Net Merit receives face-lift

Changes put more weight on fitness traits. Stillbirth rate incorporated into calving ability index.

by Tony Seykora, Paul VanRaden, and John Cole

THE Net Merit (NM$) formula has been updated for the third time since it was first introduced by USDA in 1994. The August 2006 revision updates economic values and correlations between traits, accounts for a revised definition of productive life (PL), and is influenced by two new genetic traits: service sire stillbirth (SSB) and daughter stillbirth (DSB) as part of a calving ability composite (CA$).

What are the changes to NM$?

NM$ is defined as the difference in expected lifetime profit as compared with the average genetic merit of cows within that breed born in 2000. The history of relative weights for NM$ is shown in Table 1. Emphasis on production traits has been reduced over time and has made room for additional fitness traits.

Table 1. History of NM$ weights

Trait	NM$ 1994	Holsteins NM$ 2000	NM$ 2003	NM$ 2006
Milk	6	5	0	0
Fat	25	21	22	23
Protein	43	36	33	23
PL	20	14	11	17
Somatic cell score	-6	-9	-9	-9
Udder composite		7	7	6
Feet and legs composite		4	4	3
Body size composite		-4	-3	-4
DPR			7	9
CA$*			4	6

*Available only for Holsteins and Brown Swiss

The production traits (fat and protein) now account for 46 percent of the index. PL accounts for 17 percent. Together, somatic cell score and udder composite account for 15 percent. Reproduction (daughter pregnancy rate (DPR) and CA$ accounts for 15 percent. Body size and feet-and-legs composites account for 4 and 3 percent, respectively.

So how much are bulls going to rerank?

The correlation between NM$ 2003 and NM$ 2006 is 0.975. In other words, revising the Net Merit formula caused only small changes in NM$ for most A.I. bulls. However, bulls that are excellent for PL, DPR, and CA$ may have gone up considerably in the rankings, more closely reflecting their daughters' economic merit.

What about specific traits?

Productive life (PL): Previously, cows received no credit after the first 10 months of each lactation or after 7 years of age. Beginning this August, cows continue to get PL credit as long as they are producing milk in the herd. PL credits are now based on standard lactation curves with highest credits at the peak of lactation and diminishing credits per month as the lactation progresses so that a cow with multiple lactations receives more credit than a cow with just one long lactation.

The range of predicted transmitting abilities (PTAs) for PL has gone up by about 40 percent. Credits for longer lactations and additional life after 84 months of age are the two major factors. The higher relative weight on PL in NM$ 2006 is due to this greater variation in PTAs for PL and higher costs for replacement females.

Calving ability composite (CA$): This is a new composite economic trait that includes service sire calving ease (SCE) and daughter calving ease (DCE) in addition to service sire and daughter stillbirth (SSB and DSB). CA$ is the lifetime dollar value benefit of less calving difficulty and fewer stillbirths. In the calculation of CA$, calving ease receives 40 percent of the emphasis and stillbirth receives 60 percent.

The relative weight of CA$ rose from 4 percent in NM$ 2003 to 6 percent in NM$ 2006 due to the addition of the stillbirth evaluations. CA$ has a genetic correlation of 0.85 with the combined SCE and DCE values used in NM$ 2003.

Body size: Because actual cow weights are not available for the national genetic evaluations, body size composites (BSC) are calculated with the following formulas. For Holsteins and non-Jersey breeds:

BSC = 0.50 (stature) + 0.25 (strength) + 0.15 (body depth) + 0.10 (rump width);

for Jerseys:

BSC = 0.50 (stature) + 0.40 (strength) + 0.10 (rump width).

A unit of body size composite is equivalent to about 24 pounds of mature cow weight. The body size composite was first included in NM$ 2000 at a 4 percent relative weight because it costs more to feed larger cows for body maintenance than is returned from income from larger calves and larger cows at culling. Recent research has also shown negative genetic correlations between body size and fertility, longevity, and calving ability.

Yield traits: The overall relative emphasis on yield dropped from 55 percent in NM$ 2003 to 46 percent in NM$ 2006. Several factors contributed to this decline:

1. more emphasis on PL and CA$
2. higher energy costs for cooling and transporting milk
3. no gain in milk prices paid to producers despite much inflation in labor and other input costs relative to health and reproduction
4. higher health costs associated with genetic selection for higher milk production as shown by several recent studies

The other traits in NM$, such as PL, DPR, and somatic cell score, account for replacement costs and some (but not all) health costs. Based on a review of recent studies, the value of higher milk production was reduced by 8 percent to account for those extra health costs.

To reflect average U.S. prices more accurately, fat and protein are weighted equally in NM$ 2006. U.S. prices for butterfat tend to be higher than world prices. Currently, about 50 percent of U.S. milk is used to make cheese, about 30 percent for fluid consumption, 15 percent for butter, ice cream, and other soft or frozen products, and 5 percent for powdered milk.

Table 2. Economic values of production traits

Index	Component value Volume*	Fat	Protein
	$/lbs.		
NM$	0.016	1.50	1.95
CM$	-0.010	1.50	2.80
FM$	0.057	1.50	0.57
Feed cost	0.012	0.35	0.50

*Volume is milk with fat and protein removed.

Because relative value of milk voume, fat, and protein differ by the end use of the milk, three different economic indexes are published: NM$, cheese merit index (CM$), and fluid merit index (FM$). The values of milk volume, fat, and protein use in the calculations, along with feed costs required to produce those components, are in Table 2. The value of milk with 3.5 percent fat and 3 percent protein was assumed to be $12.70 after hauling costs are deducted. Feed costs equal 31 percent of the milk price. The relative value of protein and volume change markedly whether the milk is sold as fluid or manufactured into cheese.

Which index should I use?

The majority of producers in the United States are paid for milk, fat, and protein such that they should select bulls based on NM$. However, producers in fluid markets like those in the Southeast that expect future premiums less than $1.20 per pound of protein should select on the fluid merit index (FM$). Producers who are paid more than $2.30 per pound of protein should select on the cheese merit index (CM$).

Can we make progress in the fitness traits?

Yes, we can! The theoretical response to selection for NM$ in PTA change per year and genetic value change per decade is given in Table 3.

The change in genetic value equals twice the expected progress for PTA. Thus, multiplication of annual PTA gain by 20 gives expected genetic progress per decade. Predicted results are encouraging in that all traits should change in the desired direction. An increase of 1.4 percentage points for DPR equates to about six fewer days open on average. An increase of $25 for CA$ indicates that lost income due to calving difficulty and stillbirths will average $25 less over the lifetime of each cow.

Table 3. Expected genetic progress from NM$

PTA trait	PTA change/year	Genetic value change/decade
Milk (pounds)	86	1,720
Fat (pounds)	3.8	76
Protein (pounds)	2.6	52
PL (months)	0.30	6.0
Somatic cell score (log SCC)	-0.017	-0.34
Udder composite	0.04	0.80
Feet and legs composite	0.03	0.60
Body size composite	-0.04	-0.80
DPR (%)	0.07	1.4
CA$	1.30	25

How to use NM$ . . .

When selecting bulls, start from the top of the list of bulls ranked by NM$. Availability and semen price definitely need to be taken into account. Many producers will feel more confident in selecting bulls that have more daughters distributed in many herds. Avoid bulls with high SCE for use on heifers. Mate selected bulls to individual cows to minimize inbreeding by pedigree inspection within breed or by crossbreeding.

Avoid the following:

1. Minimum standards for individual traits, such as specifying that selected bulls need to be +1,000 pounds for milk, +1.50 for udder composite, and +1.00 for daughter pregnancy rate. The traits included in NM$ are already properly weighted. A high NM$ bull that is low for one trait compensates by being higher for other traits.

2. Selection for economically unimportant traits. For example, PTA type is not in NM$ because research has shown that, after accounting for udder and feet-and-legs composites, PTA type adds no value. In fact, high PTA type bulls tend to sire daughters that are too tall, too flat in the rump, and way too sharp for optimal milk production, health, and longevity.

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