Italian Test Day Evaluation: Improving Details that Matter

F. Canavesi[1], S. Biffani[1], F. Biscarini[1]
1 – ANAFI, Cremona, Italy

Abstract

With the introduction of the random regression multiple trait multiple lactation test day model in November 2004 as the official model for genetic evaluation for production traits and somatic cell score a big cultural change was requested to the industry and the breeders. In the effort to balance precision and stability of proofs over time some limits were discovered in the current model and some changes were introduced in February 2006 genetic evaluation. The scale of proof publication was chanced in order to reduce the size of changes from one run to the next. This change reduced variations at all level by 15-20% depending on trait. The genetic base was moved from a fixed to a rolling base system and the cows that define the base are now born between 1997 and 1999. This allow farmers to choose which sire to use in their herd comparing its value to the pluriparous cows of the population. This a review of all the changes that were introduced and of the future ones that are already being tested. Work is now ongoing to better define fixed regression curves taking into account time effect and days open effects. Future plans will implement a different method to compute reliability and compare it to the official system in order to reduce possible over or underestimations.

Introduction

The work towards the development of the genetic evaluation for production traits and somatic cell score using a multiple trait multiple lactation Random Regression Test Day Model (RRTDM) based on Legendre polynomials with the same approach and programs of the Canadian Test Day Model (Jamrozik *et al.,* 1997; Jamrozik *et al.,* 1998; Schaeffer *et al.,* 1999; Kistemaker, 2003) started in 2001. The RRTDM is official in Italy since November 2004.

From that day onward a big amount of time has been devoted to meeting farmers and industry people to explain the advantages of the new system and of all the additional information that can be used to better select the bulls that will help them increase their profit.
In the meantime research has started in order to improve the system and to address the many questions that users are raising while getting acquainted with the new system.

One of the big differences between the old lactation Repeatability Animal Model and the RRTDM is that the latter assumes a more dynamic way of expressing genetic superiority, along the lactation and across lactations, that brings with itself more variation over time in bull proofs.

The aim of this paper is to present some of the work that has been done on the Italian RRTDM in order to improve:

a) its acceptance and understanding by the farmers and the industry;
b) its ability to predict future lactations for all animals in the populations.

The Italian test day model

The basic frame of the multiple lactation multiple trait model developed at CDN was adapted to the Italian population especially in the definition of fixed regression curves. The general definition of Time, Region, Age, Parity and Season (TRAPS) was adapted to the Italian dairy production system and resulted in this final definition:

1. TIME: there are three different time periods accounted for, namely, 1988-1992, 1993-1997 and > 1997.

2. REGION: four Regions are defined, the same that were used for the old mature equivalent adjustment factors: North, Centre, South and Parmesan area. The four areas identify different seasonal patterns as well as different feeding systems.

3. AGE and PARITY: age and parity are stratified together in 19 classes according to the following scheme

Class	Parity	Age in month
1	1	< 24
2	1	25
3	1	26
4	1	27
5	1	28
6	1	29
7	1	30-31
8	1	>31
9	2	<36
10	2	37
11	2	38
12	2	39-40
13	2	41-43
14	2	>44
15	3	<50
16	3	51-52
17	3	53-54
18	3	55-56
19	3	>56

4. SEASON: two seasons of calving are defined, April to September and October to March.

Days-open are not accounted for in the current structure.

Figure 1 reports the fixed curves for the three time periods as an example from the November 2005 evaluation.

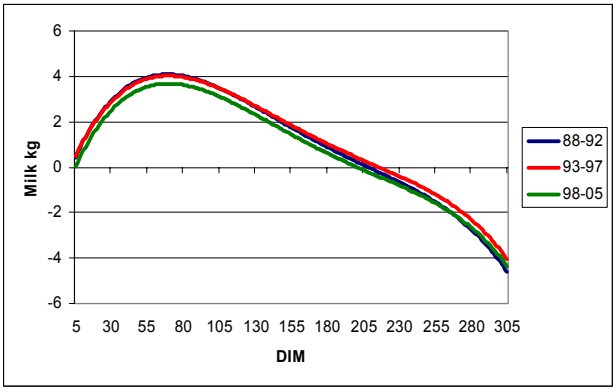

Figure 1. Fixed regression curves for milk yield of the three time periods for cows of 28 months of age, calving from April to September, in Region 1.

Table 1 report 305days genetic and permanent environmental correlations that were estimated on the Italian population.

Only test days from 5 to 305 days are used for the evaluation and only parity 1-3 are considered.

Official proof publication

For each animal the Model does compute a five parameters curve for each trait and lactation.

At present curves are only used for internal checks, published proofs are 305days cumulated production for lactation 1 to 3 for milk fat and protein yield and average daily level for somatic cell score.

The three lactations are standardized to the same scale, which in November 2004 was defined by a group of bulls and since February 2006 is the SD of third parity cows in the genetic base.

For official ranking the three lactations are combined as follows :

Milk, fat and protein yield

$$EBV305_{tot} = 0.333 \times EBV305_1 + 0.333 \times EBV305_2 + 0.333 \times EBV305_3$$

Somatic cell score

$$EBV_{tot} = 0.333 \times EBV_1 + 0.333 \times EBV_2 + 0.333 \times EBV_3$$

Other officially published proofs are TA for persistency and BV for maturity rate. Their proof scale has mean 100 and SD equal to 5 as all the other so called functional traits. Somatic cell score BV are also pulished as RBV with mean 100 and SD of 5.

Persistency is computed as the ratio between production at DIM 50-70 with production at DIM 270-290.

Maturity rate is the difference between BVs for fat and protein yield in third lactation and BVs for fat and protein production in first lactation.

Criteria for official proof publication are:

1) for Italian bulls: minimum of 70% reliability with daughters in at least 20 herds;

2) for Foreign bulls: minimum of 75% reliability with daughters in at least 20 herds;
3) for cows: minimum of 30% reliability with at least one TD after 60 DIM.

Changes in February 2006

The first changes to the RRTDM evaluation system were introduced in February 2006 and were:

1) change in the reference scale for proof publication;
2) change of the genetic base definition.

Reference Scale

When the RRTDM evaluation was developed it was agreed that the scale of the proofs was to be defined as much as possible to be close to the Lactation Repeatability Animal Model. For this purpose a group of bull born from 1995 to 1999 was chosen to define the scale. As a result all the proofs of the three lactations were scaled upward and as a consequence all the differences that were measured from one run to the next were amplified in their magnitude.

Table 2 reports the scaling factors for the three lactations that were used up to February 2006 and Table 3 the ones that are now applied.

Table 2. Scaling factors for the three lactations from November 2004 to November 2005.

	Parity 1	Parity 2	Parity 3
Milk	1.42	1.19	1.13
Fat	1.33	1.08	1.04
Protein	1.54	1.23	1.17

Table 3. Scaling factors for the three lactations from February 2006.

	Parity 1	Parity 2	Parity 3
Milk	1.24	1.03	1.00
Fat	1.29	1.02	1.00
Protein	1.29	1.03	1.00

This change had a big impact on the perception of changes from one evaluation to the next. The size of variations in subsequent genetic evaluation runs were reduced by 15-20% depending on the trait. The change affected more extreme bull and cow proofs than average proofs.

Genetic Base Definition

Since the genetic evaluation was started in Italy, a fixed genetic base system was adopted. Discussion raised each time the genetic base was updated, every 5 years. Some farmers felt that they had chosen some bulls thinking that they were higher than they actually were due to the fact that the base definition was getting "older". After few months of discussion it was decided to move to a rolling base system as in France and Canada. Genetic base animals are now born from 1997 to 1999, to ensure that the cows in the base have all the three lactation measured and not estimated based on genetic correlations. The genetic base group will change every year in the August evaluation run and move one year forward. In August 2006 the reference group will be born between 1998 and 2000.

The ongoing research

Two main areas are being investigated at the moment:

1) fixed effects definition;
2) reliability computation.

Fixed effects definition

At present changes of management systems over time are taken into account by time effect classes that group together 5 years or more. There is evidence (Figure 2) that after many years of steady increase production has started to decrease due to quota introduction and selection more towards quality of production.
Other tests showed that days open may have an effect especially on the last part of the lactation curve (Figure 3).

Some test are being run to assess the effect of residuals on proof stability over time to further improve the quality of the model applied to genetic evaluation.

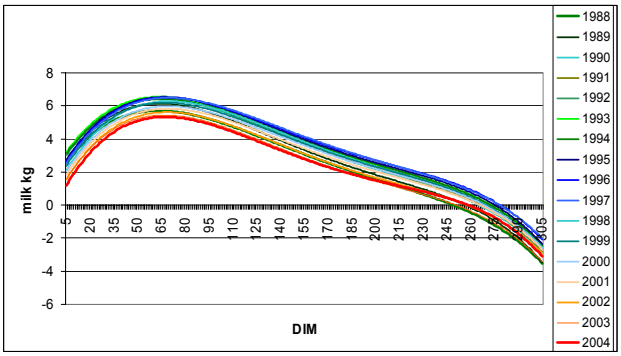

Figure 2. Fixed regression curves for milk yield of the 17 years of production for cows of 28 months of age, calving from April to September, in Region 1.

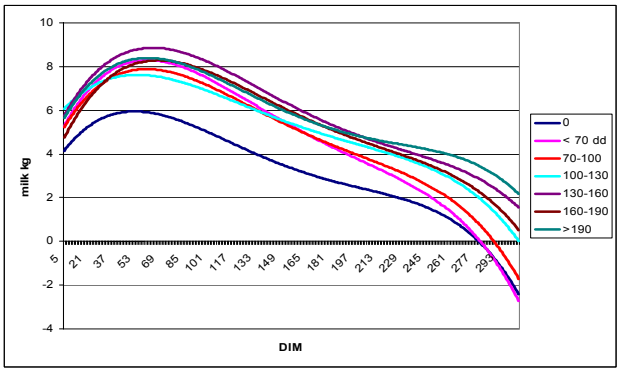

Figure 3. Fixed regression curves for milk yield of the 7 days.open classes on year 4 years of production for cows of 28 months of age, calving from April to September, in Region 1

Reliability computation

The method used for computation of reliability, developed by Jamrozik *et al.* (2000), has been shown by different studies to overestimate or underestimate reliability (Liu *et al.,* 2002; Stranden and Mäntysaari, 2004) . The project is to apply the method developed by Liu *et al.* (2004) to the same data set and compare the two systems for different groups of animals with different patterns of missing records in order to choose the system that gives the less biased approximation of reliability for all categories of animals.

Towards a more reliable system

Other possible tests envision re-estimation of genetic parameters and the possibility of running two separate genetic evaluations for production traits and somatic cell score with milk production only to take into account possible selection effects.

All this work is done with the ultimate goal of improving the general reliability of the system. In this case by reliability we also include the perception of reliability that the dairy industry and farmers themselves have toward the system.

In the world of test day models the balance between precision and stability seems to be harder to find than with the old lactation model. Perhaps it is only that we know still very little about the limits and the opportunities of test days. So there is plenty to do and to explore.

References

Jamrozik, J., Schaeffer, L.R. & Grignola, F. 1998. Genetic parameter for production traits and somatic cell score of Canadian Holsteins with a multiple trait random regression model. *6WCGALP 23,* 303-306.

Jamrozik, J., Schaeffer, L.R., Liu, Z. & Jansen, G. 1997. Multiple trait random regression test day model for production traits. *Interbull Bulletin 16,* 43-47.

Jamrozik, J., Schaeffer, L.R. & Jansen, G.B. 2000. Approximate accuracies of prediction from random regression models. *Livest. Prod. Sci. 66,* 85-92.

Kistemaker, G.J. 2003. The Canadian Test Day Model using Legendre Polynomials. *Interbull Bulletin 31,* 202-204.

Liu, Z., Reinhardt, F. & Reents, R. The multiple trait effective2002. *7thWCGALP 32,* 553-556.

Liu, Z., Reinhardt, F., Bünger, A. & Reents, R. 2004. Derivation and Calculation of Approximate Reliabilities and Daughter Yield-Deviations of a Random Regression Test-day model for genetic evaluation of Dairy Cattle. *J. Dairy Sci. 87,* 1896-1907.

Muir B. 2003. Personal communication.

Schaeffer, L.R., Jamrozik, J., Kistemaker, G.J. & Van Doormal, B.J. 2000. Experience with a test day model. *J. Dairy Sci. 83,*1135-1144

Strandén, I. & Mäntysaari, E.A. 2004. Comparison of two methods to approximate reliabilities of breeding values from test-day models. *55th EAAP Annual Meeting*, 90.

Table 1. 305days parameters for the Italian RRTDM, heritability (average daily) on the diagonal, 305 days genetic correlations below the diagonal, 305days PE correlations above the diagonal (Muir, 2003).

	m1	f1	p1	sc1	m2	f2	p2	sc2	m3	f3	p3	sc3
m1	**.30**	.86	.97	-.18	.48	.37	.47	-.02	.36	.30	.36	.05
f1	.51	**.27**	.88	-.15	.40	.50	.44	-.02	.27	.40	.33	.02
p1	.88	.62	**.28**	-.15	.47	.41	.50	-.01	.35	.33	.39	.06
sc1	.12	-.04	.12	**.17**	-.09	-.08	-.09	.36	-.07	-.05	-.06	.26
m2	.79	.42	.70	.01	**.30**	.88	.97	-.24	.42	.39	.45	.02
f2	.40	.82	.49	-.09	.63	**.29**	.90	-.27	.33	.48	.40	-.01
p2	.67	.54	.79	.03	.90	.73	**.30**	-.22	.43	.44	.49	.03
sc2	.13	.00	.13	.49	-.03	-.09	-.01	**.21**	-.14	-.16	-.15	.44
m3	.70	.35	.63	.05	.86	.51	.78	-.02	**.33**	.88	.97	-.23
f3	.37	.75	.47	-.03	.51	.84	.63	-.06	.66	**.31**	.91	-.25
p3	.57	.45	.69	.07	.74	.60	.85	-.01	.90	.75	**.33**	-.21
sc3	-.01	-.04	-.01	.43	-.17	-.14	-.16	.52	-.21	-.18	-.17	**.25**