Proxies for resilience and efficiency

using at-market sensor technologies

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WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

GENTORE

Why Resilience (and Efficiency)

Interest in novel traits that improve health & fitness

After World War II increase in (milk) production
Declining health and fertility
Changed public perception with respect to animal production and welfare

Breeding for Resilience (and efficiency) is hampered

Lack of (continuous) phenotypic information

Increased adoption of sensor technologies

High-frequency repeated measurements for individual animals
Used for monitoring or for detecting specific events
Not used for phenotyping complex traits

What data were at hand

Data from Dairy Campus

1,800 cows

5,771 lactations between 1995-2016

(Sensor) Data

Activity and Rumination Activity (SCR tags)

Milk yield (conventional / AMS)

Live-weight at/before milking

Health events and inseminations

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Step 1 Defining Resilience

Computing a Lifetime Resilience Score

500 plus points for each calving

Age at 1st calving compared to herd mean

- 1 plus/minus point for each day difference (1st parity)

Calving interval compared to herd mean

- 1 plus/minus point for each day difference (>1st parity)

Number of inseminations

- 25 minus points for inseminated culled cows (last lactation only)

Number of events

- 1 minus point for each curative treatment day
- 1 minus point for each day culled before 100 DIM

305-day milk yield

- weight 0 (currently lack of reliable data)

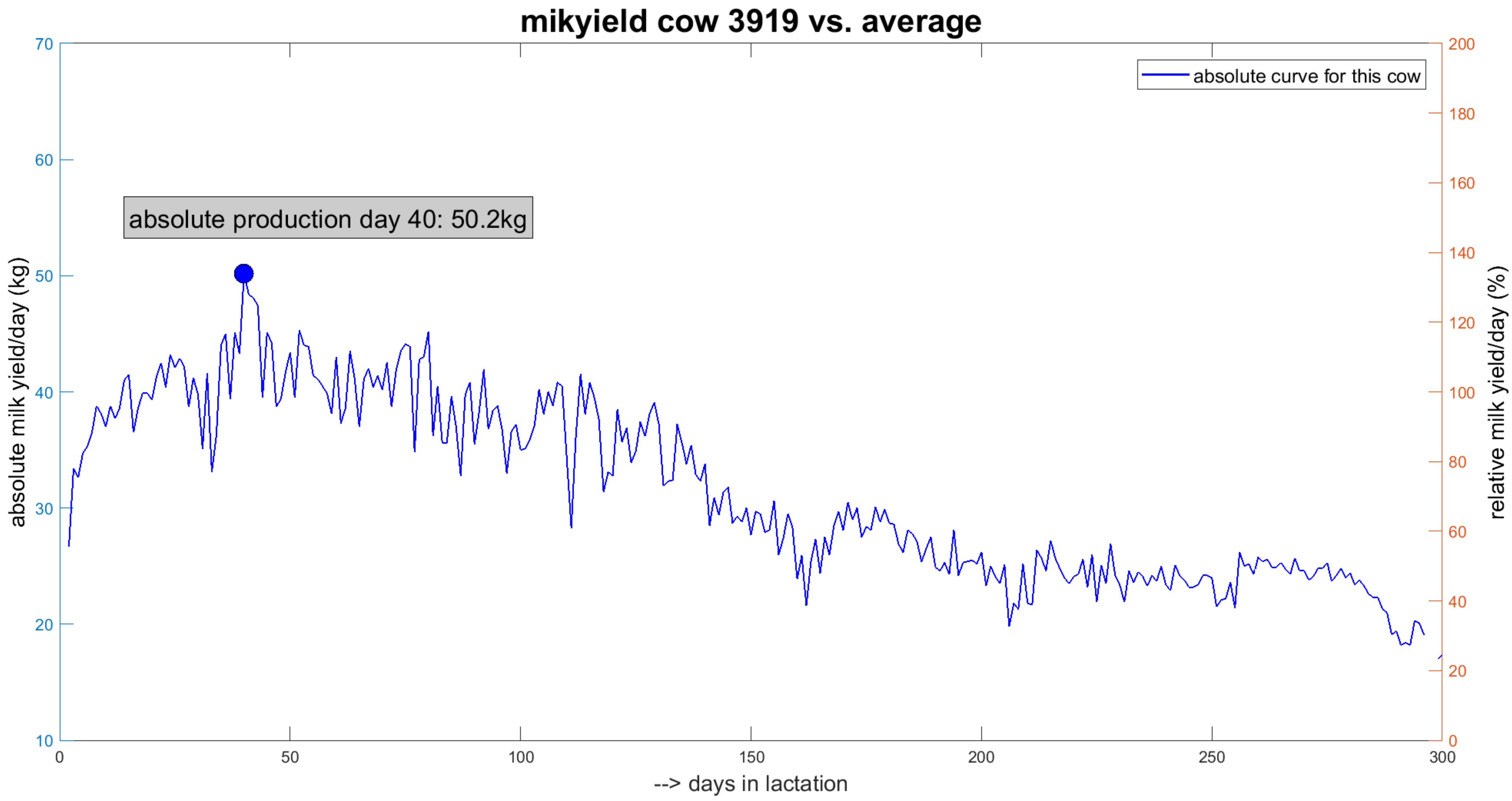
Results Lifetime Resilience scores

1800 cows, 5771 lactations received a score

1518 points on average (31 to 6031 points)

Parity	N	Total Resilience score	lac 1	lac 2	lac 3	lac 4	lac 5
1	315	412	412				
2	387	907	497	410			
3	385	1401	497	495	409		
4	313	1907	497	505	485	421	
5	227	2428	498	510	492	496	432
>=6	173	3266	502	523	508	506	495

Step 2 Defining sensor curve parameters



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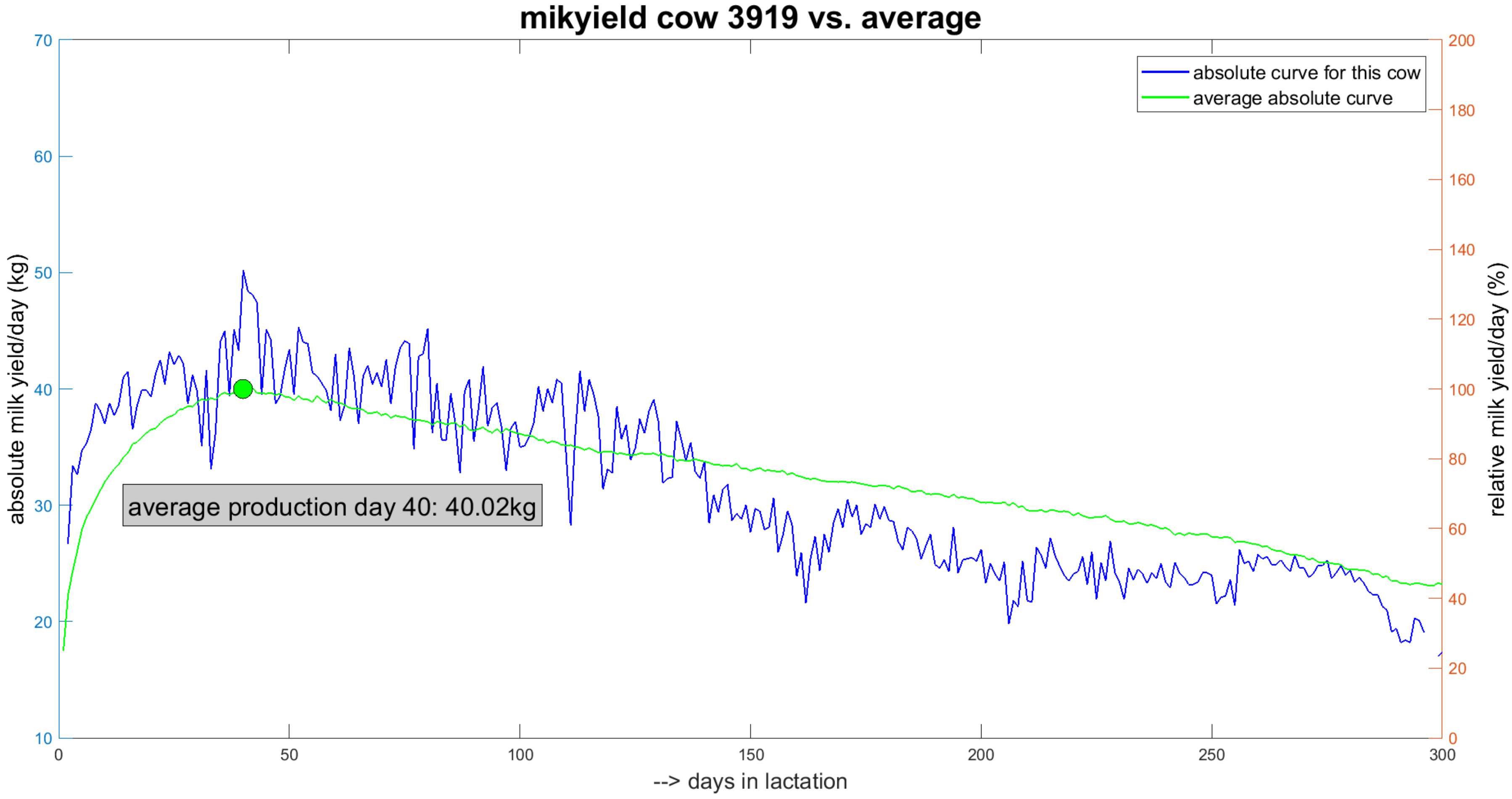

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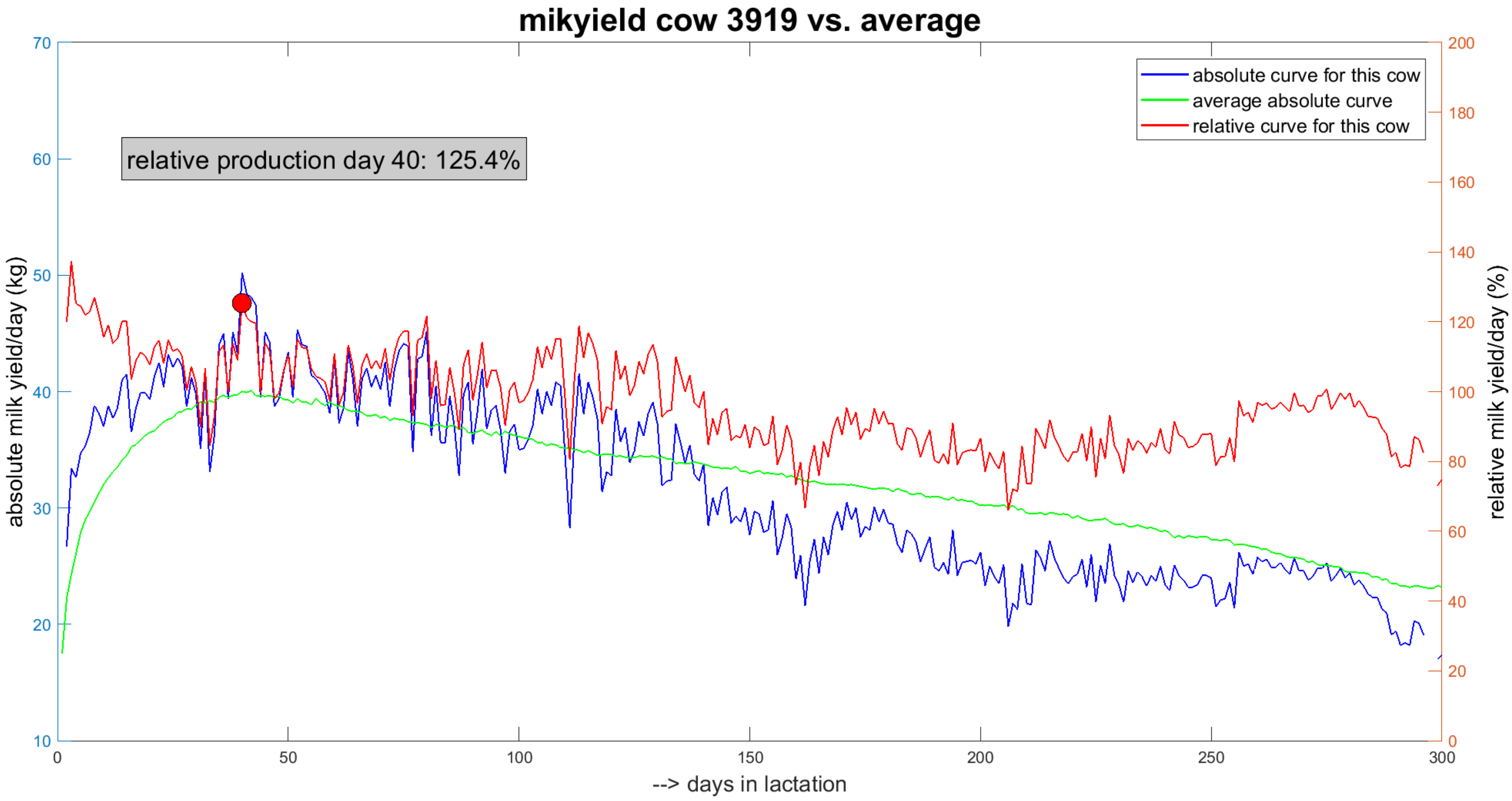

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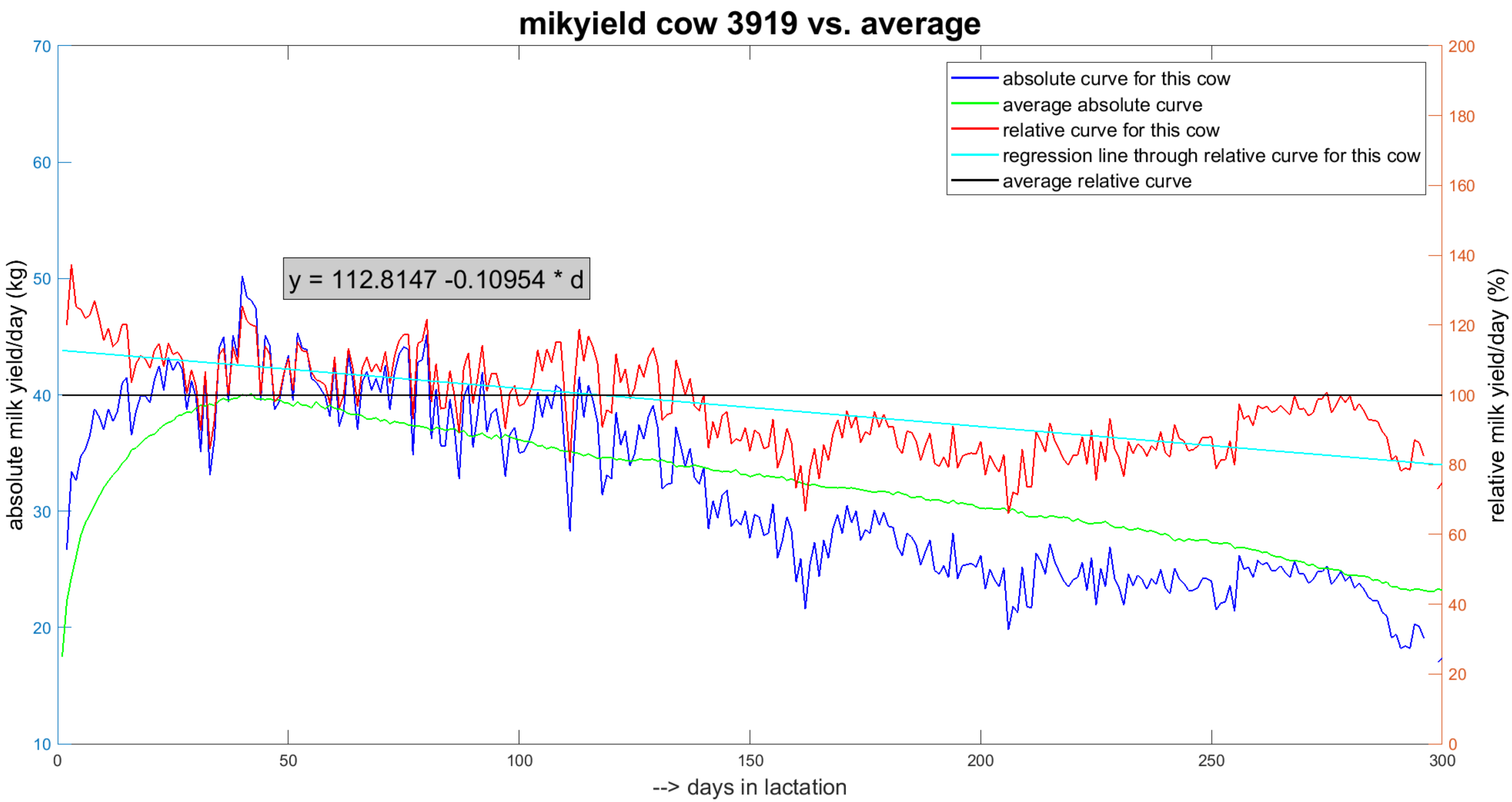

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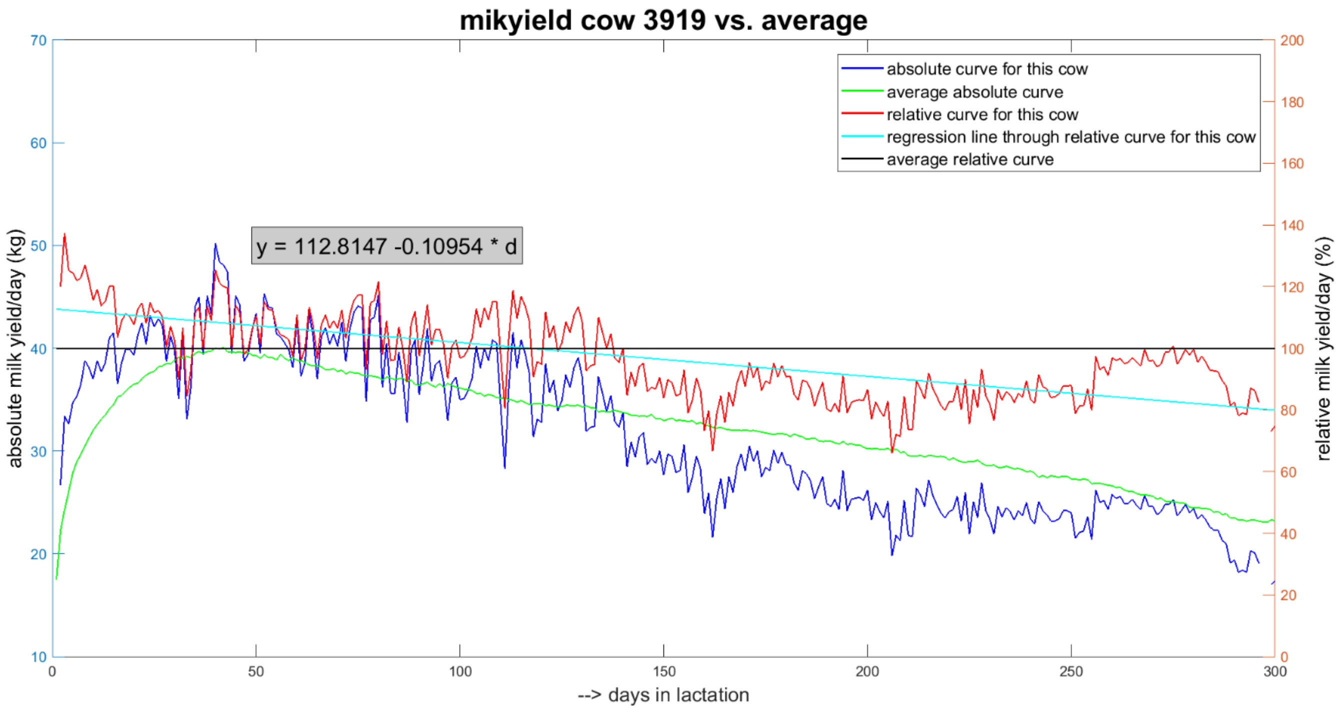

Mean and **Autocorrelation** on relative curve (red line)

Standard deviation, **Skewness**, and **Slope** of regression line through relative curve (light blue line)

Step 3 Data analyses

Data preparation

Remove outliers per sensor: mean plus minus 4*std
Compute sensor curve parameters (1-300DIM,
and 1-7, 1-60, 61-150, 151-300DIM)

Ordinal logistic regression

H = top 25%, M = middle 50%, L = bottom 25%

Use sensor curve parameters

Per sensor and all sensors simultaneously
Whole lactations and parts of lactation
Cleaned an uncleaned data

Results Ordinal Logistic Regression

Significant parameters simultaneous model (1-300DIM)

standard deviation of BW, slope of MY

similar to results for uncleaned data (but then also skewness of activity)

not consistent across partial lactations

Predictive performance using significant parameters

Average chance a cow that truly is in L is predicted to belong in L = 6.3%

	Gold standard		
	Low (L)	Middle (M)	High (H)
Prediction	n=90	n=202	n=78
Low (L)	0.063	0.113	0.042
Middle (M)	0.132	0.298	0.117
High (H)	0.048	0.135	0.052

Average chance a cow is predicted in the right category is 41.3%

151-300 d lactations slightly better than 1-300d and early partial lactations

To summarize

Limited predictive ability of sensor curve parameters

no difference between cleaned or uncleaned data

Late or entire lactation ‘better’ than early lactation

Variation in significant curve parameters

Improvements

Other weighing of Lifetime Resilience Score components

Include parameters previous lactation and dry period

Efficiency as outcome parameter