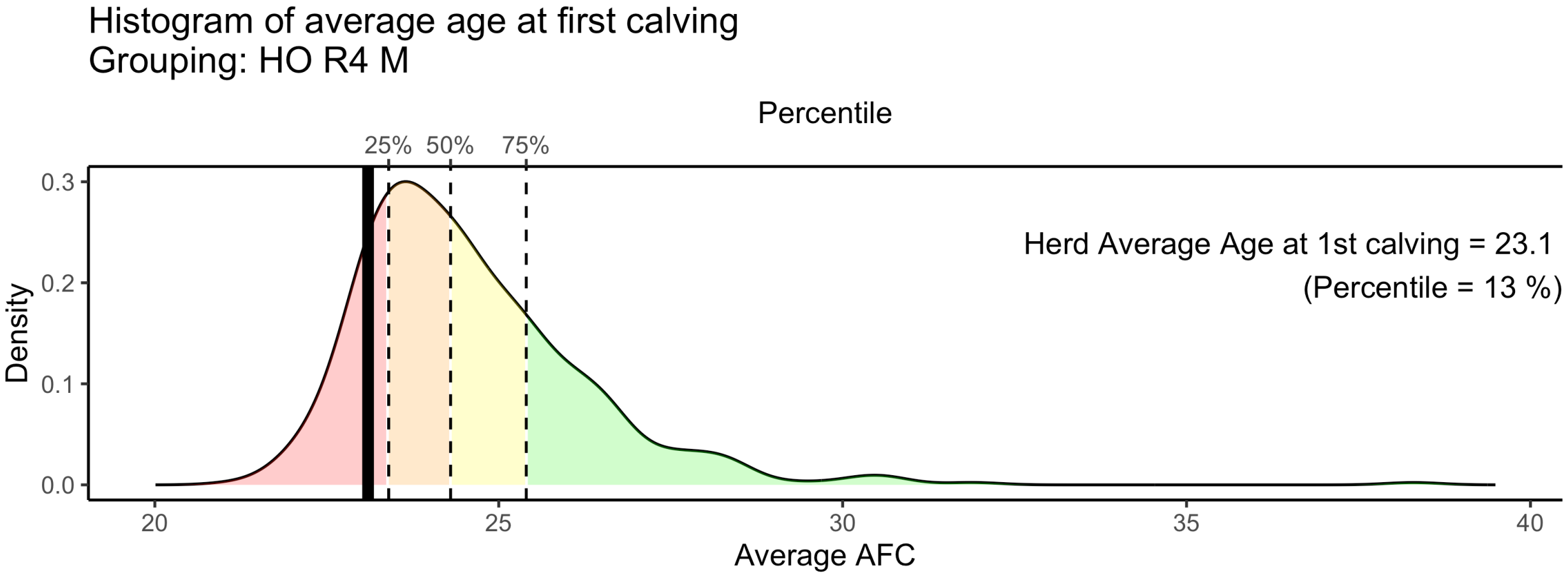



# EXAMPLE: AFC



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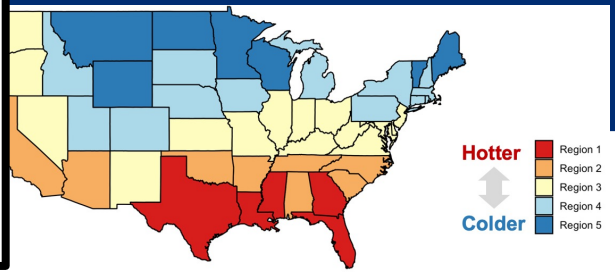
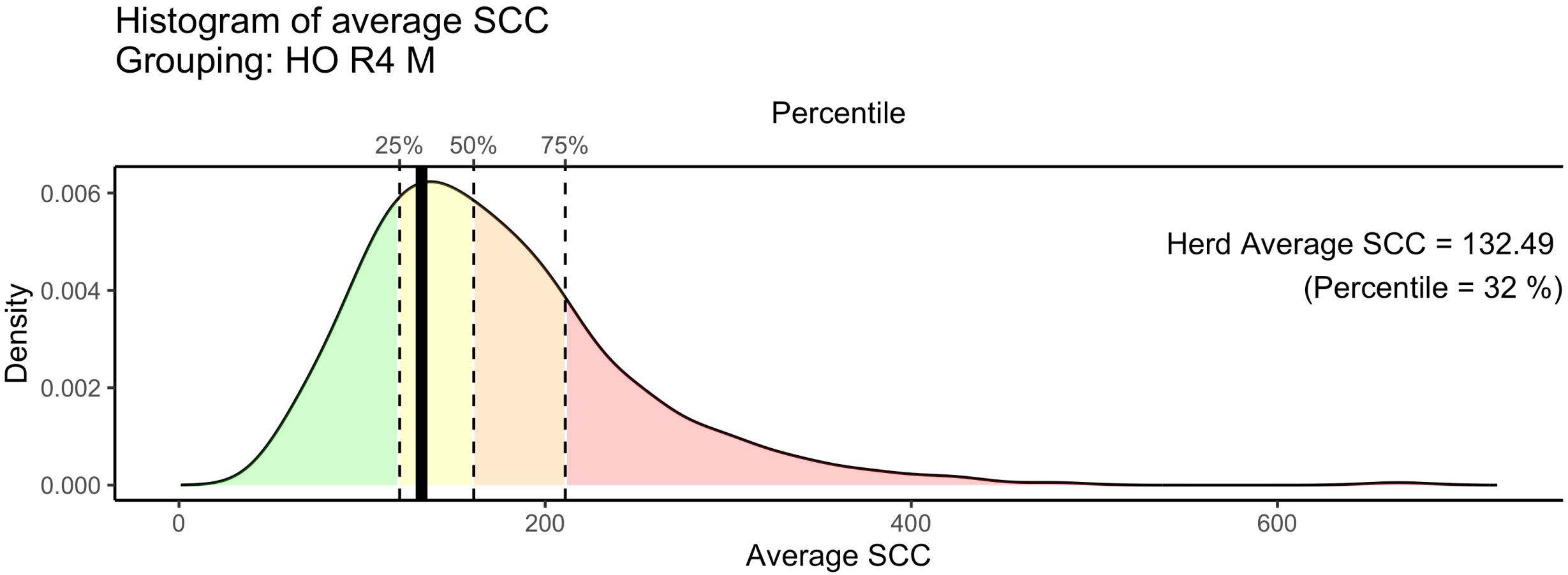



# EXAMPLE: SCC



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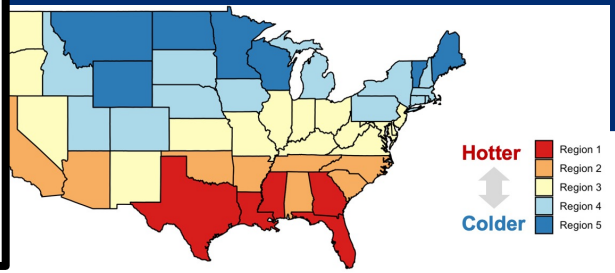
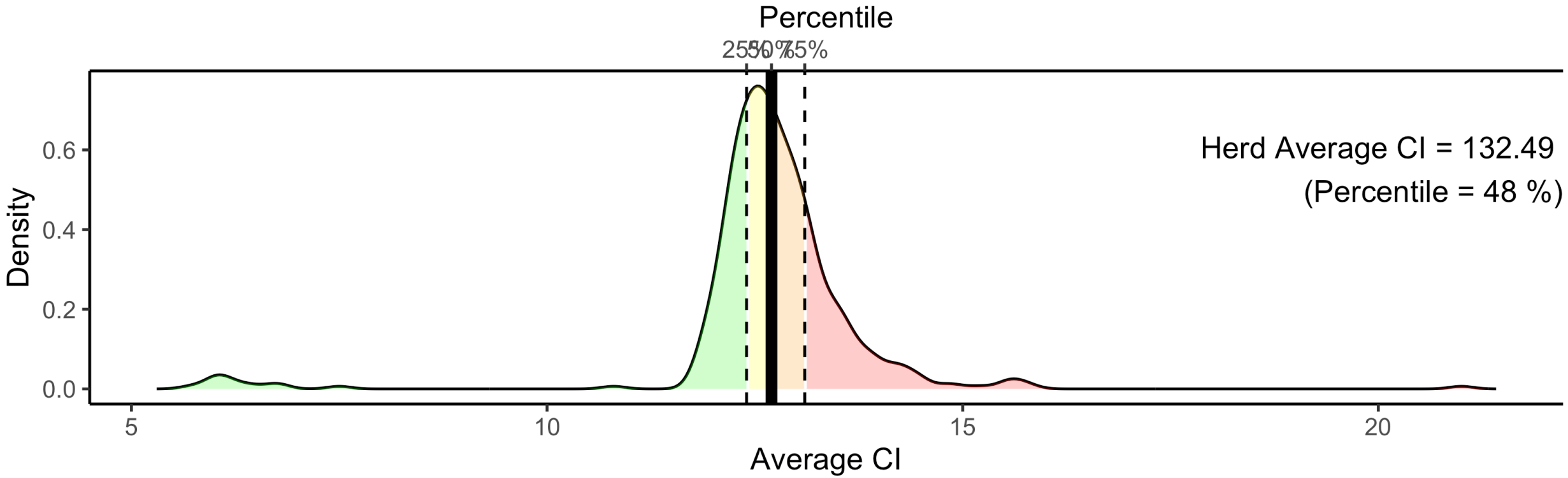
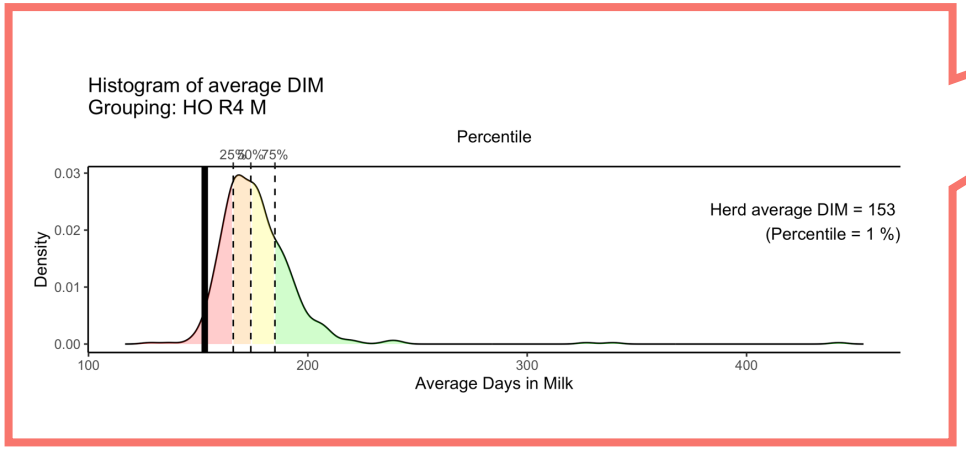



# EXAMPLE: CI

Histogram of average calving interval
Grouping: HO R4 M



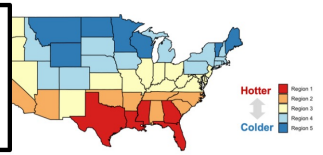
# DESIGN POSSIBILITIES




CLICK TO LEARN MORE

## HERD XXX SUSTAINABILITY REPORT 2024

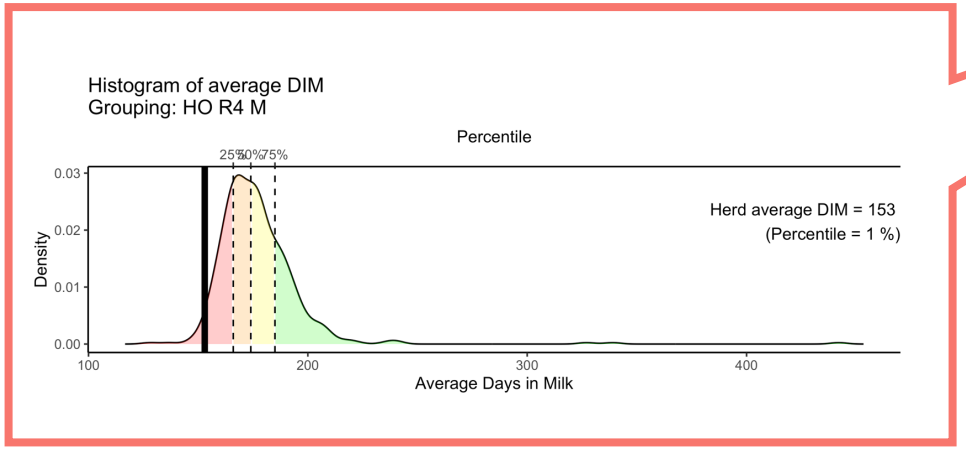
**DEMOGRAPHICS:**
**Holstein**
**Medium Size (250 – 999)**
**Region 4**
**Peer Group = 443 herds**





*some kind of written summary…*

# DESIGN POSSIBILITIES

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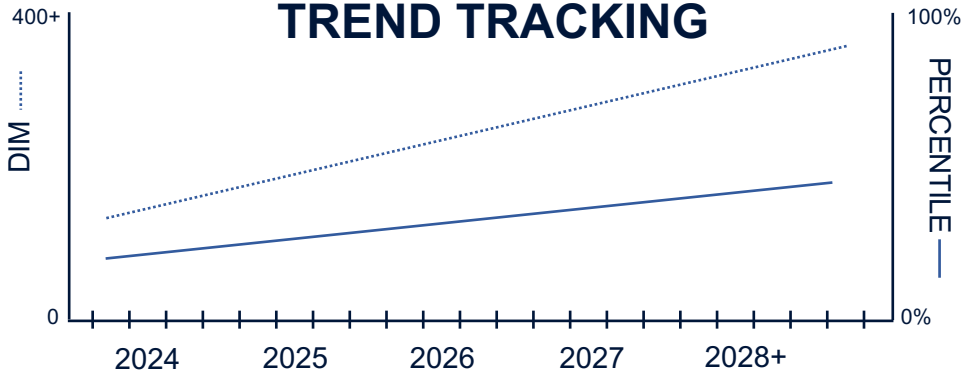
## TREND TRACKING

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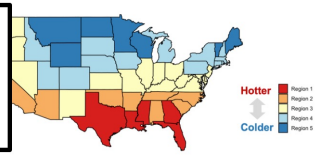



*some kind of written summary…*

One of the last coal-powered sheep.
Most sheep are all electric now.

**Dairy producers need a seat at the table**

# THE BOTTOM LINE

- ICAR has defined 43 traits related to dairy sustainability
- We can leverage DHI data to quantify these traits at the herd level and track progress over time
- These metrics (provided confidentially to each herd) would be a tool that empowers producers to advocate for their operation in sustainability conversations

# WELCOMING NEW TALENT

**Dr. Mahesh Neupane**
Quantitative genetics, genomic selection, functional genomics, cattle & goats

**Dr. Jason Graham**
Quantitative genetics & genomics, crossbred cattle, heat stress, robotic data

**Dr. Bailey Basiel**
Quantitative genetics & genomics, horn fly resistance, beef on dairy

# OTHER ONGOING RESEARCH

- Beef x Dairy
- Heat-Stress GxE
- Methane Emissions
- Heat Stress & Microbiome
- Colostrum Microbiome
- Johnes Disease
- GPTA Validation for Cows
- Hoof Health & Lameness
- Inbreeding & Diversity
- Energy Efficiency & Metabolism
- Single-Step GBLUP
- $F_{ST}$ SNP Selection for Faster Computation

UNIVERSITY OF MINNESOTA

# THANK YOU

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