ANIMAL MODEL IN ISRAEL

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Introduction

From 1986 a sire repeatability model was used in Israel for sire evaluation for production traits. In 1990 the Israel Cattle Breeders Association decided to implement the Individual Animal Model for routine evaluation of these traits.

Model

The repeatability Animal Model is described as follows:

$$\mathbf{Y}_{ijk} = \mathbf{HYS}_i + \mathbf{a}_j + \mathbf{p}_j + \mathbf{e}_{ijk}$$

Where $\mathbf{Y}_{ijk}$ is the k^{th} lactation of the j^{th} cow in the i^{th} herd-year-season; $\mathbf{HYS}_i$ is the fixed herd-year-season effect; $\mathbf{a}_j$ is the genetic effect of the j^{th} animal, including a random additive genetic effect and a fixed genetic group effect (Quaas, 1988; Westell, 1988); $\mathbf{p}_j$ is the random permanent environment effect and nonadditive genetic effects of the j^{th} cow; and $\mathbf{e}_{ijk}$ is a random residual effect associated with each record.

a $\sim(0,\mathbf{A}\sigma^2_a)$, p $\sim(0,\mathbf{I}\sigma^2_p)$, and e $\sim(0,\mathbf{I}\sigma^2_e)$, where **A** is the additive genetic relationship matrix, and **I** is an identity matrix (environmental terms are assumed to be independent). $\sigma^2_a/\sigma^2_t = \sigma^2_p/\sigma^2_t = 0.25$ for all three traits evaluated, where σ^2_t is total variance.

Lactation records were 305 day production for kg milk, kg fat or kg protein; precorrected for length of lactation, days open, freshening month, freshening age, and parity. Incomplete lactations were extended to 305 days. All HYS with valid records were included in the analysis.

Programming strategy

1. Process yield (SAS)
   - Read update yield records
   - Discard invalid data
   - Compute HYS
   - Assign index to HYS

2. Process pedigree (SAS)
   - Read update pedigree data
   - Find grandparents
   - Sort by sex, birth date, ID
   - Convert ID to IN
   - Assign unknown parents to groups

3. Prepare for iterations (FORTRAN)
   - Calculate coefficients due to groups and relationships

4. Iteration program (FORTRAN)
   - Obtain solutions for all model elements: a, p, HYS, G.

5. Prediction error variance evaluation (FORTRAN)
   - Compute REL .

6. Merge solutions, ID and REL (SAS).

Figure1. Main operational steps for animal model evaluation system. ID = identification number, IN = index number, a = additive genetic effect, p = permanent environment effect, HYS = herd-year-season effect, G = group effect, and REL = reliability. Computer languages used are given in parenthesis.

Solutions were computed for all effects in the model during each round of iteration. Each round required one pass through the processed lactation file and through the files containing the coefficients due to relationships and groups. Gauss-Seidel iteration (Van Norton, 1959) was used for HYS, sire and group effects. For cow additive genetic and permanent environment effects, Gauss-Seidel block iteration (Vargas, 1962) was applied. Starting values were zero for all the estimates.

The computing algorithm designed for this analysis requires retaining in memory only one value for each animal evaluated, the previous solution; in addition to four values for each HYS, the previous solution, the number of lactations and the sum of the lactations; two values for each phantom group; and the group x group block of the coefficient matrix.

Numbers and types of equations are given in Table 1.

Table 1. Numbers of equations solved by the Animal Model.

Effect	Number of equations
Genetic: cows	206,692
sires	811
unknown parent groups	41
Permanent environment	138,310
Herd-year-seasons	6744
TOTAL	**352,598**

Computing requirements and Results

All the computations were done on a Vax 4000/60 computer with 24 MB RAM memory. Each Gauss-Seidel iteration round required 219.9 sec. The G-S iteration required 5.2 Mb and the other programs less than 4 Mb. Prediction error variances were estimated by the method of Misztal and Wiggans (1988), as corrected by Misztal *et al.* (1991). Each PEV iteration required 45 sec.

The annual genetic and phenotypic trends for milk, fat and protein calculated from the estimated cow breeding values over nine years (1981-1989) are given in Table 2. The genetic trends are relatively large for kg milk, kg protein and kg fat and slightly negative for % fat and % protein. This agrees with the expectations according to the selection index applied in Israel in the last decade.

Table 2. Genetic and phenotypic annual trends for milk, fat (kg and %) and protein (kg and %)

Trait	Trends	
	Genetic	Phenotypic
Kg milk	128	84
Kg fat	2.36	-1.15
Kg protein	3.02	0.33
% fat	-0.017	-0.040
% protein	-0.0096	-0.023

References

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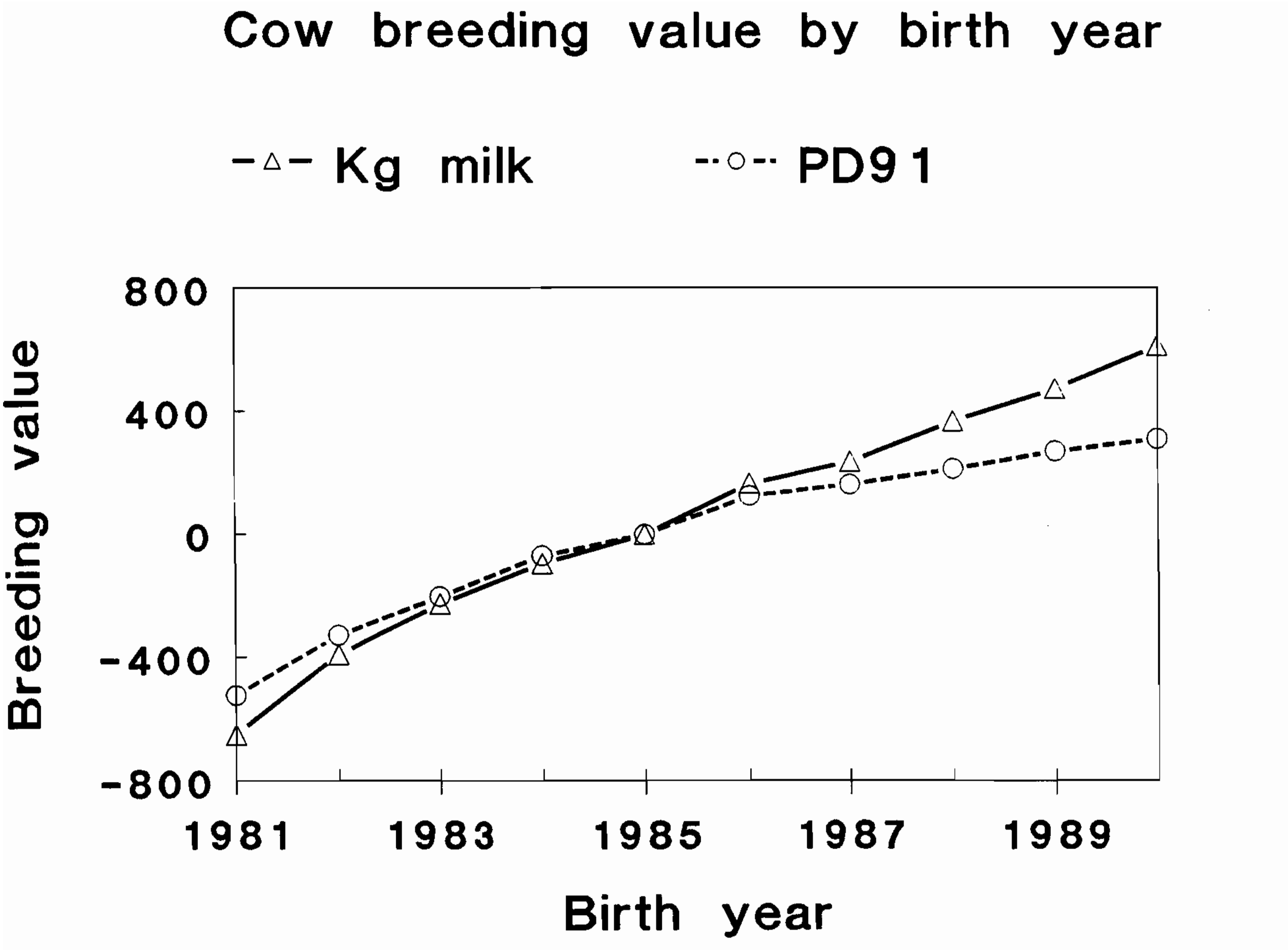
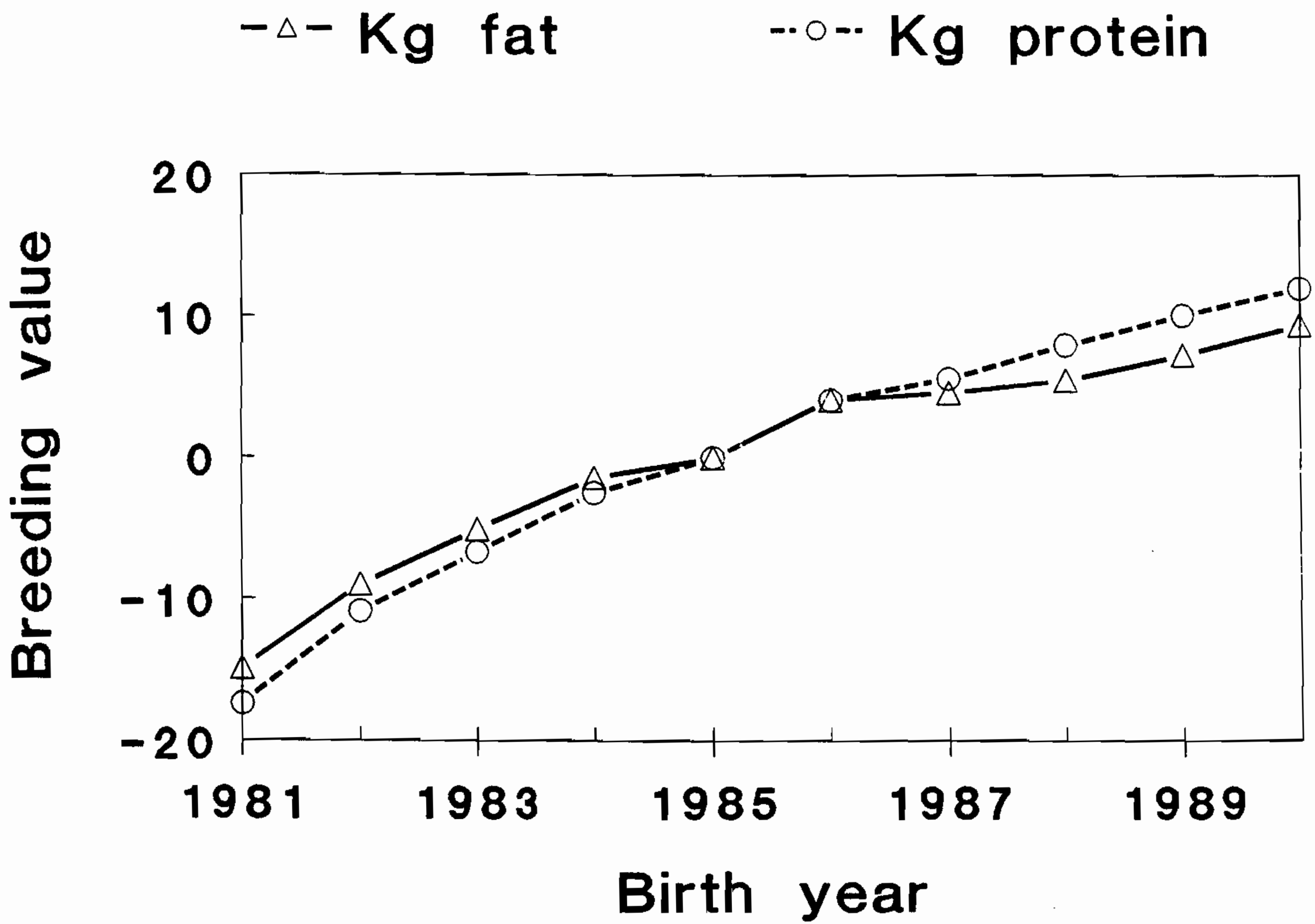
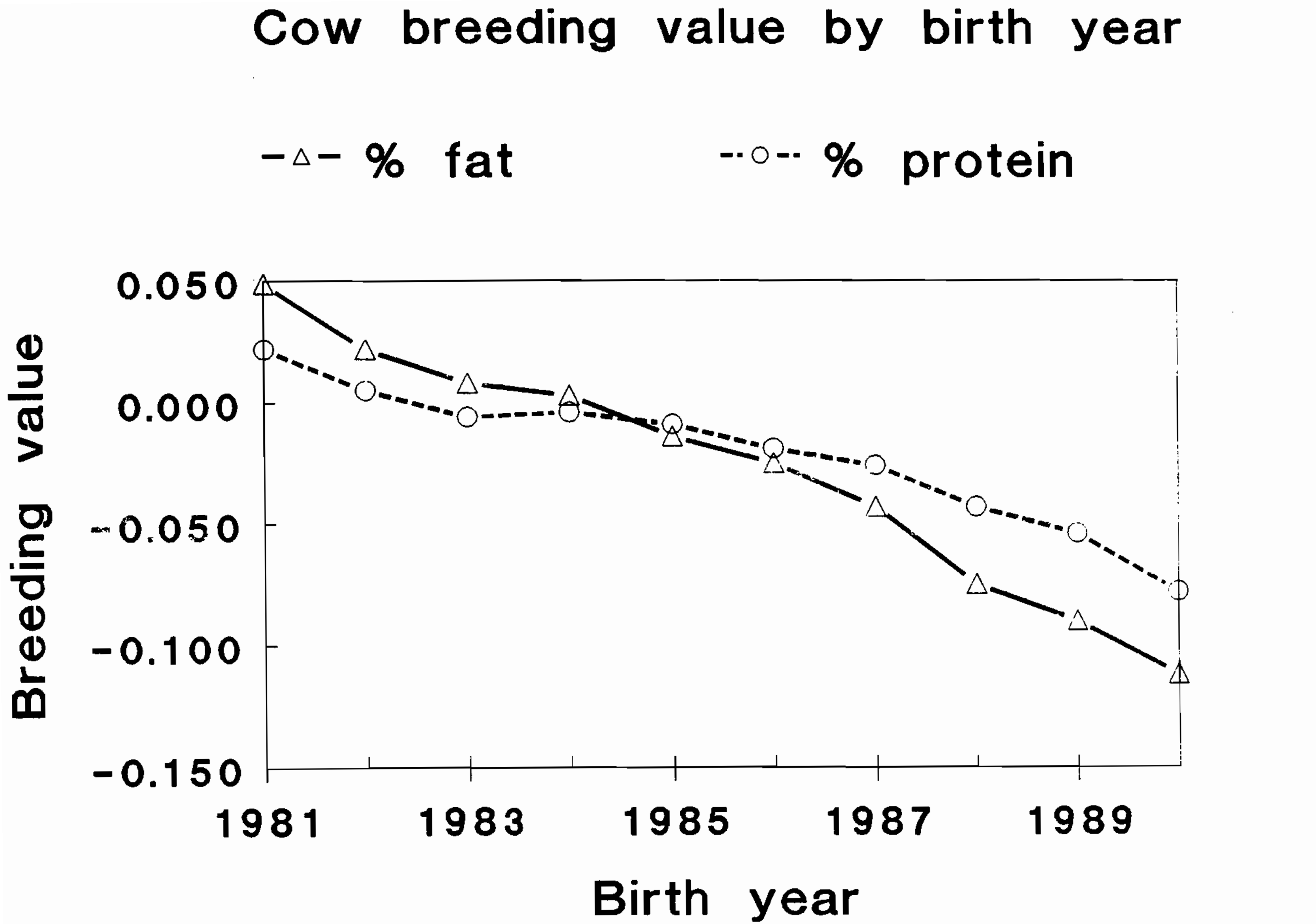

Cow breeding value by birth year
Kg milk
PD91
Breeding value
800
400
0
-400
-800
1981
1983
1985
1987
1989
Birth year

Cow breeding value by birth year




Cow breeding value by birth year
% fat
% protein
0.050
0.000
-0.050
-0.100
-0.150
Breeding value
1981
1983
1985
1987
1989
Birth year