

# Development of a multivariable Reproductive Index to assess fertility of dairy cows

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## INTRODUCTION

- Reproductive efficiency is determined by a number of complex cow and environmental factors
- Methodologies refining the identification of cows with low and high fertility would be a valuable tool for research in multiple areas, including genetic selection

## OVERALL OBJECTIVE

To develop a Reproductive Index (RI) to predict the probability of a timely pregnancy in a large population of dairy cows.

### Procedures:

The **RI** represents a calculated predicted probability that a cow will become pregnant, as a function of the explanatory variables used in a logistic model.

RI included the random effect of farm and a complement of significant fixed effects influencing a pregnancy outcome: 1) incidence of retained placenta; 2) metritis; 3) clinical endometritis; 4) lameness at 35 DIM; 5) resumption of ovulation by 50 DIM; 6) season of calving; and 7) parity number.

The RI ranges from 0 to 1 as the probability of pregnancy:

$$P(\text{pregnancy} | \alpha, \beta) = e^{\sum \beta_i Z_i + \mu} / 1 + e^{\sum \beta_i Z_i + \mu}$$

Where:

- $P(\text{pregnancy} | \alpha, \beta)$  is the probability that a cow will be pregnant
- $Z_i$  = set of fixed factors
- $\mu$  = random effect of farm
- $B_i$  = set of multiplicative slopes and
- $\sigma$  = scale parameter

### Statistical analysis:

## RI vs. real data

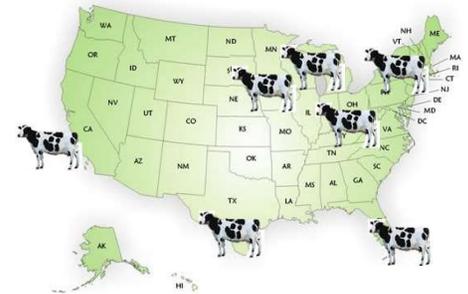
Multivariate logistic regression was used for testing the correspondence between the resulting RI and **real** individual fertility data (**pregnancy per AI and pregnancy loss between 32 d and 60 d after AI**) from this population.

RI values were categorized as **low (LRI)** for cows in the lowest quartile (RI < 0.26); **medium (MRI)**; 0.26 ≥ RI ≤ 0.39) for cows within the interquartile range, and **high (HRI)**; RI > 0.39) for cows in the top quartile.

## MATERIAL & METHODS

**Study Population:** A total of 11,733 cows calving in 16 farms located in 4 regions: Northeast [4 herds], Midwest [6 herds], Southeast [1 herd], and the Southwest [5 herds].

**Procedures:** Cows were enrolled at parturition and monitored weekly for multiple reproductive events, disease occurrence, and survival.



## RESULTS

Cows in the HRI category had 2.30 (95% CI = 2.00 to 2.62) and 1.63 (1.40 to 1.91) times greater odds of becoming pregnant at first and second AI than LRI cows, respectively.

Figure 1: Frequencies (%) of reproductive events by category of Reproductive Index (RI)

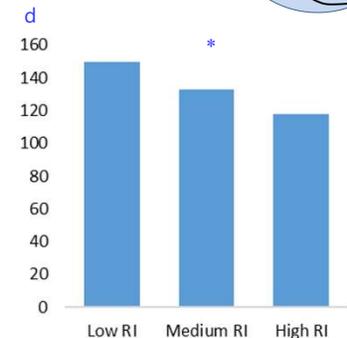
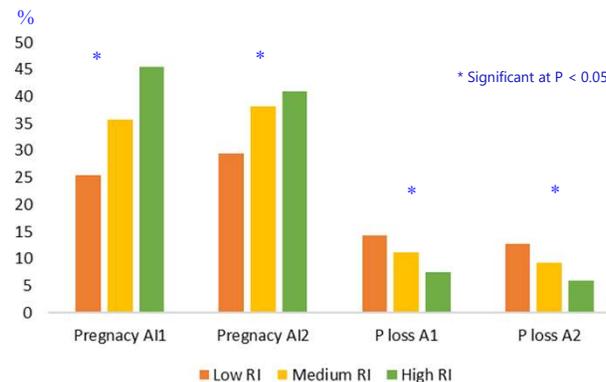


Figure 21: Number of days open by category of Reproductive Index (RI)

## CONCLUSIONS

- There was a consistent agreement between categories of the predicted RI and the measures of fertility collected from dairy cows.
- The proposed RI is a viable method to refine the allocation of cows into potential low and high fertility populations. This is a viable tool to assist in phenotypic determination for genetic selection purposes.