Association of individual cow milk fatty acid proportion and variance with milk production

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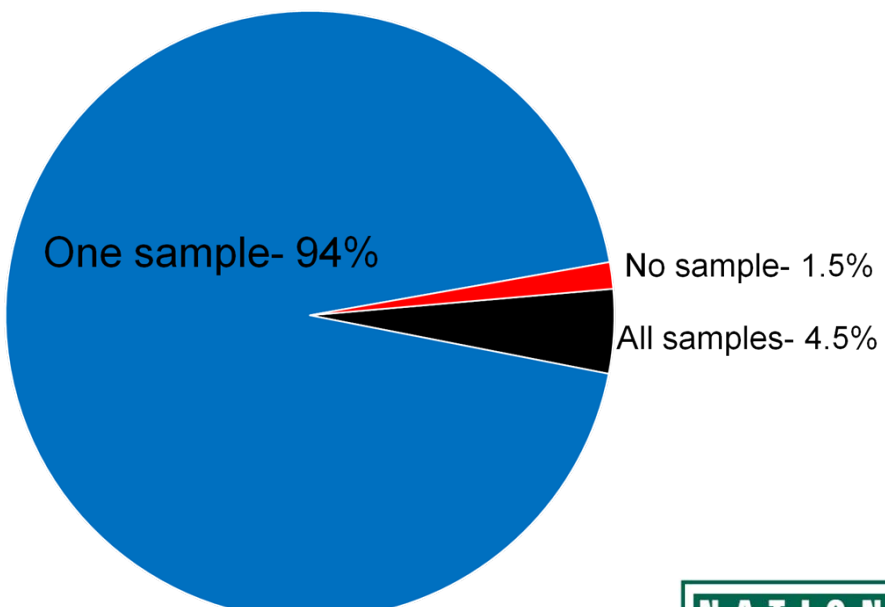
United States Milk Testing

- 3.9M of cows (41.9%) on DHI testing
- > 90% of cows sampled at one milking, once monthly



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United States Milk Testing

FTIR Instruments

Fat
Protein
Lactose
SCC
MUN
Fatty Acids
Casein
Other traits/
components

National
Cooperator
Database

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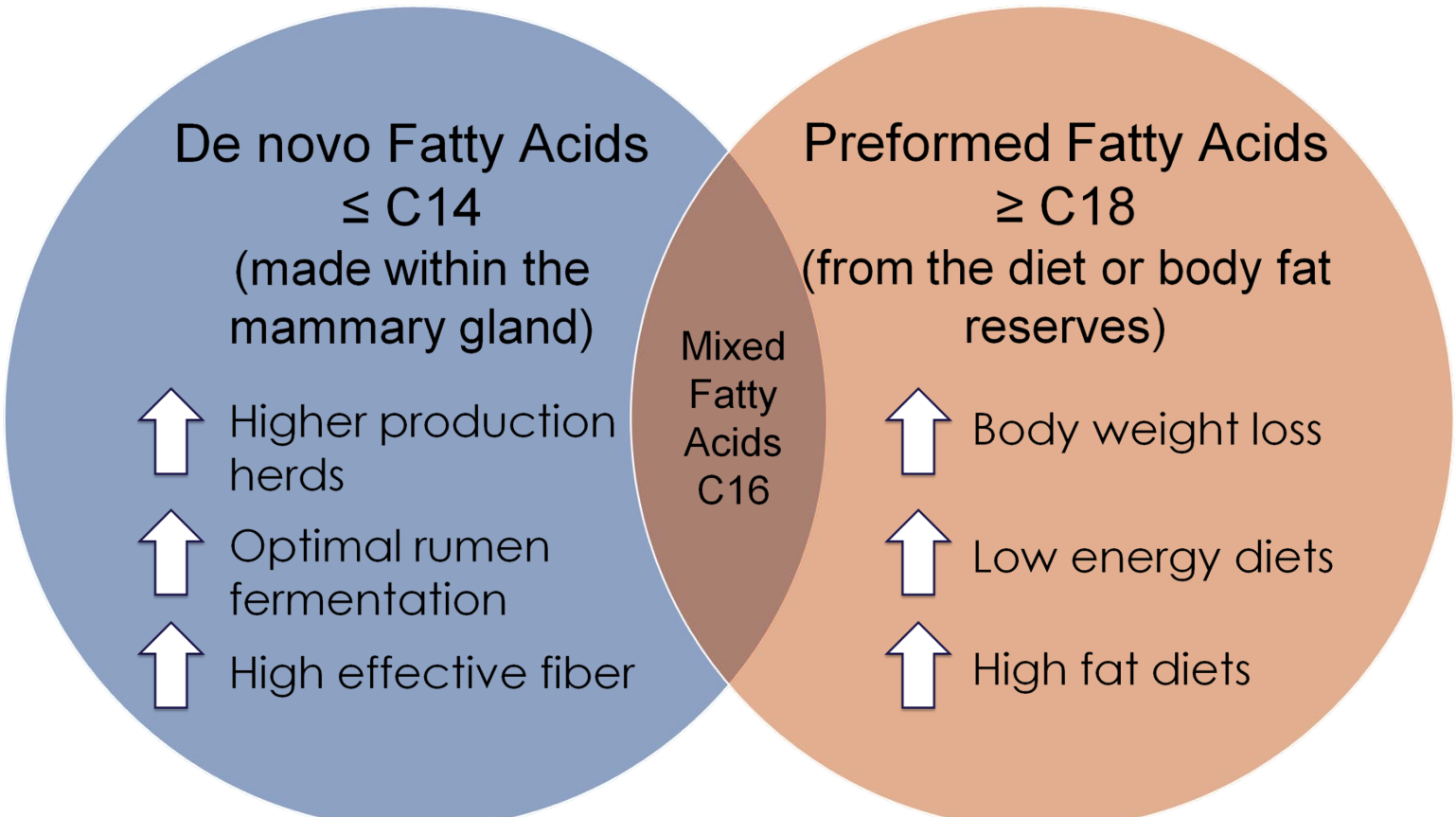
* At the herd (bulk tank) level

Milk Fatty Acid Origins



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Woolpert et al., 2016; Barbano et al., 2018; Santschi, 2019

Lactation Factors Project

- Re-evaluate projection factors and update yield trait predictions

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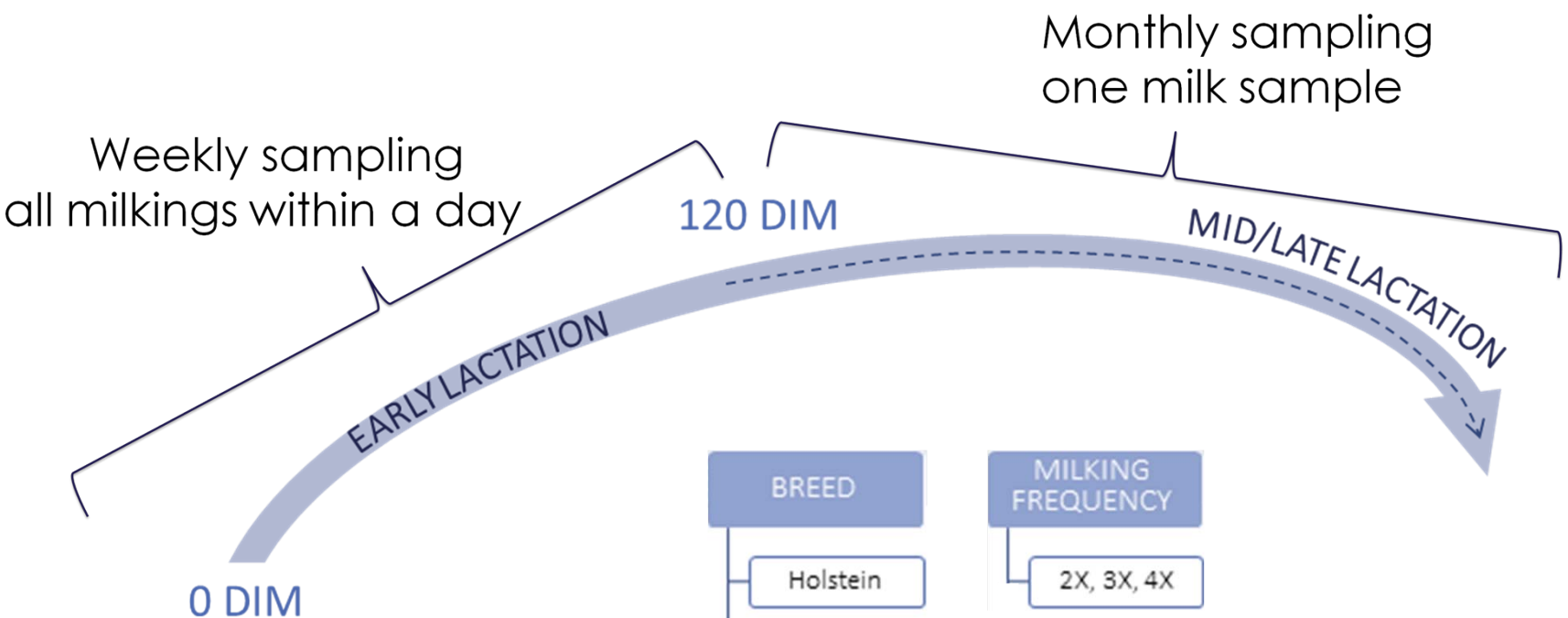
Lactation Factors Project



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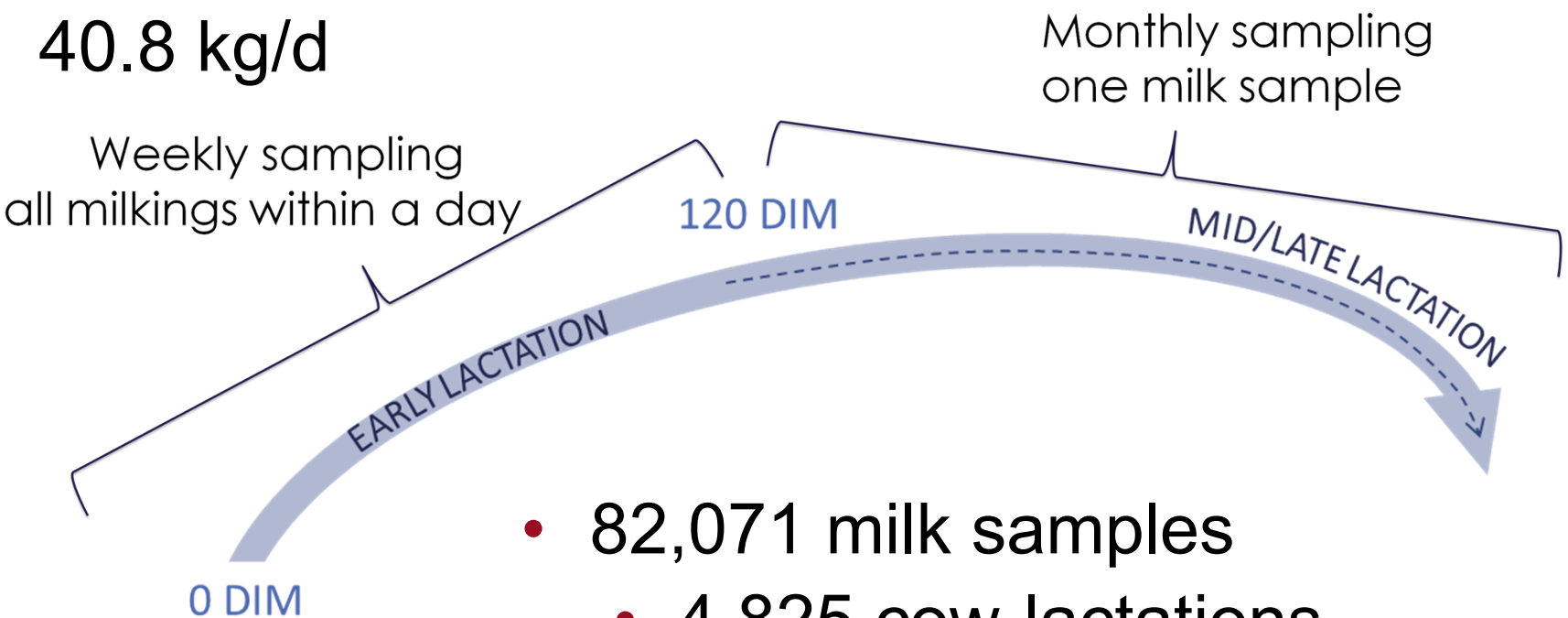
Dataset

- 2,400 cow 3x Holstein herd
  - 40.8 kg/d



- 82,071 milk samples
  - 4,825 cow-lactations
  - 3,518 unique cows

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Objective

1. Identify associations of morning milking de novo and preformed fatty acids with:
   - Test day yield
   - 305 day cumulative yield
   - Test day energy corrected milk
2. Identify if the variance of morning milking de novo and preformed fatty acids are associated with lactation yield

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Methods

- 3 lactation stages
  - First milk test (30 ± 3 DIM)
  - Peak milk test (68 ± 30 DIM)
  - Mid-lactation milk test (100 ± 3 DIM)

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Methods

- Mixed linear model (lmer; R 4.3.1)
  - **Fixed effects**: fatty acid proportion, parity (binary), their interaction, day in milk
  - **Random effect**: month of sample

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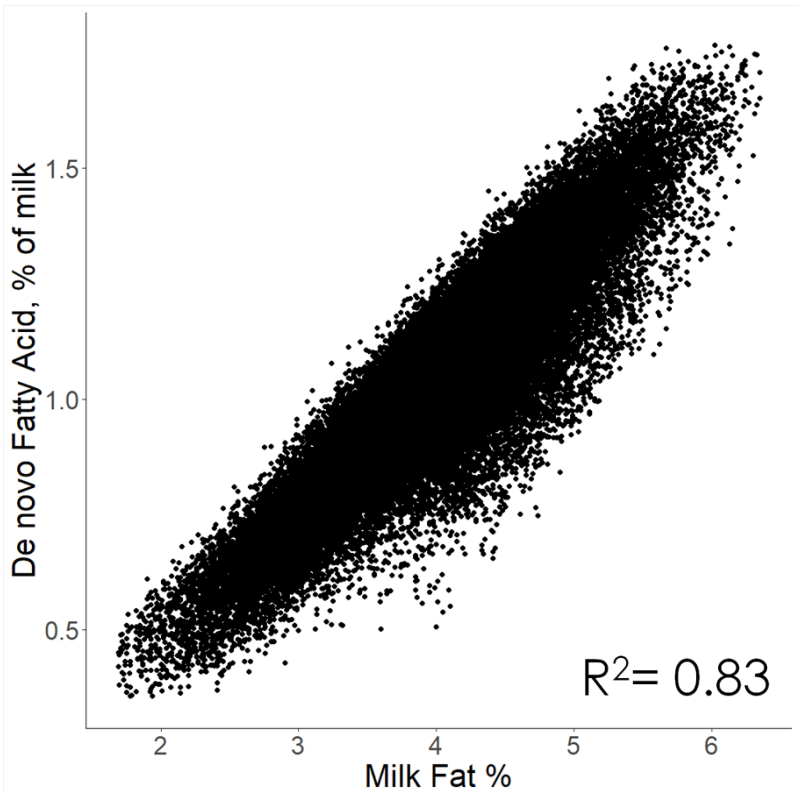
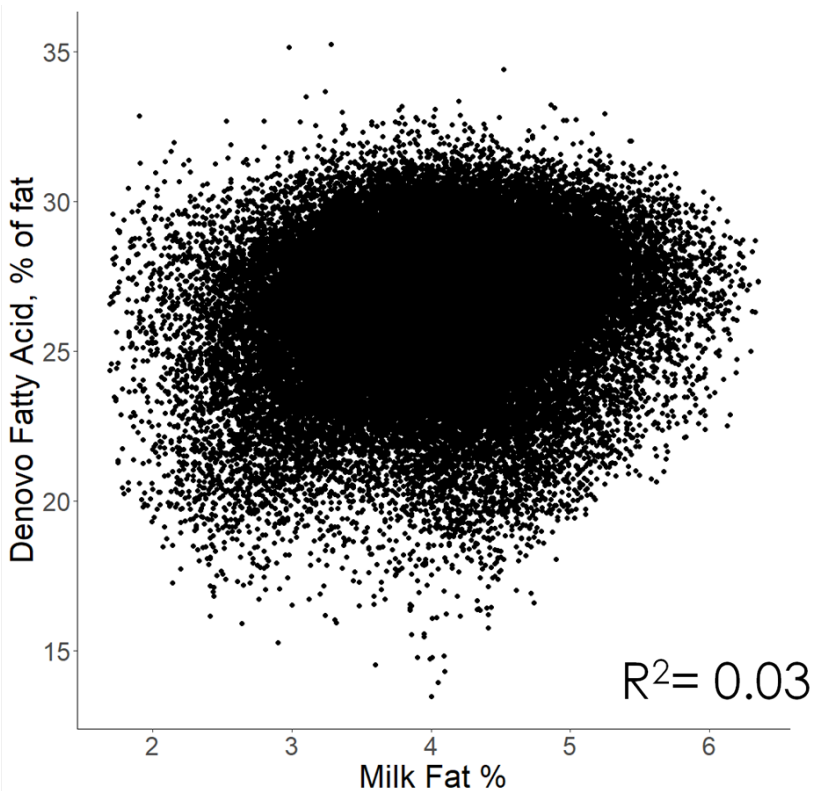
Fatty Acid Units





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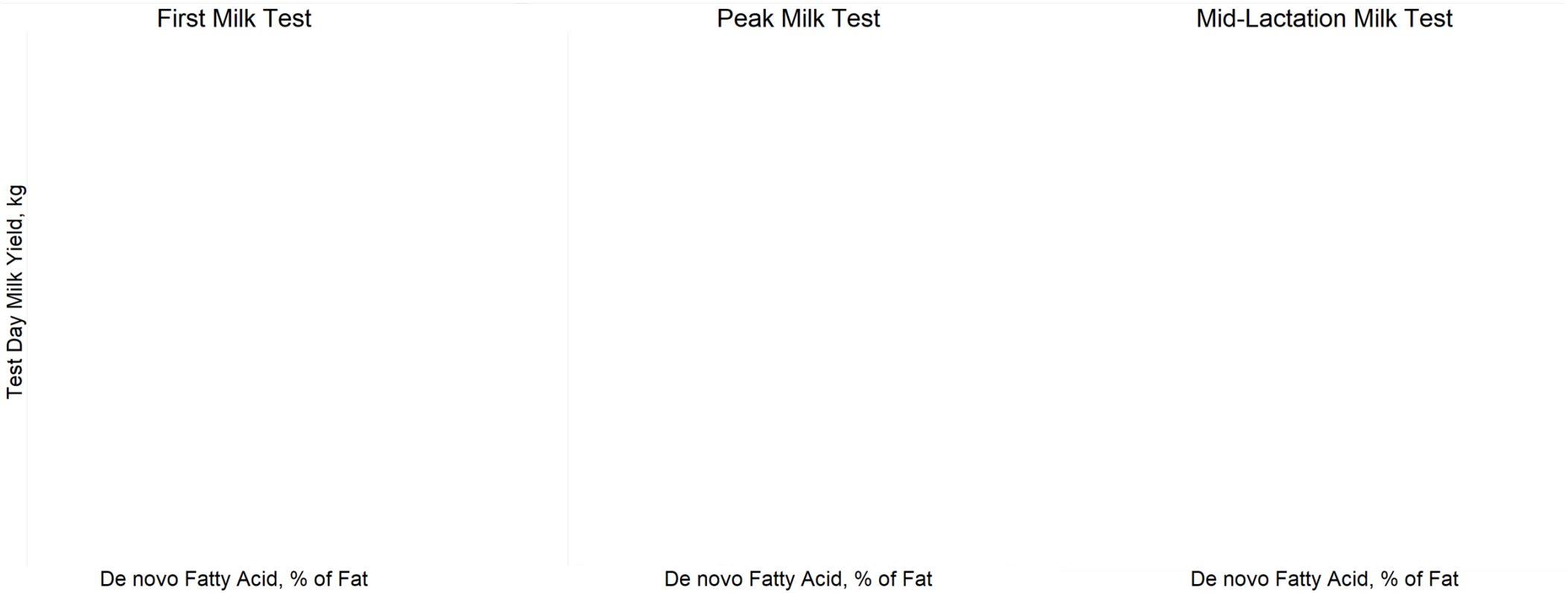
De novo: Test Day Milk



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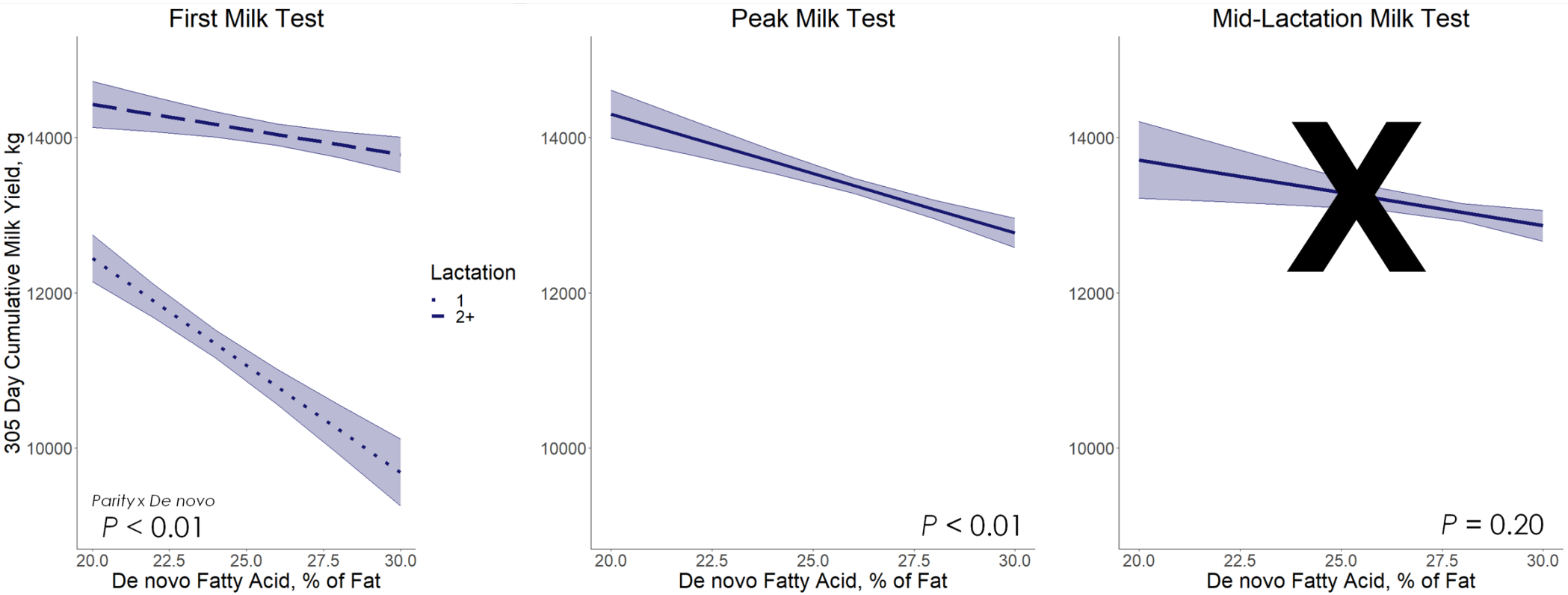
De novo: 305 Day Cumulative Milk Yield



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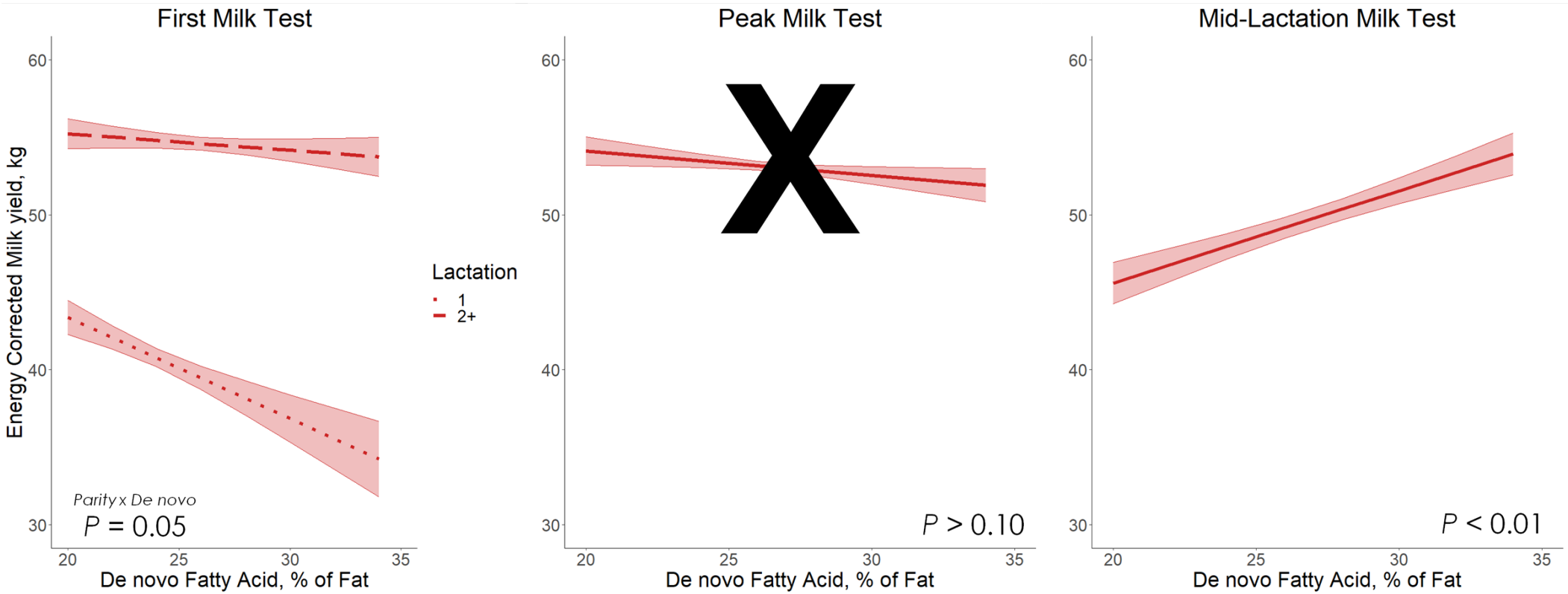
De novo: Energy Corrected Milk



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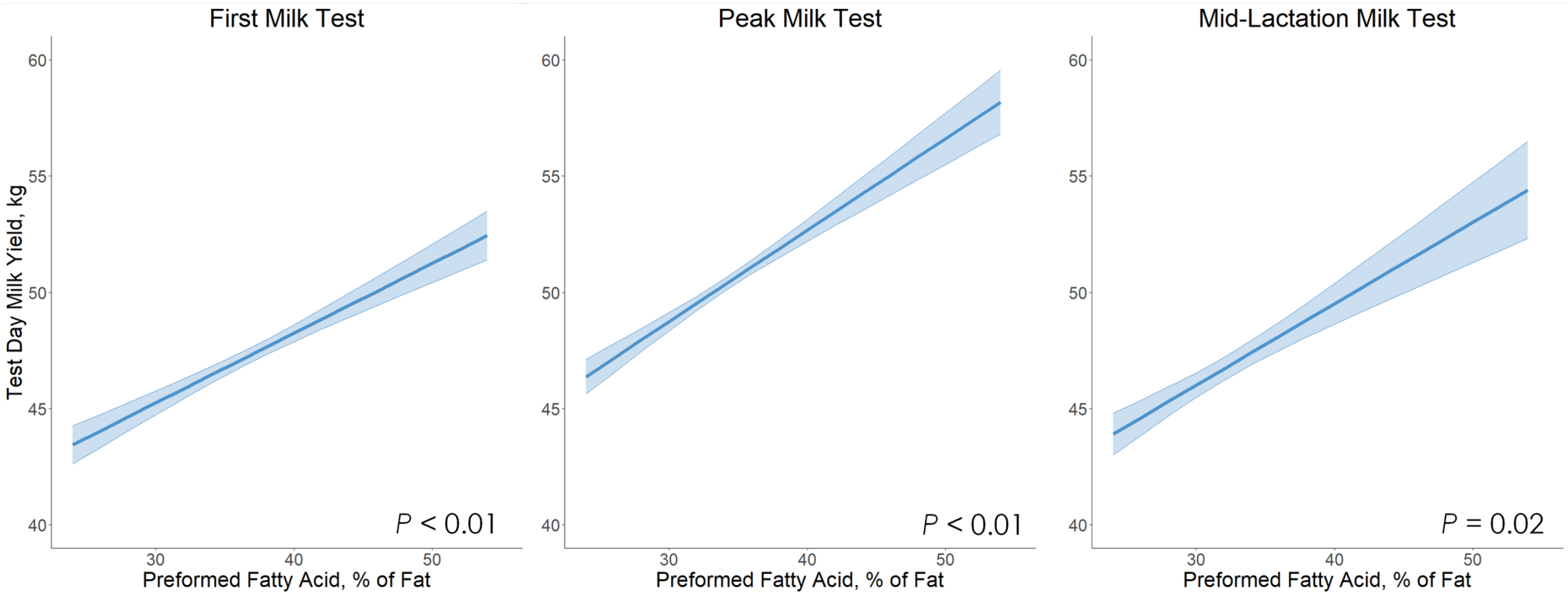
Preformed: Test Day Yield



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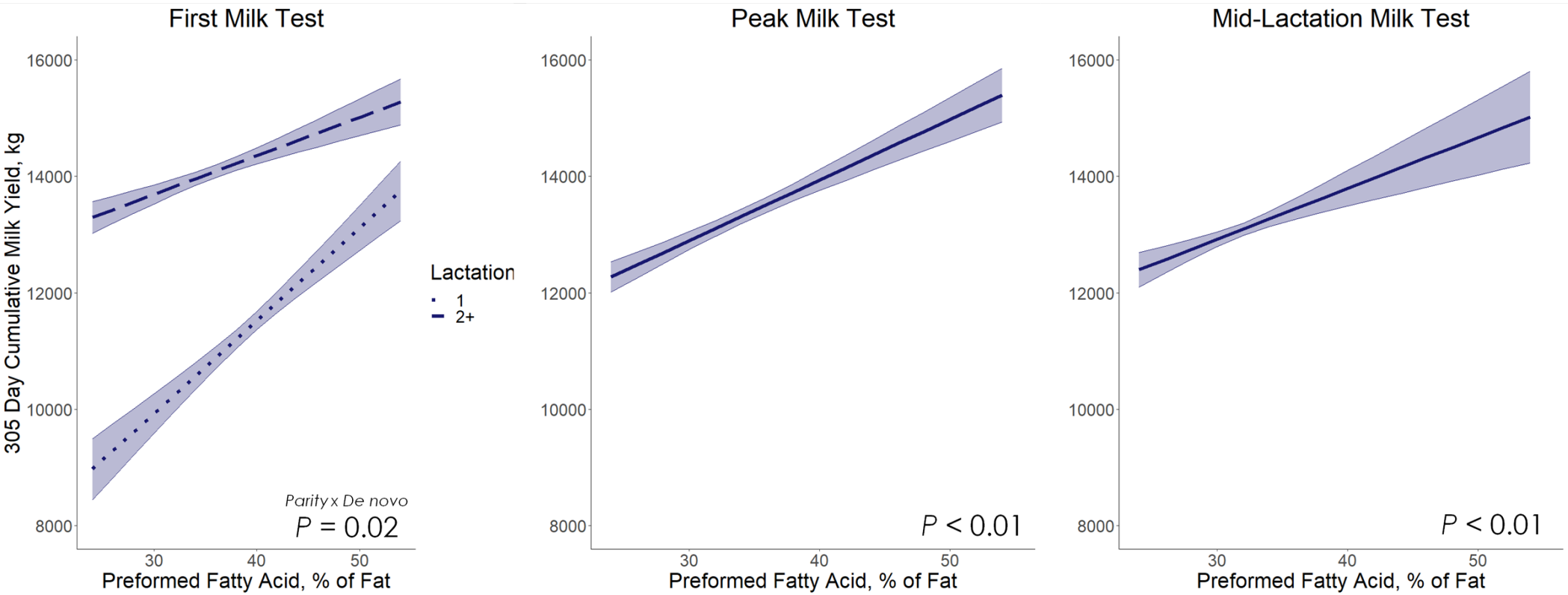
Preformed: 305 Day Cumulative Milk Yield



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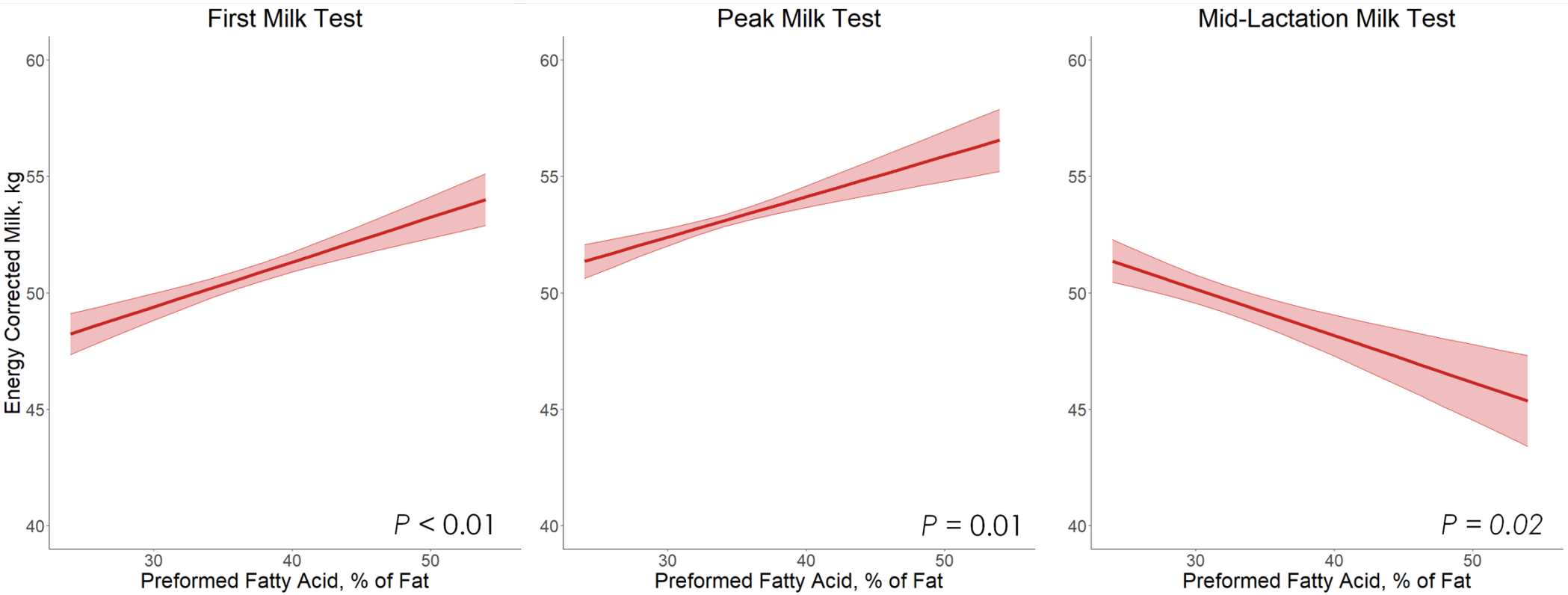
Preformed: Energy Corrected Milk Yield



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Fatty Acids Summary

Variable	De novo Fatty Acid	Preformed Fatty Acid
Test Day Yield		
305 Day Cumulative Milk Yield	Early & Peak 	
Energy Corrected Milk Yield	Early Lactation  Mid- Lactation 	Early & Peak  Mid- Lactation 

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Objective

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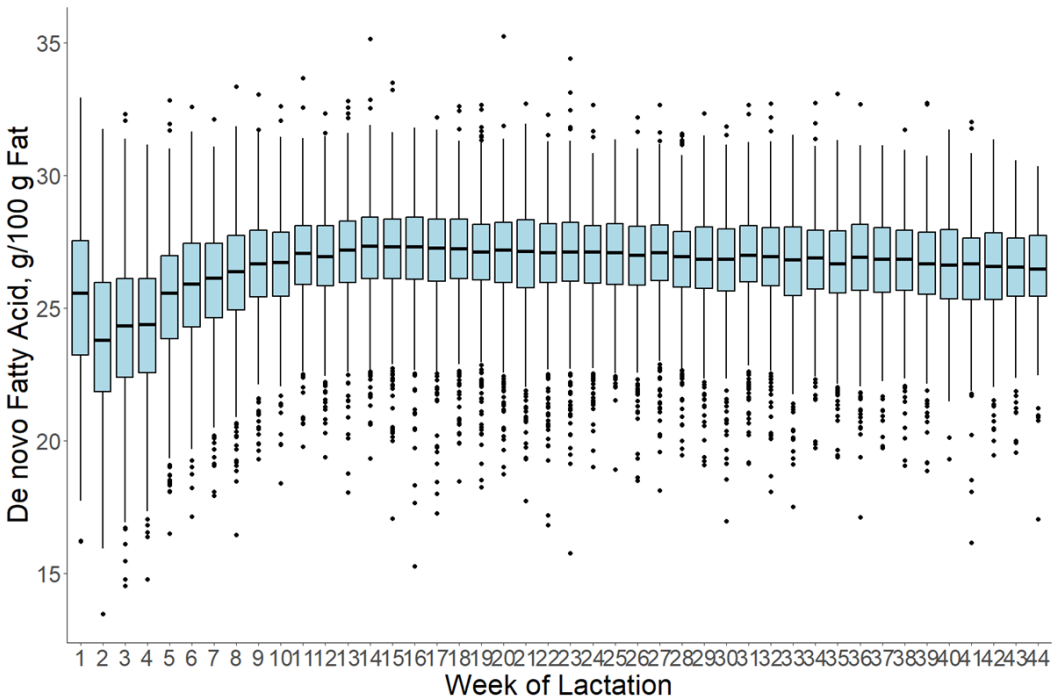
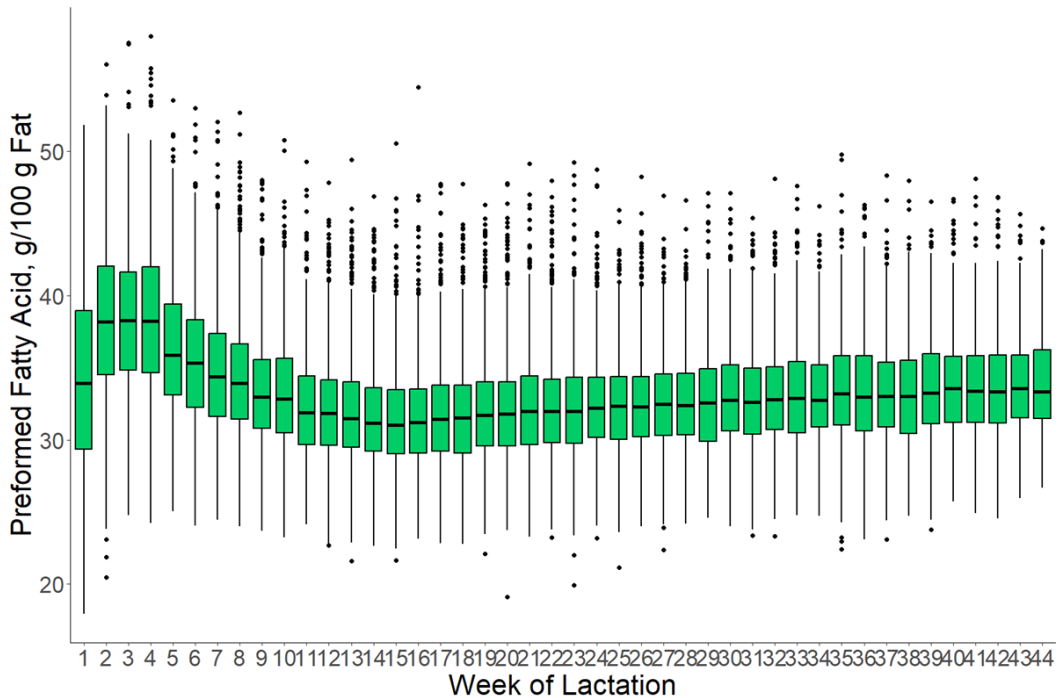
Variation in Fatty Acids Across Lactation





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Methods

- For de novo and preformed:
  - Fit individual cow Wilmink lactation curve
    - Deviance = observed – predicted value
    - Variance = log[Variance(Deviance)]

Variation in De novo Fatty Acids

Low Variance

High Variance

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Methods

- Mixed linear model (lmer; R 4.3.1)
  - **Fixed effects**: fatty acid variance, parity (binary), their interaction
  - **Random effect**: month-year of calving

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Fatty Acid Variance and Lactation Yield

Variable, kg	Estimate	SEM	*P*-Value
De novo			
28 Day Cummulative Yield	97.88	52.40	0.06
305 Day Cummulative Yield	1848.04	596.83	<0.01

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Summary

1. Identify associations of morning milking de novo and preformed fatty acids with performance
    - Strong associations depending on parity and lactation stage
2. Identify if the variance of morning milking de novo and preformed fatty acids are associated with lactation yield

    •Higher variation of de novo associated with greater lactation yield
        - Further work into association with health, diet, etc. is ongoing

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THANK YOU FOR YOUR ATTENTION

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