Presented at the INTERBULL Open Meeting, Prague, Czech Republic, September 7, 1995.

MACE as an Alternative to Conversion Formulae for Linear Type Evaluation of US and Foreign Bulls

Kent A. Weigel
University of Wisconsin, USA

Objective: The objective of this study was to examine the potential of MACE methodology as an alternative to regression-based conversion procedures for type evaluation of European and Canadian bulls in the USA.

Data: Data for the current study were obtained from five countries. Bulls born in 1980 or later were considered. Genetic correlations were calculated using all bulls with proofs in both the importing (USA) and exporting countries. Bulls with ≥ 15 daughters in 10 herds were included in the MACE analyses, and bulls with ≥ 75% reliability in both the importing and exporting countries were used in Wilmink conversions. Bulls with ≥ 90% reliability in the home country were used to develop conversion formulae from MACE solutions.

			Number of Bulls		
Country	Date	MACE	Correlation estim.	Wilmink conv.	MACE conv.
USA	Jan. 1995	8834			
Canada	Jan. 1995	2999	293	254	367
Germany	Dec. 1994	1479	83	75	143
Italy	Jan. 1995	1639	162	161	352
Holland	Mar. 1995	3139	174	155	578

Methods: MACE analyses were conducted in a pairwise manner; i.e., USA and Canadian bulls, USA and German bulls, etc., so four analyses were done for each trait. Genetic correlations between countries were estimated as the correlation between sire solutions for bulls with evaluations in both countries divided by the product of the square root of average reliability within each country (Calo method). Variances of sire transmitting abilities for each trait within each country were estimated using the simple iterative procedure of Schaeffer et al. (1995 ADSA Symposium). Conversion formulae were calculated using the Wilmink procedure with bulls having at least 75% reliability in both countries. MACE conversion formulae were calculated by regression of MACE breeding values in the importing country on those in the exporting country for bulls with ≥ 90% reliability in the exporting country (b values were inflated if bulls proven in USA only were included).

Results and Summary: Estimated genetic correlations between USA traits and corresponding traits in other countries ranged from .47 to .99 due to differences in trait definitions among countries. Estimated correlations between the USA and Germany were lowest, most likely due to the smaller number of bulls with proofs in both countries. Correlations estimated using the Calo method were 4% to 15% larger than estimates obtained from Wilmink conversion analyses, although differences were slightly smaller if minimum reliability limits were used with the Calo method. Rank correlations between MACE evaluations in the home country and those in the USA were from .71 to .99, which indicates that the ability of MACE to accomodate re-ranking among countries is more important for type traits than for production traits. This also indicates the importance of using MACE solutions, rather than the MACE conversion formulae, for type traits. Means and standard deviations of MACE and (Wilmink) converted evaluations were similar for most traits, and Wilmink and MACE conversion formulae did not differ substantially. It is important to consider possible biases in international evaluations of economically important secondary traits due to differences in trait definition. For example, type traits may be scored subjectively taking into account level of milk production. Correlations between EBV milk and EBV final type score in each country were as follows: USA .15, CAN .08, DEU .22, ITA .33, and NLD .41. MACE should provide more accurate international breeding values for extreme bulls than regression-based conversion formulae; conversions for extreme bulls have up to 15% higher standard error than for average bulls for production traits under intense selection, but this may be less important for type traits.

TABLE 1. Trait definition (line 1), estimated variance of sire transmitting ability (line 2), and correlation with USA trait (line 3). In line 3: left value = estimated genetic correlation between foreign trait and USA trait using Calo procedure, middle value = estimated genetic correlation between foreign trait and USA trait using Wilmink conversion procedure, right value = rank correlation between USA MACE evaluation and home-country MACE evaluation.

USA	CANADA	GERMANY	ITALY	HOLLAND
STATURE 1.22	STATURE 26.2 .99 .90 .99	STATURE 200 .93 .78 .94	STATURE 1.72 .97 .90 .99	STATURE 30.6 .97 .89 .93
STRENGTH 1.16	CHEST WIDTH 30.1 .93 .84 .97	CHEST WIDTH 202 .95 .81 .93	STRENGTH 1.75 .96 .89 .99	BODY DEPTH 26.1 .81 .75 .92
BODY DEPTH 1.03	FRAME/CAPACITY 27.9 .97 .87 .97	BODY DEPTH 202 .86 .74 .92	DEPTH 1.65 .97 .90 .99	BODY DEPTH 26.1 .88 .81 .94
DAIRY FORM 1.66	DAIRY CHARACTER 21.4 .90 .79 .94	ANGULARITY 217 .75 .67 .90	ANGULARITY 1.35 .85 .79 .97	MUSCULARITY 27.3 -.58 -.53 -.73
RUMP ANGLE 1.62	PIN SETTING 31.4 .86 .80 .98	RUMP ANGLE 218 .92 .82 .97	RUMP ANGLE 2.36 .99 .91 .99	RUMP ANGLE 30.2 .94 .89 .98
THURL WIDTH 1.22	PIN WIDTH 26.7 .90 .81 .95	RUMP WIDTH 189 .89 .77 .94	RUMP WIDTH 1.76 .87 .81 .96	RUMP WIDTH 30.3 .81 .75 .90
REAR LEG SET 2.22	REAR LEG SET 36.5 .86 .76 .98	REAR LEG SET 248 .83 .75 .94	LEGS SIDE 2.93 .90 .84 .96	REAR LEG SET 31.3 .81 .75 .94
FOOT ANGLE 1.95	FOOT ANGLE 34.1 .78 .72 .96	FOOT ANGLE 256 .47 .42 .71	FOOT ANGLE 2.52 .80 .74 .95	CLAW DIAGONAL 30.9 .63 .58 .76
FORE UDDER 1.57	FORE ATTACHMENT 31.1 .89 .81 .97	FORE UDDER 294 .58 .48 .80	FORE UDDER 2.70 .90 .83 .96	FORE UDDER 32.9 .84 .77 .91
UDDER HEIGHT 1.69	UDDER HEIGHT 26.2 .83 .78 .97	UDDER HEIGHT 253 .77 .67 .86	UDDER HEIGHT 2.32 .75 .71 .92	UDDER HEIGHT 29.1 .83 .76 .92
UDDER WIDTH 1.72	UDDER WIDTH 34.1 .80 .74 .97	UDDER HEIGHT 253 .62 .55 .77	UDDER WIDTH 1.79 .70 .66 .90	UDDER HEIGHT 29.1 .73 .65 .83
UDDER CLEFT 1.73	MEDIAN SUSPENS. 25.0 .86 .77 .98	CENTRAL LIGAMENT 219 .68 .56 .86	LIGAMENT 2.70 .86 .80 .96	UDDER SUPPORT 27.3 .87 .80 .95
UDDER DEPTH 2.06	FORE UDDER BKDN. 29.0 .72 .68 .83	UDDER DEPTH 239 .76 .66 .93	UDDER DEPTH 2.06 .96 .89 .99	UDDER DEPTH 30.7 .99 .91 .97
TEAT PLACEMENT 1.72	FORE TEAT PLACE. 27.8 .96 .86 .98	TEAT PLACE. 231 .81 .69 .95	TEAT POSITION 2.11 .83 .77 .95	TEAT PLACE. 28.8 .90 .80 .96
FINAL SCORE 0.73	FINAL SCORE 25.4 .86 .78 .96	FINAL SCORE 174 .73 .62 .79	FINAL SCORE .54 .84 .79 .90	FINAL SCORE 26.9 .87 .79 .86

TABLE 2. Means and standard deviations of actual evaluations for USA bulls and converted (using Wilmink procedure) and MACE evaluations (on USA scale) for bulls from five countries born in 1988 and 1989.

TRAIT		USA	CANADA		GERMANY		ITALY		HOLLAND	
		ACTUAL	CONV	MACE	CONV	MACE	CONV	MACE	CONV	MACE
STATURE	MEAN	.15	.88	.84	.09	.22	-.01	-.04	-.07	-.18
	SD	.96	1.03	.92	1.07	.90	1.00	1.00	1.19	.93
STRENGTH		.09	.56	.68	.44	.11	-.06	-.13	-.02	-.27
		1.03	1.03	.89	.97	.90	1.02	1.06	1.06	.92
BODY DEPTH		.20	.66	.74	.40	.22	-.02	-.11	-.01	-.21
		1.03	.99	.95	.97	.90	1.07	1.06	1.13	.97
DAIRY FORM		.94	.08	.27	.02	.29	.33	.48	.44	.61
		1.08	1.05	1.09	1.08	.91	.83	.92	.83	.69
RUMP ANGLE		.02	-.41	-.40	-.16	-.06	.05	.07	.12	.09
		1.27	1.13	1.11	1.27	1.10	1.23	1.26	1.20	1.02
THURL WIDTH		.06	.60	.70	.18	.08	-.30	-.21	-.05	-.30
		1.06	1.10	1.01	.94	.94	1.08	1.11	1.01	.87
REAR LEG SET		-.14	.04	.07	.03	-.08	-.25	-.24	-.07	-.24
		1.23	1.05	1.07	1.04	.94	1.09	1.16	1.16	1.16
FOOT ANGLE		.14	.01	-.02	.25	.20	-.11	.02	.20	.03
		1.12	.86	.86	.50	.78	1.09	1.07	.79	.90
FORE UDDER		.24	.79	.62	.12	.11	-.05	.00	-.05	-.27
		1.03	.85	.90	.63	.79	.78	.95	.90	.78
UDDER HEIGHT		.30	.72	.67	.21	.05	.00	.05	.04	-.10
		1.02	.90	.94	.73	.80	.77	.88	.98	.82
UDDER WIDTH		.41	.57	.65	.28	.13	.06	.16	.19	-.01
		1.01	.86	.98	.58	.70	.75	.87	.79	.76
UDDER CLEFT		.22	.20	.21	.43	.11	.13	.06	.04	-.03
		1.07	.84	.91	.68	.75	.77	.92	1.01	.82
UDDER DEPTH		-.02	.66	.52	.36	.14	-.08	-.01	-.59	-.40
		1.24	.92	.89	.91	.95	1.19	1.31	1.28	1.05
TEAT PLACEMENT		.09	.07	-.02	.36	.12	.00	.05	-.22	-.18
		1.19	1.13	1.12	1.02	.91	1.06	1.00	1.10	.93
FINAL SCORE		.39	.57	.58	.30	.24	.05	.13	.02	-.07
		.75	.62	.64	.54	.57	.47	.58	.72	.63

TABLE 3. Estimated "a" and "b" coefficients for converting type evaluations from each of four countries to the USA using the Wilmink (WILMK) procedure or regression of USA MACE evaluations on home country MACE evaluations.

		CANADA		GERMANY		ITALY		HOLLAND	
		a	b	a	b	a	b	a	b
STATURE	WILMK	.24	.245	-9.48	.095	-.20	.832	-28.9	.283
	MACE	.26	.224	-8.51	.086	-.22	.835	-21.5	.212
STRENGTH		.38	.217	-7.59	.084	.04	.796	-24.7	.246
		.41	.202	-7.74	.082	.01	.826	-18.8	.188
BODY DEPTH		.31	.206	-7.64	.082	-.15	.820	-26.4	.263
		.31	.198	-8.17	.085	-.19	.803	-20.1	.201
DAIRY FORM		-.96	.267	-9.82	.096	-.55	.852	21.7	-.216
		-.89	.262	-9.40	.092	-.76	.993	19.4	-.197
RUMP ANGLE		.03	.221	-10.28	.099	-.02	.812	-28.0	.280
		-.05	.210	-8.93	.086	.02	.835	-23.1	.231
THURL WIDTH		.40	.220	-7.72	.082	-.28	.840	-24.2	.241
		.42	.217	-8.64	.089	-.14	.834	-19.4	.194
REAR LEG SET		.07	.212	-9.58	.096	-.34	.760	-26.6	.264
		.06	.224	-9.48	.094	-.29	.809	-24.8	.246
FOOT ANGLE		-.10	.188	-4.38	.046	-.12	.817	-20.8	.210
		-.22	.208	-9.50	.094	-.07	.865	-19.8	.199
FORE UDDER		.36	.187	-4.79	.048	-.18	.567	-22.5	.226
		.20	.208	-6.89	.067	-.25	.674	-20.7	.206
UDDER HEIGHT		.11	.211	-6.49	.068	-.36	.645	-26.7	.265
		-.02	.226	-8.74	.088	-.43	.702	-22.9	.227
UDDER WIDTH		.26	.158	-5.04	.054	-.51	.681	-21.4	.214
		.10	.188	-8.18	.082	-.58	.746	-20.6	.205
UDDER CLEFT		-.37	.219	-6.35	.066	-.25	.575	-29.2	.289
		-.47	.235	-9.18	.090	-.46	.677	-25.0	.247
UDDER DEPTH		.13	.209	-7.73	.080	.00	.892	-33.2	.328
		.05	.223	-10.18	.101	.01	.974	-26.4	.260
TEAT PLACEMENT		-.25	.253	-8.41	.087	-.32	.836	-28.7	.287
		-.35	.249	-9.73	.097	-.41	.862	-24.9	.249
FINAL SCORE		.12	.153	-5.98	.062	-.33	.837	-18.6	.184
		.04	.158	-7.83	.078	-.36	.939	-16.0	.159