Application of random regression models for Gaussian and binary traits to estimate genetic parameters in low input dairy cattle herds

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Background

- Low input dairy herds
  - Production traits
  - Reproduction traits
  - Functional traits
- Aim
  - Variance and covariance components
  - Apply different types of random regression models
- Prerequisite
  - Breeding programs
  - Simulation

Original data

- Official records:
  - Brown Swiss
  - low input farms in Switzerland
  - Production traits:
    - 36,877 records
    - 1,293 cows
  - Reproduction traits:
    - 9,982 records 1,434 cows
    - 5,296 records 1,427 cows
  - Pedigree file:
    - 3,542,563 animals
    - Birth year: 1908-2009

Data

- Traits and programs

Trait complex	Full Name	**Abbreviation**
Production	Milk yield	**MY** (in kg)
	Fat%	**Fat%**
	Protein%	**Pro%**
	Lactose%	**Lac%**
	Somatic cell score	**SCS**
	Milk urea nitrogen	**MUN** (in mg/dl)
Reproduction	Age at first calving	**AFC** (in d)
	Calving to 1st service	**CTFS** (in d)
	Days open	**DO** (in d)
	Gestation length	**GL** (in d)
	Calving interval	**CI** (in d)
	No. insemination	**NI**
	Calving ease	**CE** (scale 1-4)
	Still-birth	**SB** (0 or 1)
	Conception rate	**CR** (0 or 1)

VCE6 (Groeneveld, E., K. Milena and M.Norbert, 2008)

THRGIBBS1F90 (Misztal et al., 2002)

Methods

- Random regression animal model-1 and 2 (VCE,)

$$\mathbf{y} = \mathbf{Xb} + \mathbf{Zu} + \mathbf{Wp} + \mathbf{e},$$

- Covariates
  - Production traits: DIM, 5-365
  - Fertility traits: parity, 1-8 (Schaeffer, 2004)

- Legendre polynomials

- Effects
  - Production traits: HTD, parity
  - Reproduction traits: herd, age, CY, CS, IY, IN, rS

Methods

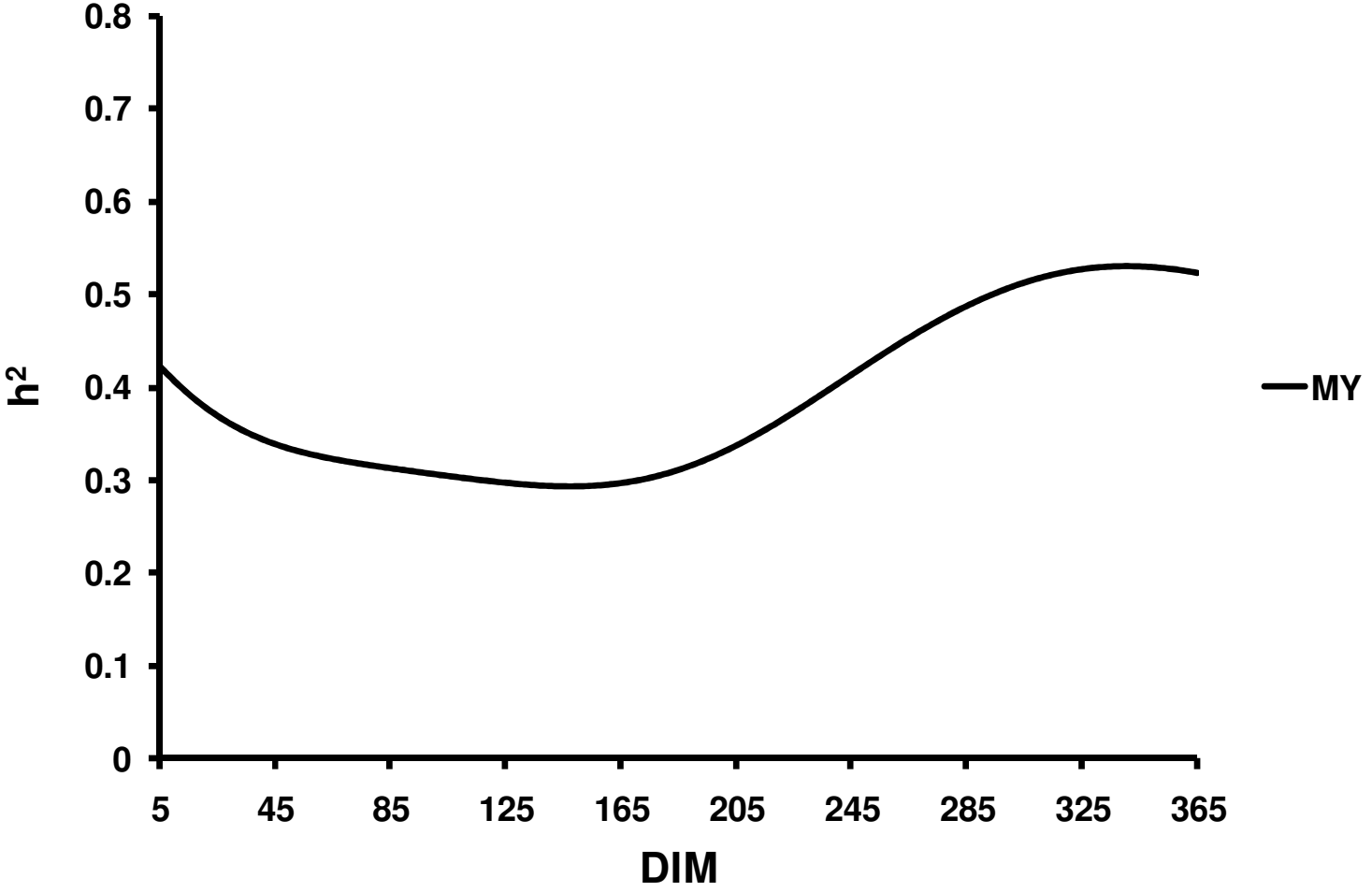
- Random regression sire model-3 (Tusruta et al. 2009)

$$\begin{bmatrix} \mathbf{l} \\ \\ \mathbf{y} \end{bmatrix} = \begin{bmatrix} \mathbf{Xb} + \mathbf{Ws} + \mathbf{Z}_1\mathbf{u} + \mathbf{Z}_2\mathbf{p} + \mathbf{e} \\ \\ \mathbf{Xb} + \mathbf{Z}_1\mathbf{u} + \mathbf{Z}_2\mathbf{p} + \mathbf{e} \end{bmatrix}$$

- Covariates: DIM 20-220
- Legendre polynomials
- Fix effects:
  - Herd, insemination year and season

Results

- Heritabilities of production traits from model-1 (DIM)



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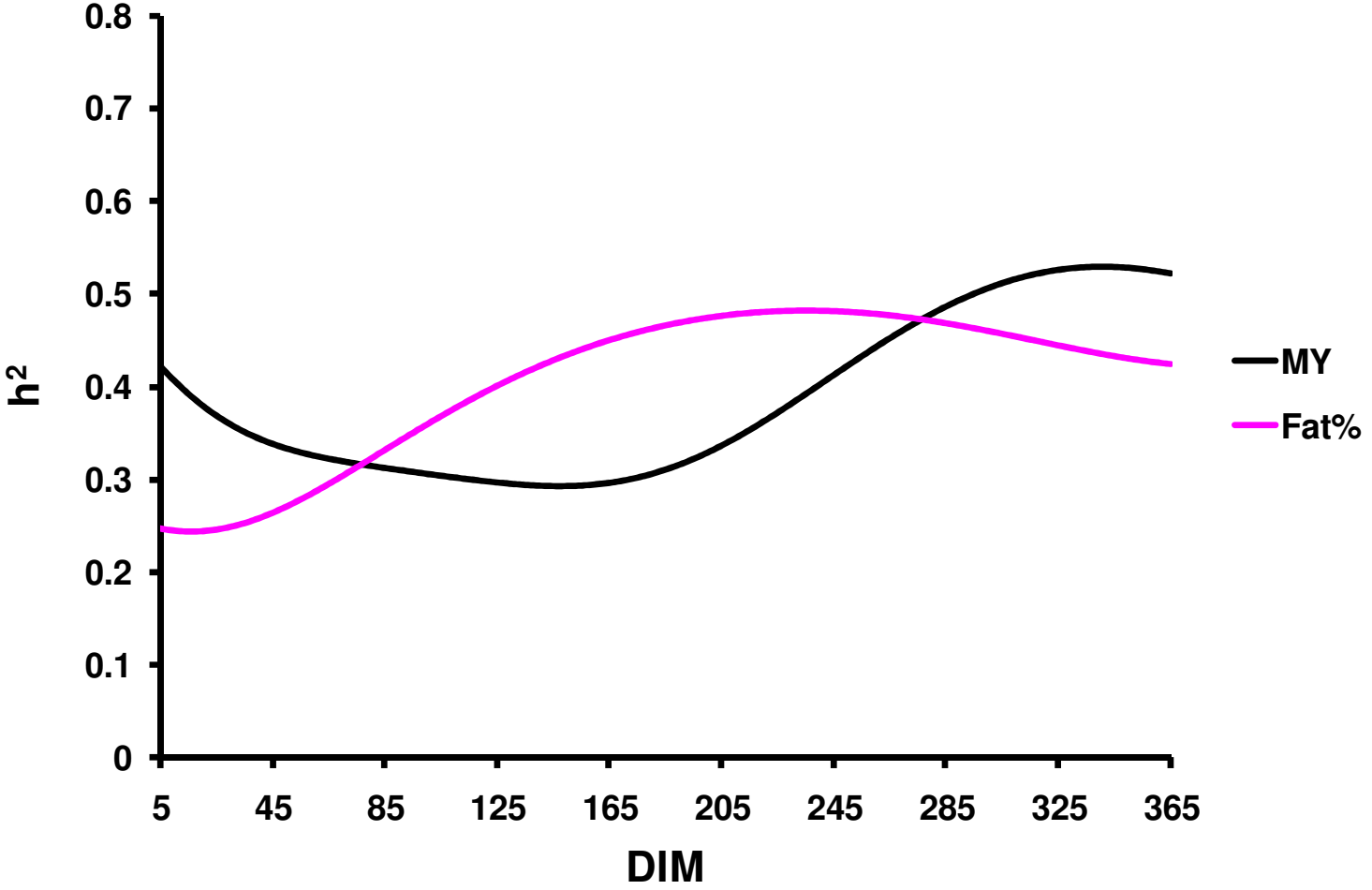

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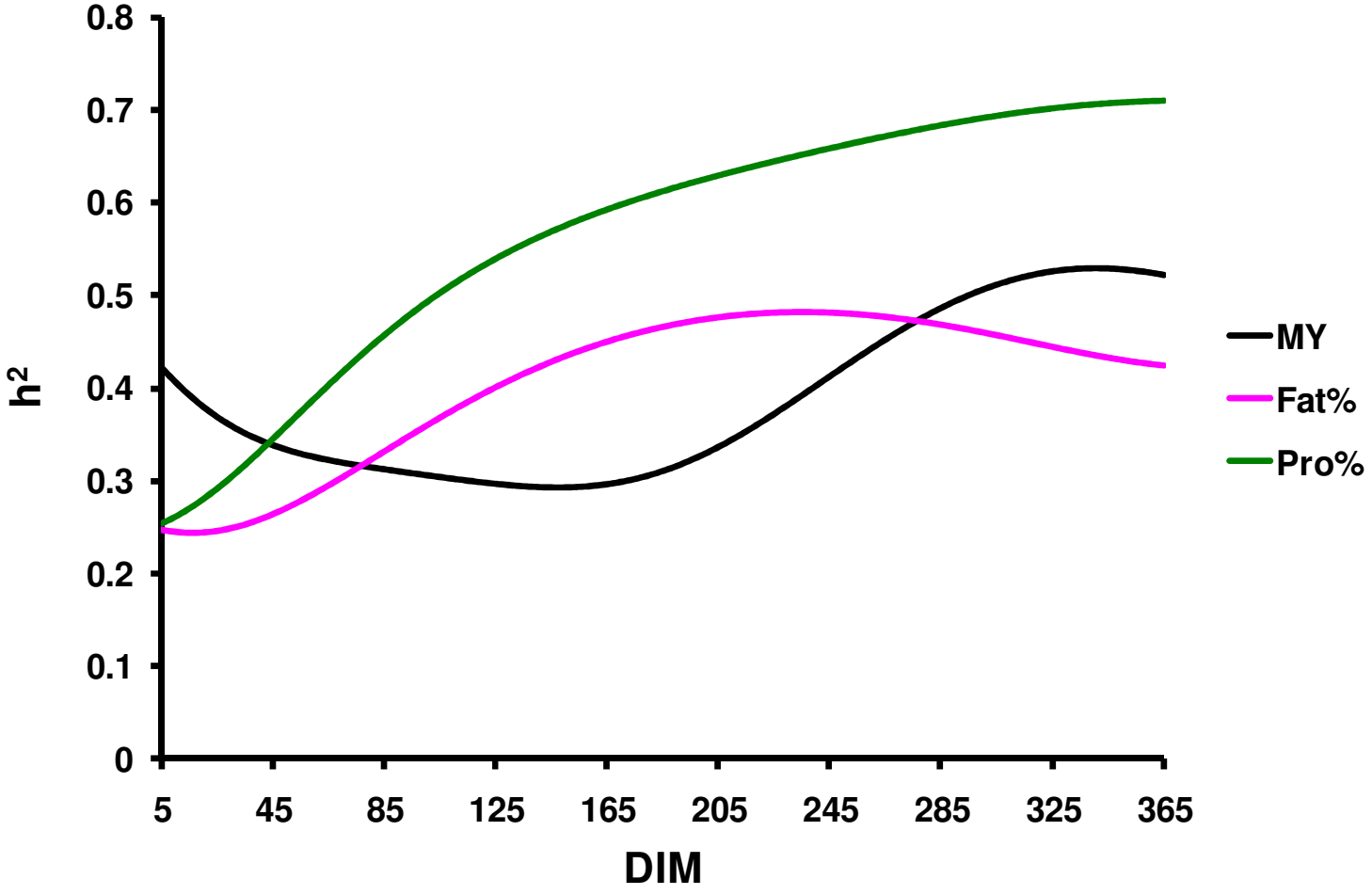

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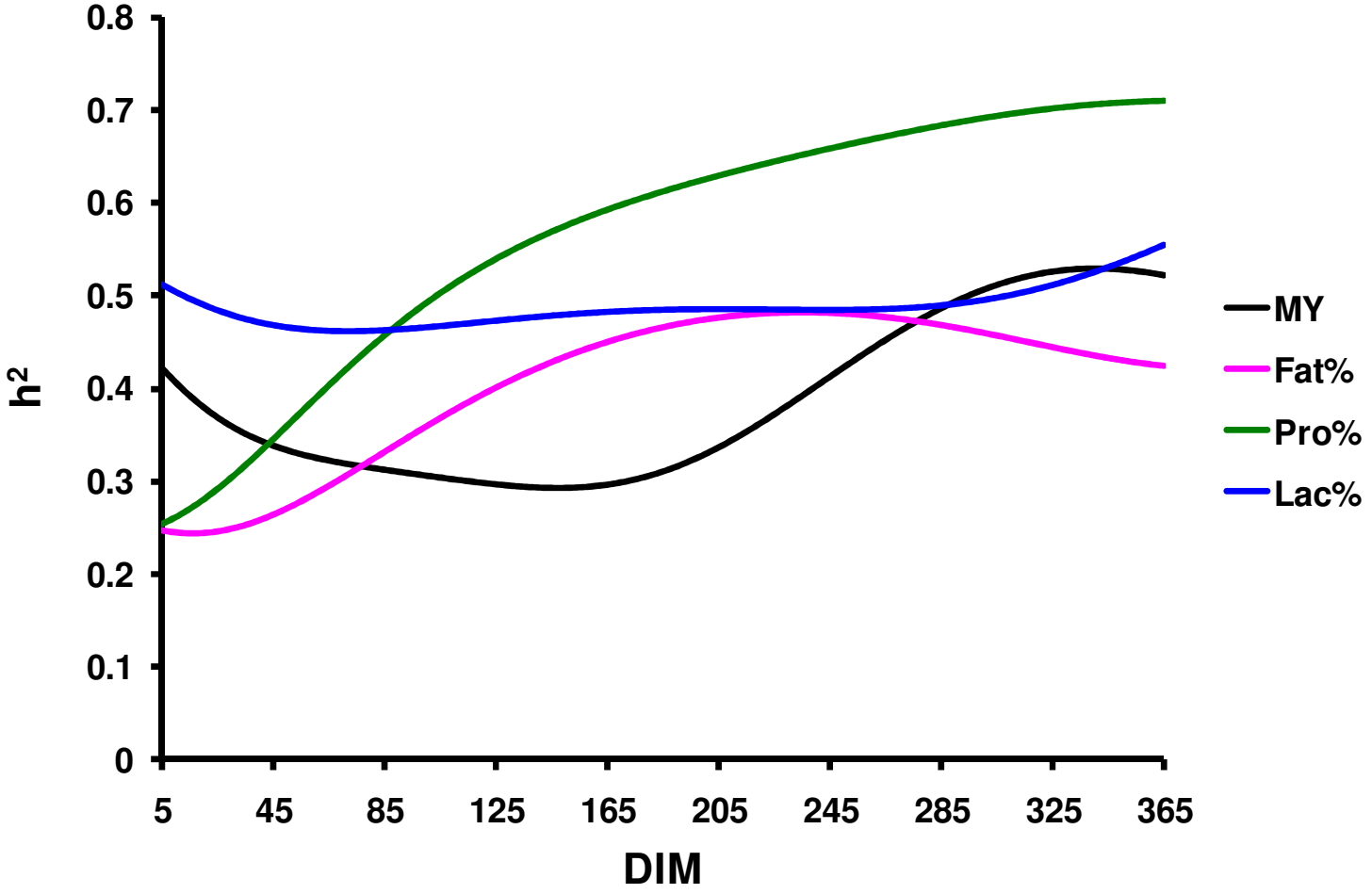

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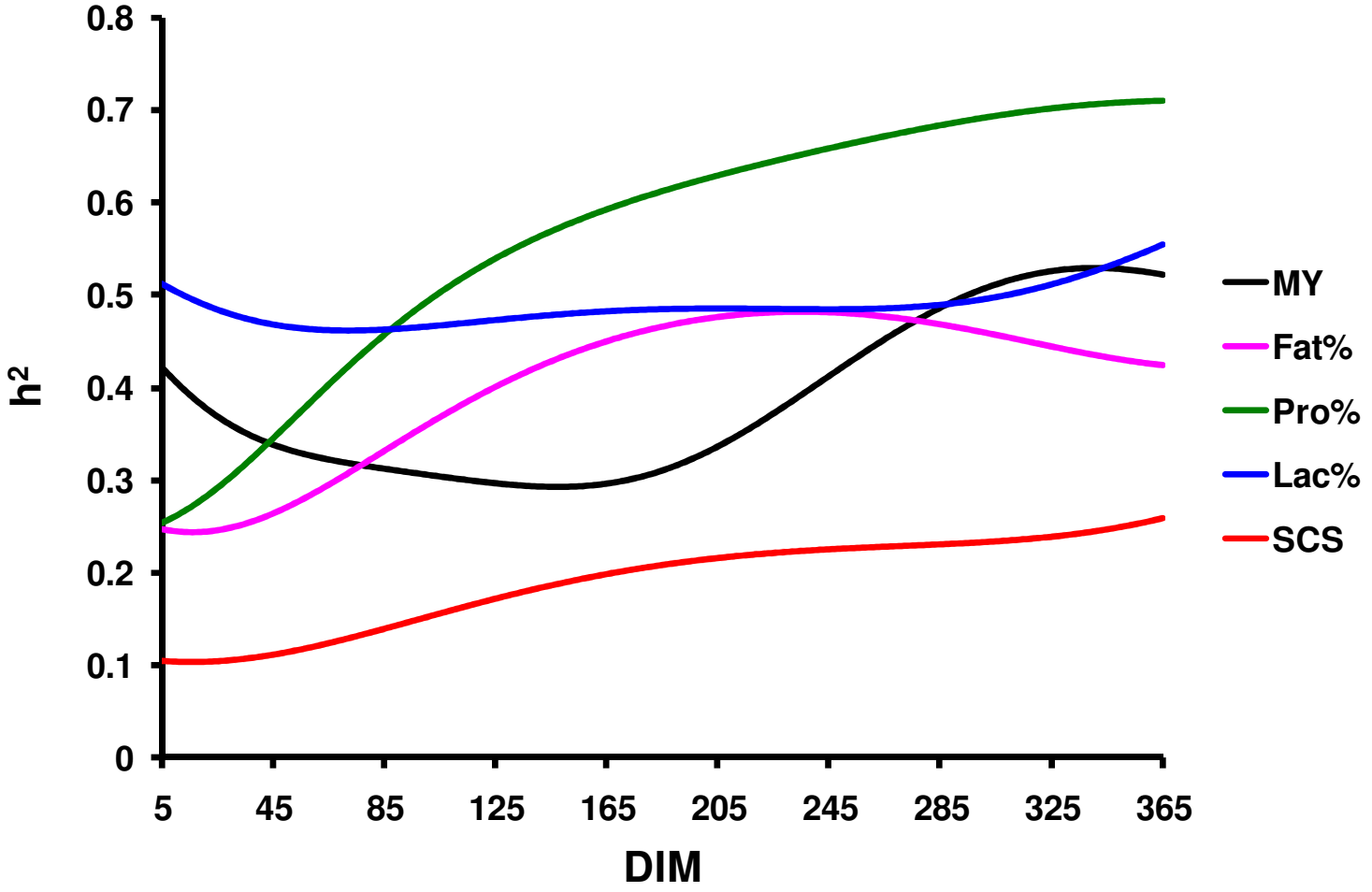

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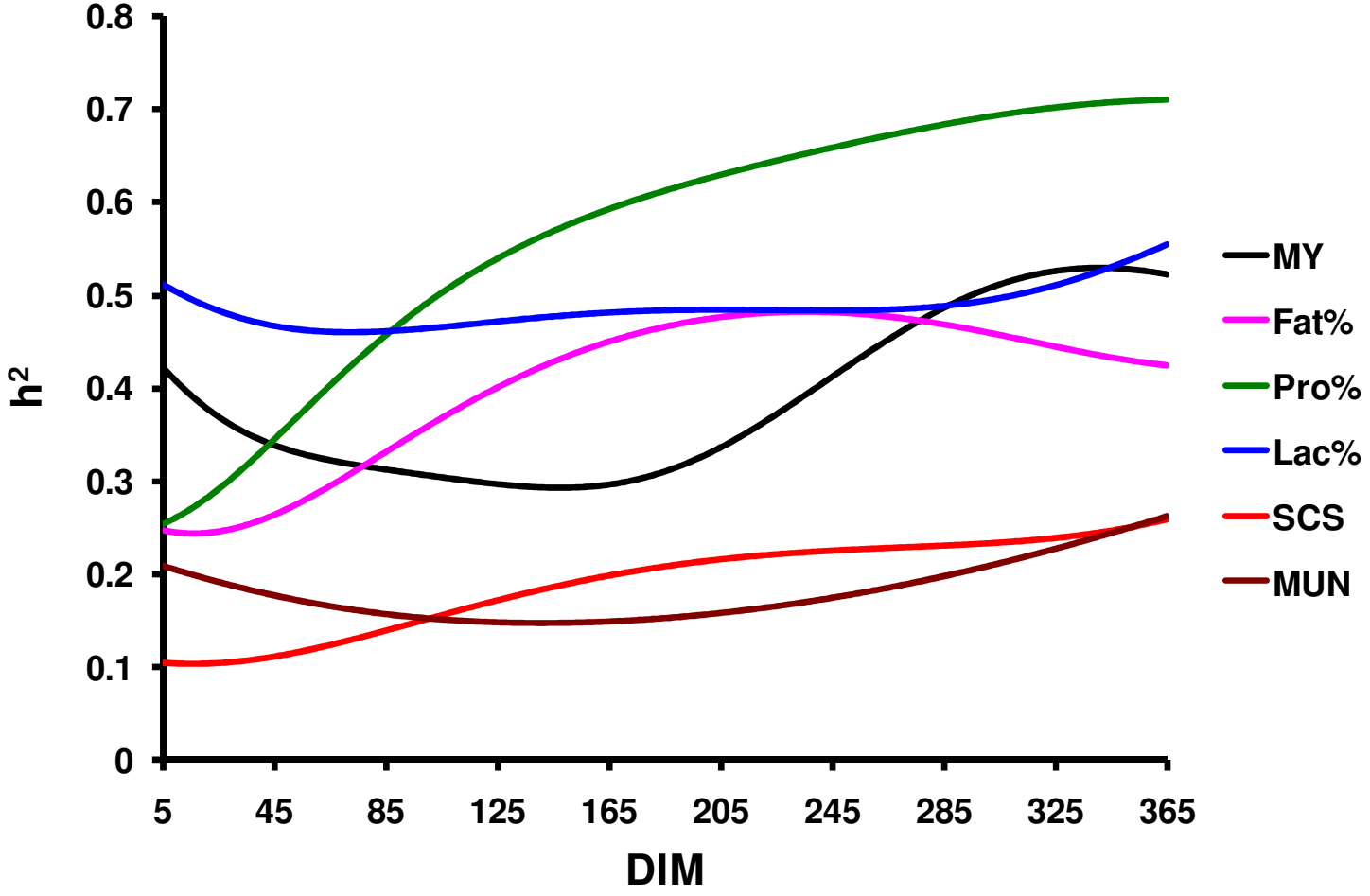
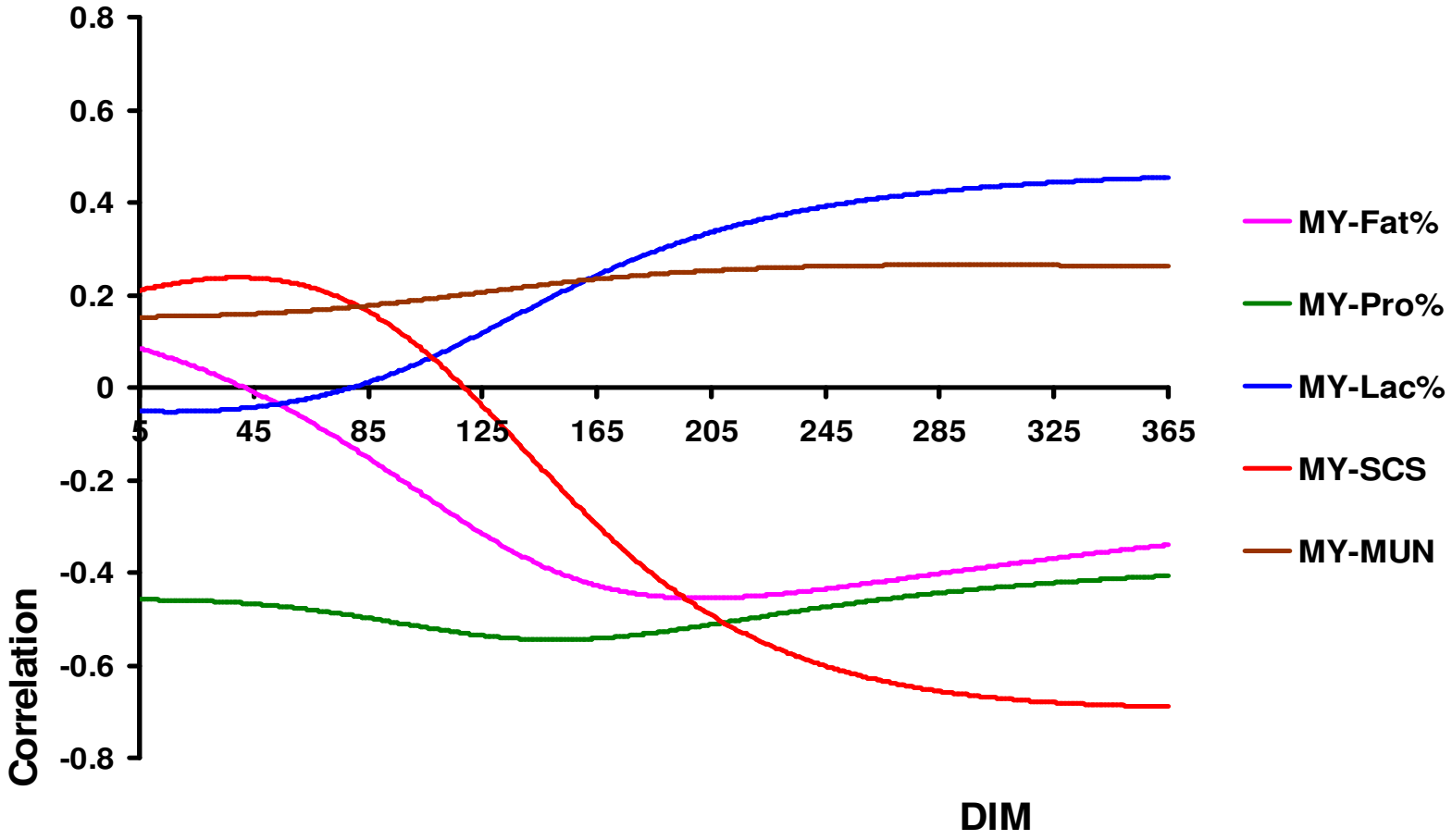


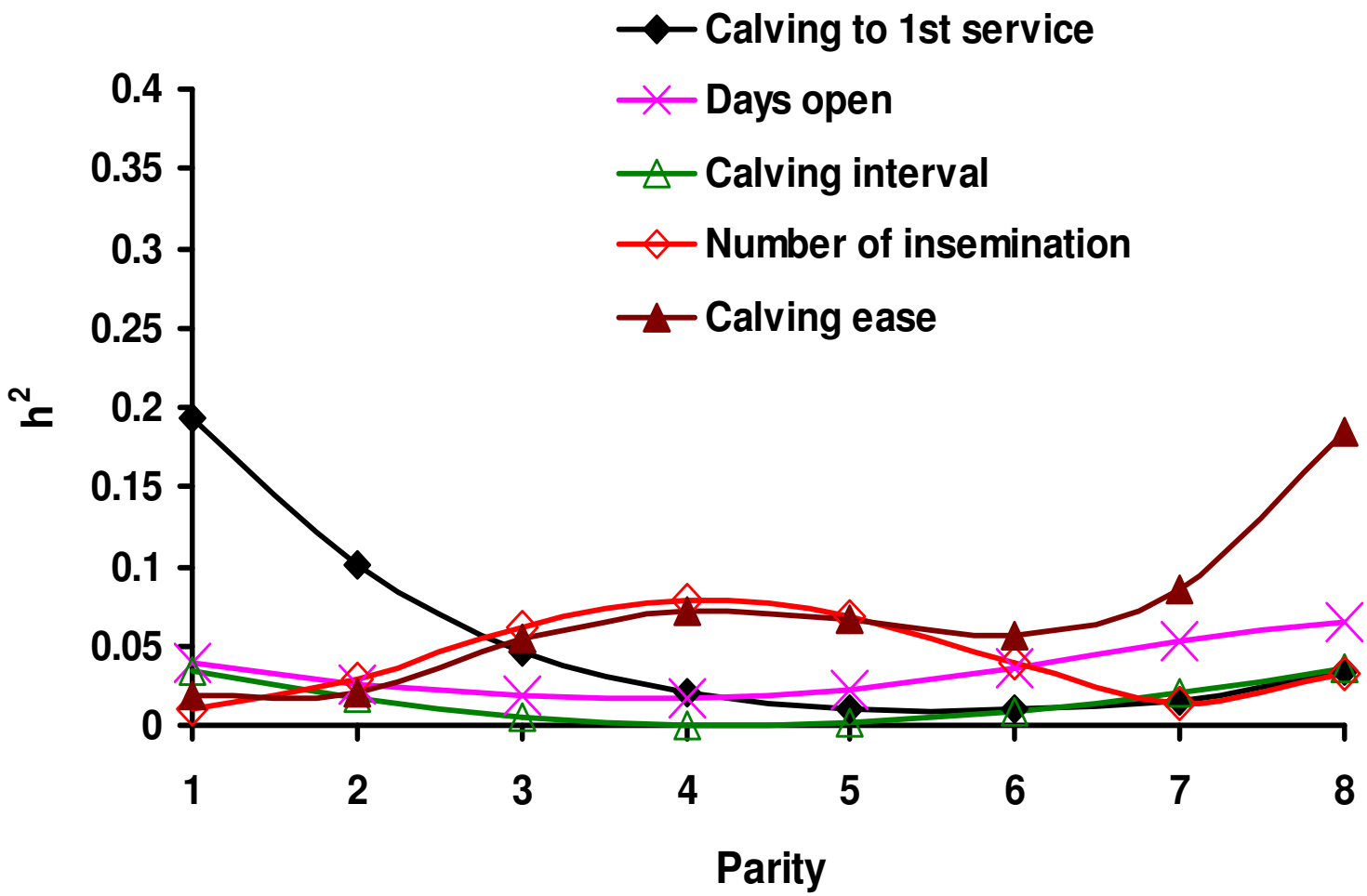
Results

- Genetic correlation from model-1 (DIM)



Results

- Heritabilities of reproduction traits from model-2 (parity)



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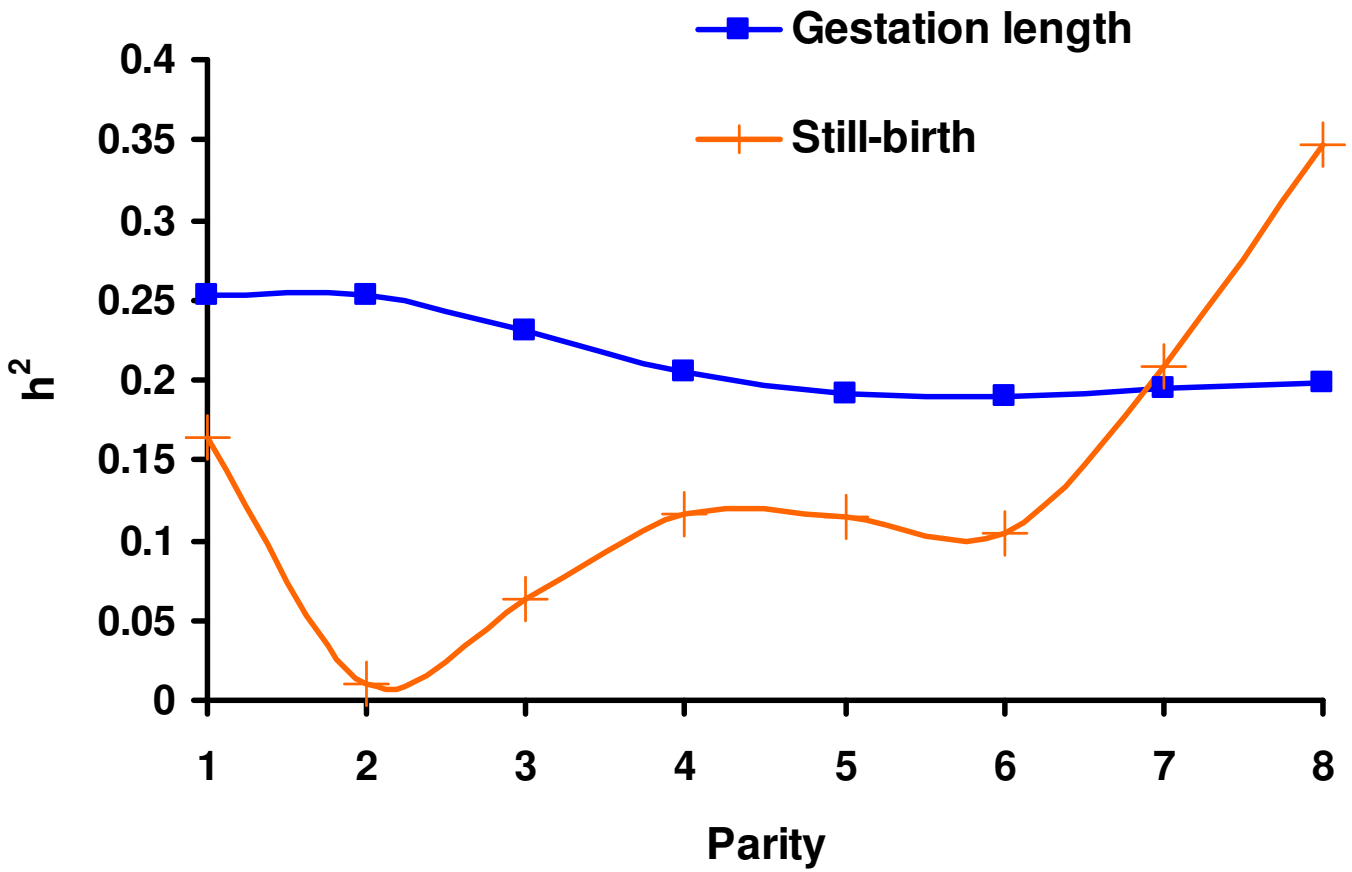
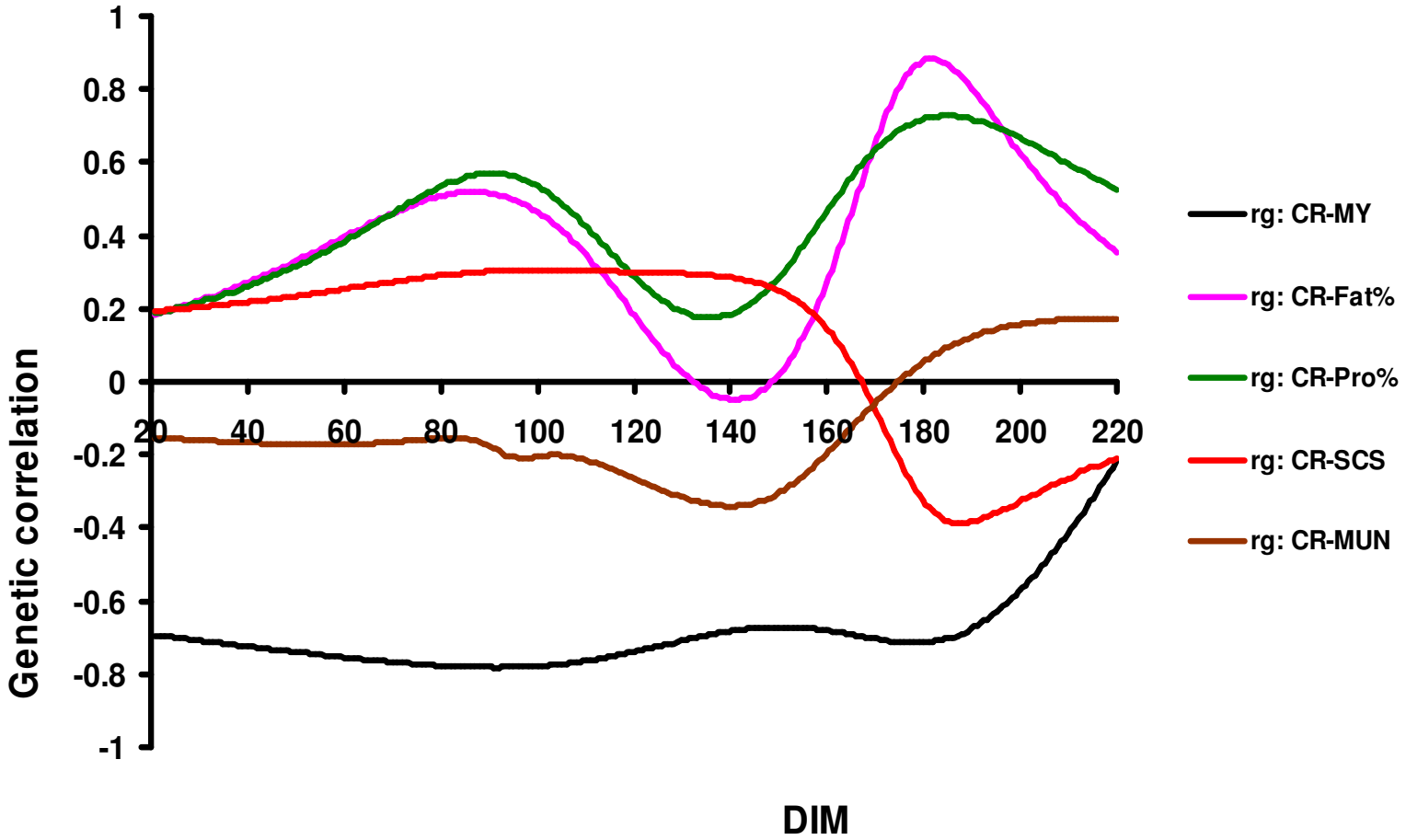


Results

- Daily relationships between conception rate (CR) and five Gaussian traits from model-3



Discussion

- Daily heritabilities of MY, Fat%, Pro%, Lac%, SCS and MUN followed the same pattern as found for high input production systems

- A positive correlation between MY and Fat%
  - possibilities of the mobilization of body fat reserves

- A positive correlation between MY and MUN implies
  - more energy goes to milk
  - an energy shortage for protein production
  - increased levels of MUN

Discussion

- Heritabilities of female reproduction traits were generally low, but
  - heritabilities of gestation length 0.21-0.25
  - heritabilities of calving to 1st service > days open and number insemination

- Genetic antagonism was found between CR and MY, and between CR and MUN

- Simulate daily observations of cows

- Set up suitable breeding programs

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Thank you for your attention !