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University of Wisconsin-Madison

# Identifying the “anonymous” cow

## Calculating resilience indicators in US Holstein cows using pen-level data

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NATIONAL DHIA

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

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COUNCIL ON DAIRY CATTLE BREEDING

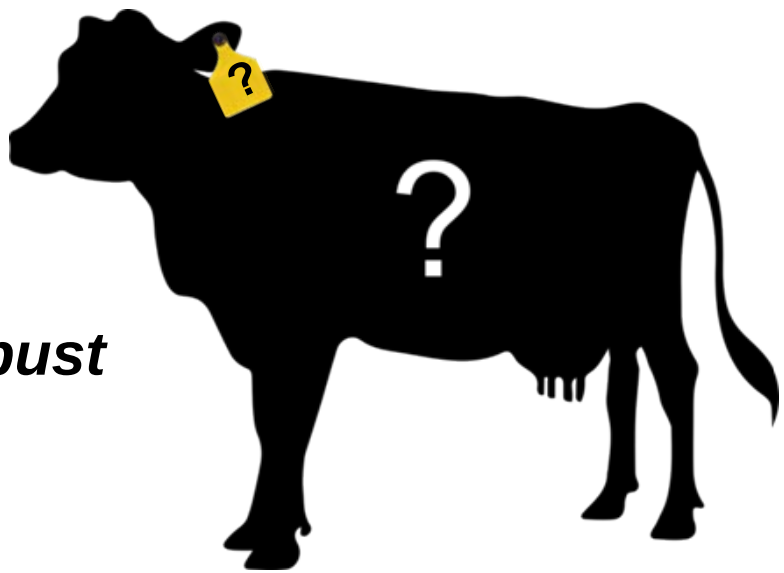
# Outline

1. Calculating consistency indicators
2. Resilience indicators
3. Resilience at the pen level
4. Conclusions

# How do we identify the “anonymous cow”?

***“Resilient”***

***“Labor efficient”***




***“Robust”***

***“Trouble free”***

**Rosy-Lane Shamrock 5489-ET**

*“ Interestingly enough, most of our teammates at the farm failed to notice her during her twelve-year lifespan. How could the queen of our herd go unnoticed? Her life, like that of dozens of other cows at Rosy-Lane, stayed relatively maintenance-free. She produced large quantities of high quality, nutritious milk, while living life like a herd animal - she blended in.”*

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# What is consistency?

"A level of performance that does not vary greatly in quality over time."

# Our Goal:

To achieve predictable performance in unpredictable conditions

Oxford University Press

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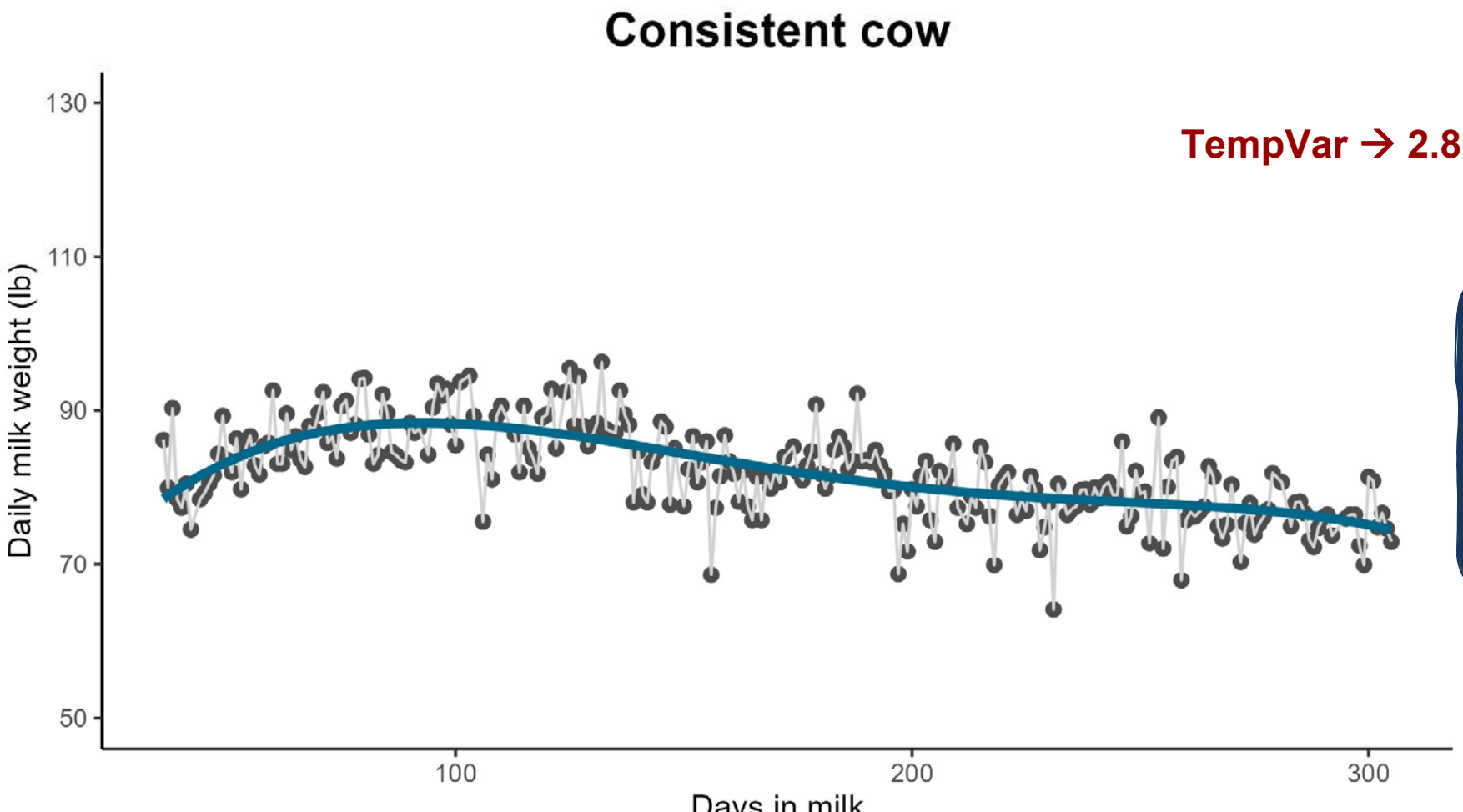
# Data

- **Number of records:**
    - 387 million individual daily milk weights
    - 82 million historical aggregated daily milk weights
    - 35 million test day records
    - 5.1 million health records
    - 3.2 million breeding records
- **Number of herds:** 312 herds in 37 states across the U.S.
- **Number of cows:** 702,861

DRMS
DAIRY RECORDS MANAGEMENT SYSTEMS

# 1. Consistency

Guinan et al., 2023




**TempVar → 2.86**

**TempVar = total variance over a lactation. Less variation = more consistency!**

# 1. Consistency

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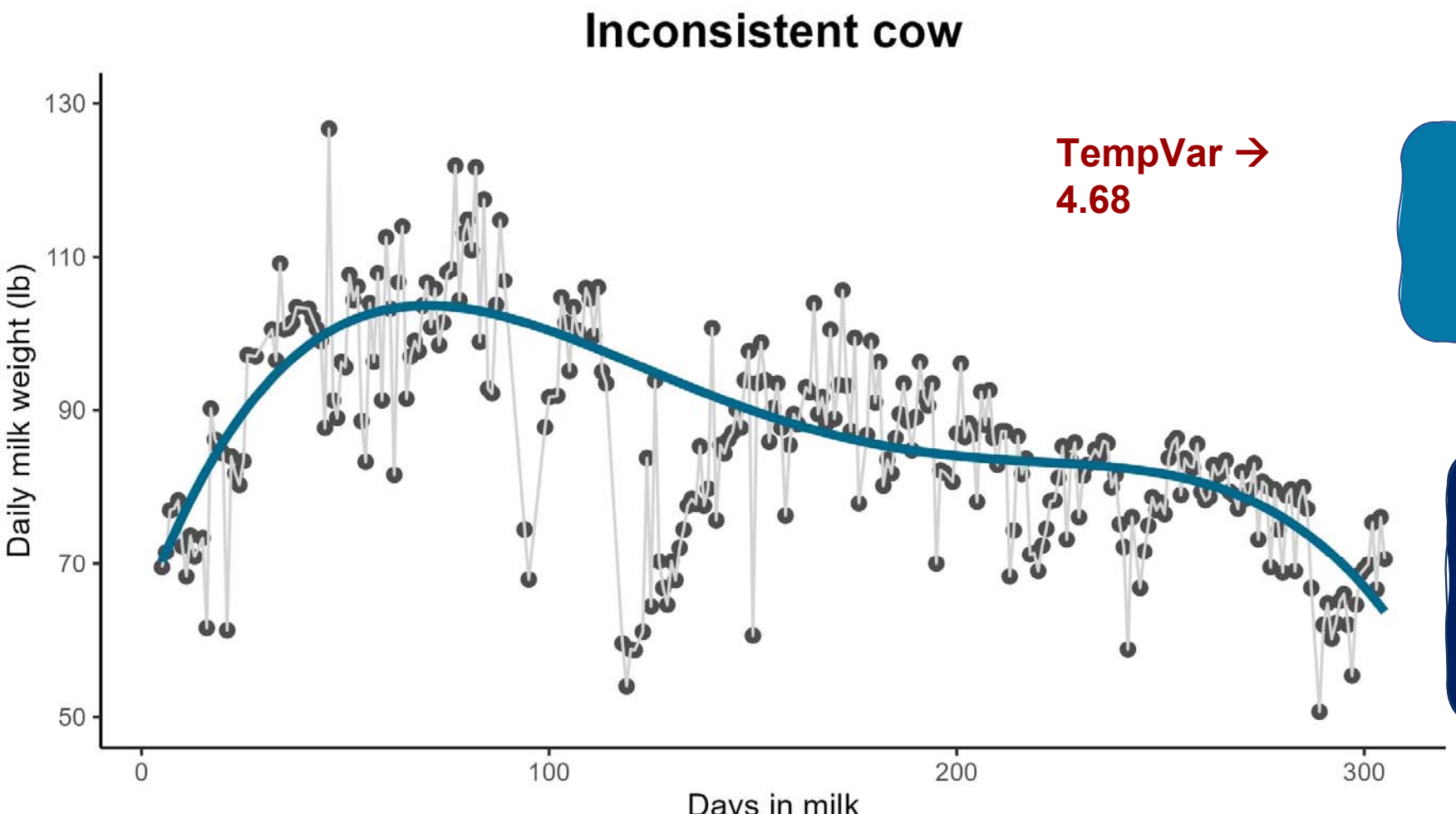
Guinan et al., 2023




**TempVar → 4.68**

**Consistency is heritable!**

$h^2$ = 0.24 (0.01)

**Favorable estimated genetic correlations with health, longevity and fertility traits!**

Guinan et al., 2023

## Take home messages

- Consistent performance is heritable → $h^2 = 0.24$
- Consistent cows → fewer health problems, increased longevity, more labor efficient
- Milk meter data → Extracting value from data routinely generated on farm


*"Trouble free, anonymous cow"*

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# What is resilience?

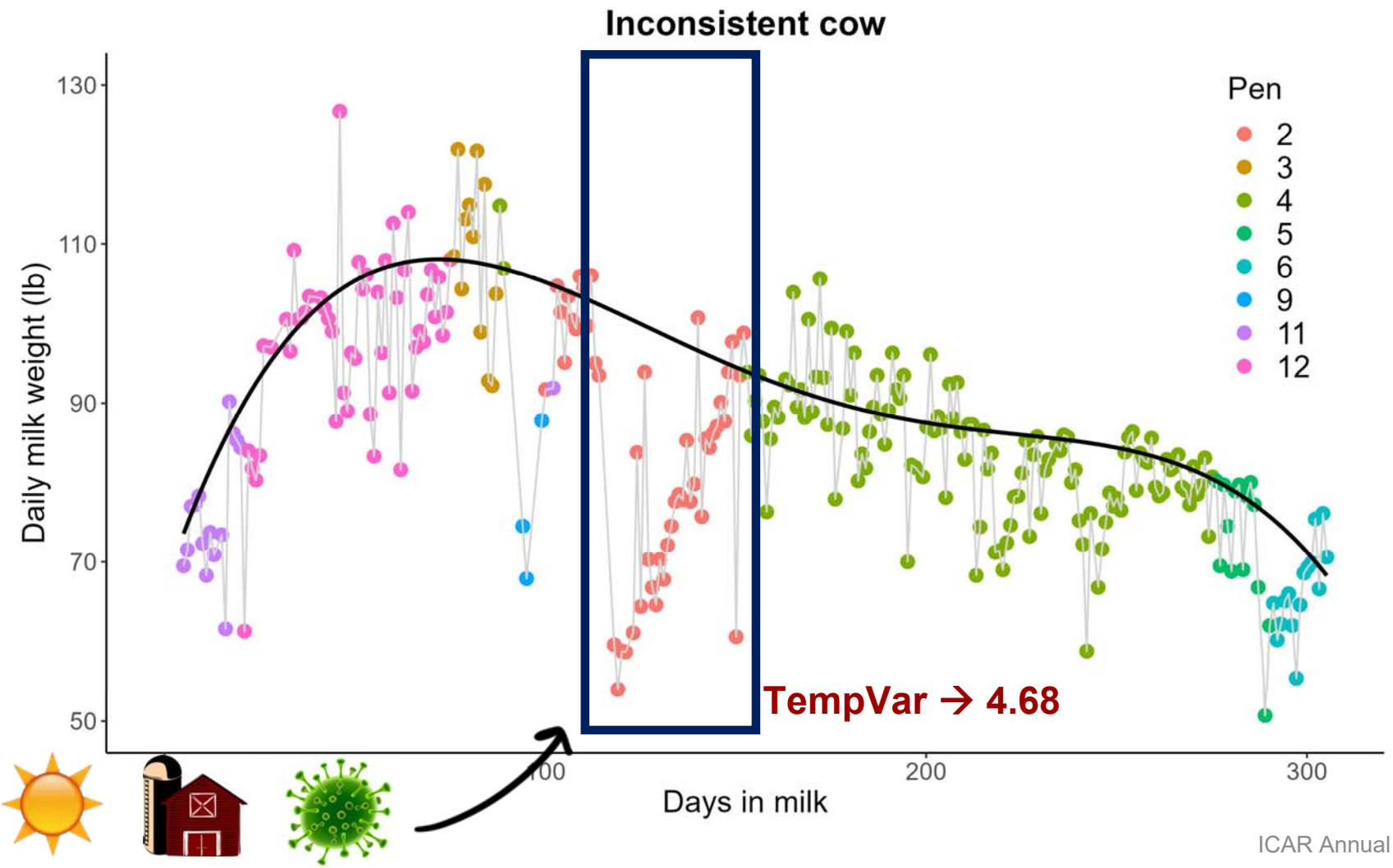
**The capacity to bounce back to normal functioning after a perturbation OR maintain specific functions in the face of change or stress"**

Scheffer et al., 2018

# Our Goal:

**To first identify perturbations and then calculate individual cows' response at the pen level**

# 2. Resilience indicators




- Can group demographics provide additional information for resilience indicators?
- Were all cows in the pen affected by the perturbation (feed, weather, system changes)?
- How are cows moved pens based on changes in production? i.e., sick pen

# 3. Resilience at the pen level

**1. Calculate % cows with negative residuals**

**On a specified milking day within a particular pen of a specific herd, calculate the percentage of cows with a negative residual between observed and expected daily milk weight**

2. Identify Perturbation

Identify periods of 5 consecutive days in a pen where >= 60% of the cows have negative residuals

3. Correct for milk production level

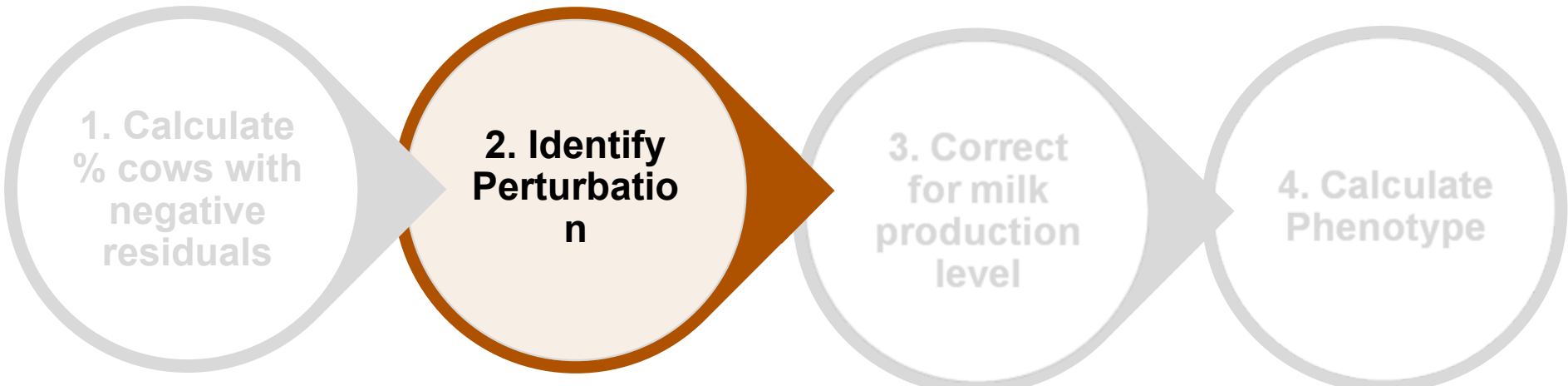
Within herd pen milking date contemporary group, correct the residual milk production by the expected milk production

4. Calculate Phenotype

% Milk Loss

$$\frac{\text{Mean residual milk}}{\text{Mean expected milk}} * 100$$

# 3. Resilience at the pen level




On a specified milking day within a particular pen of a specific herd, calculate the percentage of cows with a negative residual between observed and expected daily milk weight

**Identify periods of 5 consecutive days in a pen where >= 60% of the cows have negative residuals**

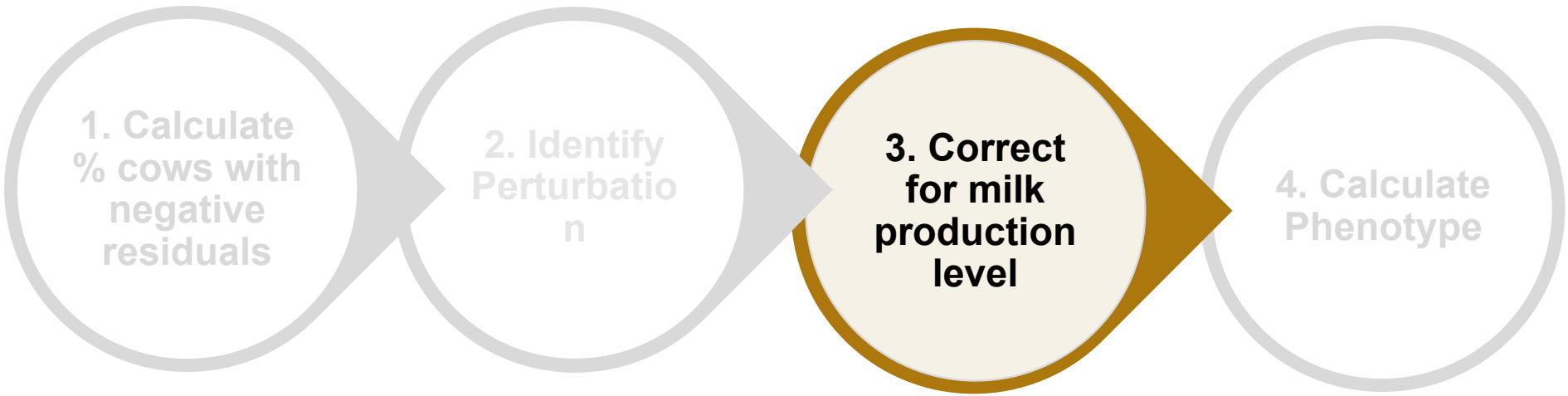
Within herd pen milking date contemporary group, correct the residual milk production by the expected milk production

% Milk Loss

$$\frac{\text{Mean residual milk}}{\text{Mean expected milk}} * 100$$

(Adriaens et al., 2020)

# 3. Resilience at the pen level



# 3. Resilience at the pen level


On a specified milking day within a particular pen of a specific herd, calculate the percentage of cows with a negative residual between observed and expected daily milk weight

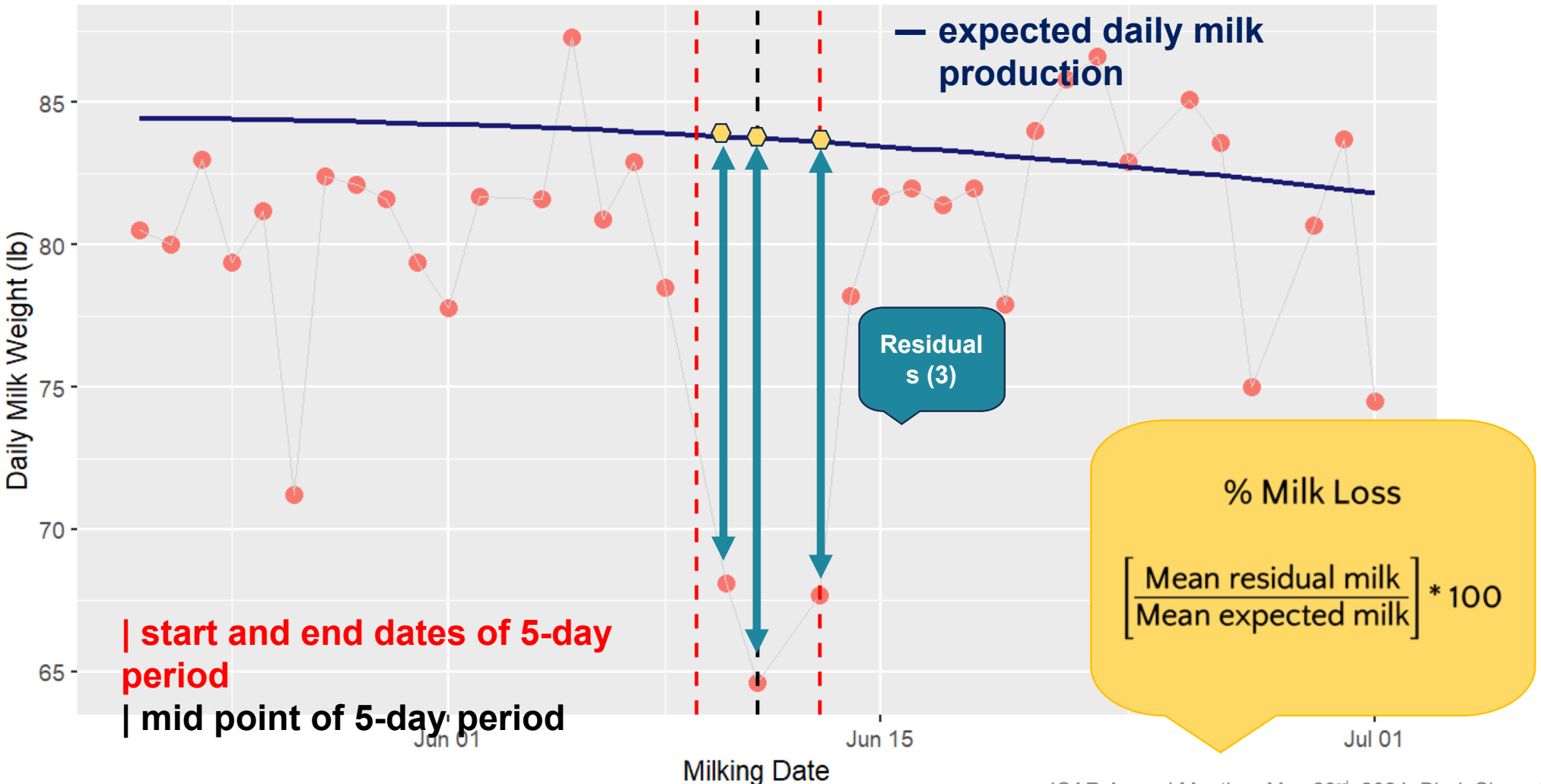
Identify periods of 5 consecutive days in a pen where >= 60% of the cows have negative residuals

Within herd pen milking date contemporary group, correct the residual milk production by the expected milk production

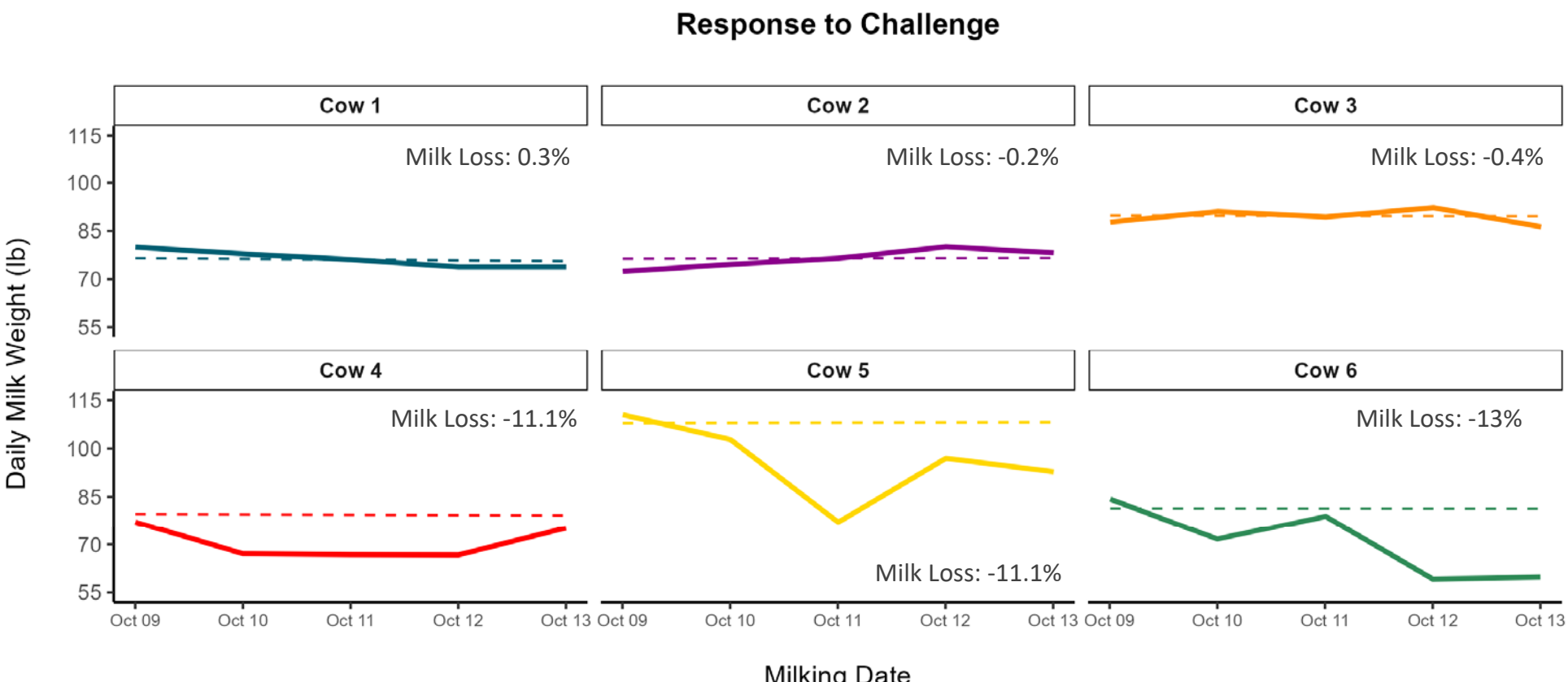
% Milk Loss

$$\left[\frac{\text{Mean residual milk}}{\text{Mean expected milk}}\right] * 100$$

# 3. Resilience at the pen level



# 3. Resilience at the pen level



# 3. Resilience at the pen level

- **Lactation 1 Holstein cows**
- **2018 - 2023**
- **>= 25 cows per herd-pen-milking_date**

**Challenge Level**

**Resilience Expressed**

**% Milk Loss = AFC + DIM + herd-pen-milking date + cow + e**

**cow ~ *N*** (0, $A\sigma_a^2$)

| % residuals negative | Herds (n) | Cows (n) | Herd-pen-milking_date (n) | $\sigma^2_g$ | $\sigma^2_e$ | $h^2$ |
|---|---|---|---|---|---|---|
| 60 | 161 | 81,245 | 1,235 | 0.40 (0.12) | 38.50 (0.22) | 0.01 (0.003) |
| 70 | 129 | 39,240 | 527 | 1.03 (0.27) | 37.73 (0.36) | 0.03 (0.007) |
| 80 | 79 | 14,245 | 170 | 4.26 (0.96) | 37.72 (0.93) | 0.10 (0.02) |
| 90 | 21 | 1,719 | 26 | 23.77 (8.07) | 40.43 (7.13) | 0.37 (0.12) |

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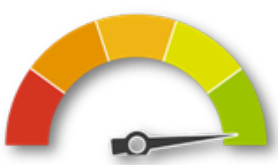
# Take home messages

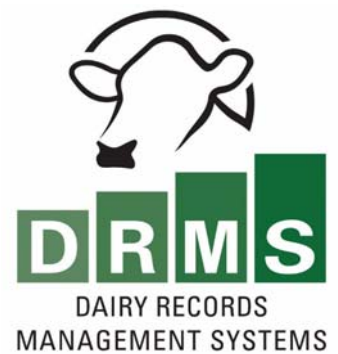
- Resilience is heritable (0.01 – 0.37)
- Cows respond differently to perturbations at the pen level
- Resilience is expressed in challenging conditions

**Challenge Level**



**Resilience Expressed**






**Thank you!**

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