

Introduction

The latest routine international evaluation for udder traits took place as scheduled at the Interbull Centre. Data from thirty-three (33) countries were included in this evaluation.

International genetic evaluations for udder health traits of bulls from Australia, Austria-Germany, Belgium, Canada, Croatia, Czech Republic, Denmark-Finland-Sweden, Estonia, France, Hungary, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, South Africa, Slovak Republic, Spain, Switzerland, the United Kingdom, the United States of America, Poland, Lithuania, Latvia, Croatia, Slovenia, Portugal and Uruguay were computed. Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed data were included in this evaluation.

Countries sending real MAS data (other countries participate to the MAS evaluation using SCS data as predictor):

HOL : DFS, NLD, FRA, CAN, ITA, CHE, USA, DEU, GBR, AUS
RDC : DFS, NLD, CAN, GBR, AUS
BSW : NLD, FRA, CHE, GBR, USA
JER : DFS, NLD, CAN, GBR, AUS, USA
SIM : NLD, CHE, GBR
GUE : No evaluation for MAS yet

Changes in national procedures

Changes in the national genetic evaluation of uder traits are as follows:

ITA (SIM) Base change
KOR (HOL) Correction in some animals' information causing some animals to no longer be submitted
JPN (HOL) Some changes in proofs caused by additional records and in EDCs caused by modification of pedigree.
DFS (HOL,RDC) Some drops in information due to editing checks of fertility and calving infomation: check if the herd is participating in disease regristration and if the fertility registrations is in agreement with calving informations. If not, the record is deleted.
FRA (ALL) Base change, HOL & SIM/MON: Several missing bulls in current submission some traits. Those bulls don't appear among the publication files provided for this run. Bulls affected concern « old » bulls, 98% of them being born before 1995. Moreover, pedigree updates have also been carried out. SIM &MON: Used to participate with very old data now removed from the evaluation
AUS (ALL) Drops in information due to data clean-up such as pedigree changes, status change of a bull which leads to a good number of bulls no longer being qualifying.
CAN (ALL) Base change
DEU (ALL) Base change
CHE (ALL) Base change. BSW: Manual edits in the database due cause some drops in information. The scs evaluation for BSW now runs univariat and no longer multivarait with mil, fat and pro as before. The heritability and the genetic variances for scs remain unchanged
DEA (BSW, SIM) Some drops in information due to ongoing pedigree corrections based on results from ongoing genotyping of females in the populations.
SVN (HOL, BSW) Base change
POL (HOL) New organisation, CGen, replacing NIAP. New model and estimated new genetic parameters as part of a single step evaluation. New base change to be aligned with production traits. Only bulls with a minimum number of 10 herds were submitted. A new data editing pipeline has been implemented including stricter filters on herd size, contemporary group size, outliers identification, and the cows' breed causing a reduction in the number of daughters and herds for almost all the bulls in the evaluation. Applied the mtedc software for EDC calculation. Changed Type Of Proof from 12 to 11 due to a new procedure for setting type of proof: The previous procedure counted daughters based on milk yield and used this information to set the bulls type of proof for all traits. Currently, the Type Of Proof is based on each trait-specific daughter count. Pedigree clean-up and verification. Some animals appear to be missing in this evaluation because they were either identified as duplicate of another animal during predigree clean-up or dropped in the numbers of daugters or herds below publication criteria or there were breed inconsistency of bulls which actually were not HOL
ITA (HOL) Base chnage, Drim of one year of phenotypic data. MAS: Different statistical model applied with change in variance components: Information about differential somatic cell count (DSCC) has been added, Pluriparae information included (maximum parity order 3), stricter editing criteria causing drops in information: filtered for age at calving within parity, removed outliers for SCS and DSCC, for inclusion of the lactation, the first test day (TD) must be within 60 days in milk (DIM) while the maximum distance between 2 consecutives TDs must be <= 70 DIM. Moreover, at least 3 TDS are needed to consider a lactation.
ITA (BSW) Base change
EST (HOL, RDC) Base change
NLD (ALL) Base change
ISR (HOL) Base change, Changes to edits and correction factors, which resulted in slight reductions in the number of herds and daughters for some bulls
USA (ALL) Base change, drops in information due to pedigree accuracy and herd-year minimum edits.
URY (HOL) Base change
GBR (ALL) Few drops in infromation due to data updates from milk recording companies
NZL (ALL) Some drops in information, especially EDC, added a filter for which if a daughters breed didn't match a bulls breed the daughter got dropped from a bulls proof, this has affected the national herd because of the number of cross bred animals present. GUE: Used to participate with very old data now removed from the SCS evaluation
LVA (HOL, RDC) New legal organisation called Rural Support Service - LAD. Changes in data selection have been made using our new recording system, CILDA, removing daughters with unfinished lactations. Causing drops in information and some bulls not been submitted anymore
CZE (HOL) Changed the in-house solver to Misztal's BLUPF90. Reliability is now computed using ACCF90 while before it was calculated via a simple method based on EDCs. Base change.

Trimmed old bulls, born before 1992, which used to have "N" status for publication.
LTU (HOL, RDC) New database with merging of registered and breeding animals.
PRT (HOL) Base change, new variance components and new heritabilities, drops in EDC due to changes in pedigree
HUN (SIM) The lower limit for the date of lactation was changed from 1999 to 2000.

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

A new document called confdoc_DEFINITION{runid}.itb has been introduced reporting all the trait definitions applied by countries as reported in the PREP.

During 2023-2024, Interbull Centre and the Interbull Technical Committee (ITC) have worked on developing a new procedures for adjusting of the international correlations after a given test run in case countries would decide NOT TO implement the changes tested in the next routine run. Until now, the relative difference between the previous routine's and test run's correlations, for each pair of countries, was assessed and the average value of the two was used whenever such difference did exceed a threshold of 0.01. Otherwise, correlations from the latest test run were used. However, in some cases, the difference in correlations between routine/test runs were way above a 1% difference so that by using the average value the newly derived correlations would still be greatly affected by the changes tested but not implemented. This remark has been made in few occasions by some participating countries. A new approach proposed by Peter Sullivan, was developed and extensively tested. The new approach is based on first identifying the relative impact of the changes tested by a country during the test run (but not implemented in a routine run) and then correcting the whole correlation matrix detracting such estimated impact. This new approach would assure that the new correlations would be free from any effect from any changes tested but not implemented. The new procedure has been fully developed during 2023 and extensively tested during 2024 and introduced officially in the April 2025 routine evaluation.

DATA AND METHOD OF ANALYSIS

Data were national genetic evaluations of AI sampled bulls with at least 10 daughters or 10 EDC (for clinical mastitis and maternal calving traits at least 50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at least 10 herds. Table 1 presents the amount of data included in this Interbull evaluation for all breeds.

National proofs were first de-regressed within country and then analysed jointly with a linear model including the effects of evaluation country, genetic group of bull and bull merit. Heritability estimates used in both the de-regression and international evaluation were as in each country's national evaluation.

Table 2 presents the date of evaluation as supplied by each country

Estimated genetic parameters and sire standard deviations are shown in APPENDIX I and the corresponding number of common bulls are listed in APPENDIX II.

SCIENTIFIC LITERATURE

The international genetic evaluation procedure is based on international work described in the following scientific publications:

International genetic evaluation computation:
Schaeffer. 1994. J. Dairy Sci. 77:2671-2678
Klei, 1998. Interbull Bulletin 17:3-7

Verification and Genetic trend validation:
Klei et al., 2002. Interbull Bulletin 29:178-182.
Boichard et al., 1995. J. Dairy Sci. 78:431-437

Weighting factors:
Fikse and Banos, 2001. J. Dairy Sci. 84:1759-1767

De-regression:
Sigurdsson and G. Banos. 1995. Acta Agric. Scand. 45:207-219
Jairath et al. 1998. J. Dairy Sci. Vol. 81:550-562

Genetic parameter estimation:
Klei and Weigel, 1998, Interbull Bulletin 17:8-14
Sullivan, 1999. Interbull Bulletin 22:146-148

Post-processing of estimated genetic correlations:
Mark et al., 2003, Interbull Bulletin 30:126-135
Jorjani et al., 2003. J. Dairy Sci. 86:677-679
<https://wiki.interbull.org/public/rG%20procedure?action=print>

Time edits
Weigel and Banos. 1997. J. Dairy Sci. 80:3425-3430

International reliability estimation
Harris and Johnson. 1998. Interbull Bulletin 17:31-36

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for the next routine evaluation can be found on
<http://www.interbull.org/ib/servicecalendar>.

NEXT TEST INTERNATIONAL EVALUATION

Dates for the next test run can be found on
<http://www.interbull.org/ib/servicecalendar>.

From this year an extra MACE test run has been scheduled in May, data submissions' deadline and target for distribution of results are all reported in the above link.

PUBLICATION OF INTERBULL ROUTINE RUN

Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honor the agreed code of practice, decided by the Interbull Steering Committee, and only publish international evaluations on their own country scale. Evaluations expressed on another country scale are confidential and may only be used internally for research and review purposes.

PUBLICATION OF INTERBULL TEST RUN

Test evaluation results are meant for review purposes only and should not be published.

^LTable 1. National evaluation data considered in the Interbull evaluation for udder health (April Routine Evaluation 2025).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		155	9030	1798	865	
BEL			2426			
CAN		112	14363	940	900	
CHE	289		3524	108		3784
CZE			4577			
DEA	6257					25707
DEU			25004		318	
DFS			14887	2405	8401	
ESP			4832			
EST			1495		502	
FRA	518		18770			503
FRM						4873
GBR	165	321	7867	824	627	110

HUN			3455			223
IRL			3276			
ISR			1834			
ITA	2258		9682	59		1953
JPN			7274			
KOR			1770			
LTU			981		363	
LVA			1453		674	
NLD	262		17667	300	114	568
NOR					4430	
NZL	85		9443	5405	1500	
POL			12101			
PRT			3184			
SVK			1216			
SVN	365		755			748
URY			2226			
USA	1227	756	43398	5532	798	118
ZAF			1206	625	125	
HRV			986			1069
CAM					50	
=====						
No.Records	14743	1344	228682	17996	19667	39656
Pub. Proofs	11640	1069	161902	14490	18403	35422

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

BSW scs

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.70									
FRA	0.91	1.03								
NLD	0.89	0.93	3.68							
USA	0.88	0.90	0.84	0.21						
CHE	0.88	0.94	0.94	0.79	10.43					
DEA	0.87	0.97	0.92	0.84	0.97	11.94				
NZL	0.70	0.75	0.74	0.65	0.71	0.63	0.37			
ITA	0.88	0.90	0.89	0.82	0.96	0.92	0.66	14.92		
GBR	0.93	0.96	0.94	0.90	0.93	0.94	0.79	0.89	11.39	
SVN	0.80	0.80	0.80	0.79	0.79	0.78	0.66	0.81	0.82	10.97

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.61									
FRA	0.81	0.96								
NLD	0.80	0.73	4.09							
USA	0.82	0.83	0.75	2.73						
CHE	0.87	0.86	0.86	0.78	11.57					
DEA	0.90	0.69	0.88	0.71	0.89	11.94				
NZL	0.68	0.64	0.64	0.64	0.69	0.73	0.37			
ITA	0.86	0.72	0.82	0.74	0.89	0.92	0.69	14.92		
GBR	0.83	0.83	0.82	0.80	0.80	0.72	0.63	0.75	2.29	
SVN	0.79	0.72	0.75	0.72	0.71	0.83	0.76	0.82	0.76	10.96

GUE scs

	CAN	GBR	USA	AUS
CAN	6.00			
GBR	0.92	13.67		
USA	0.92	0.90	0.25	
AUS	0.81	0.86	0.76	0.23

HOL scs

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	5.81																												
CHE	0.90	10.80																											
DEU	0.95	0.95	12.92																										
DFS	0.93	0.92	0.97	11.80																									
EST	0.89	0.88	0.94	0.92	17.78																								
FRA	0.95	0.94	0.96	0.96	0.90	1.14																							
GBR	0.94	0.93	0.96	0.94	0.90	0.96	12.89																						
NLD	0.92	0.94	0.97	0.94	0.91	0.94	0.96	4.24																					
USA	0.94	0.84	0.89	0.87	0.89	0.90	0.91	0.87	0.20																				
ISR	0.85	0.82	0.83	0.80	0.84	0.82	0.80	0.79	0.87	0.24																			
ITA	0.90	0.89	0.94	0.92	0.93	0.94	0.91	0.90	0.88	0.81	5.95																		
AUS	0.79	0.85	0.81	0.81	0.74	0.83	0.86	0.83	0.73	0.65	0.76	0.25																	
HUN	0.89	0.88	0.93	0.90	0.91	0.91	0.89	0.88	0.91	0.85	0.93	0.72	1.35																
BEL	0.92	0.92	0.97	0.96	0.94	0.96	0.93	0.94	0.89	0.80	0.94	0.79	0.92	0.52															
JPN	0.86	0.78	0.83	0.85	0.80	0.89	0.84	0.80	0.85	0.75	0.80	0.73	0.78	0.83	0.45														
ESP	0.93	0.90	0.95	0.94	0.91	0.96	0.93	0.91	0.91	0.85	0.94	0.76	0.92	0.96	0.81	11.88													
ZAF	0.90	0.88	0.91	0.89	0.86	0.93	0.90	0.88	0.89	0.80	0.92	0.82	0.90	0.91	0.83	0.94	26.31												
NZL	0.74	0.79	0.76	0.77	0.70	0.79	0.82	0.78	0.67	0.63	0.71	0.89	0.65	0.73	0.76	0.72	0.79	0.40											
IRL	0.81	0.90	0.86	0.86	0.80	0.86	0.88	0.88	0.77	0.73	0.80	0.81	0.81	0.85	0.75	0.83	0.82	0.80	0.12										
CZE	0.91	0.87	0.94	0.92	0.91	0.92	0.90	0.89	0.89	0.81	0.93	0.72	0.95	0.94	0.80	0.94	0.90	0.67	0.77	18.41									
SVK	0.84	0.84	0.90	0.89	0.88	0.89	0.83	0.83	0.84	0.80	0.89	0.69	0.92	0.92	0.77	0.91	0.88	0.61	0.80	0.92	0.40								
POL	0.88	0.86	0.93	0.91	0.91	0.90	0.88	0.88	0.84	0.79	0.90	0.73	0.93	0.93	0.77	0.91	0.85	0.67	0.81	0.91	0.87	13.41							
LTU	0.84	0.85	0.90	0.88	0.91	0.85	0.83	0.85	0.78	0.83	0.86	0.71	0.86	0.91	0.77	0.87	0.84	0.67	0.78	0.88	0.89	0.87	0.34						
LVA	0.86	0.90	0.93	0.93	0.93	0.90	0.90	0.90	0.84	0.79	0.91	0.80	0.91	0.94	0.79	0.90	0.87	0.77	0.84	0.91	0.86	0.92	0.88	481.31					
PRT	0.77	0.77	0.78	0.77	0.77	0.78	0.78	0.77	0.77	0.75	0.77	0.65	0.78	0.78	0.77	0.78	0.78	0.63	0.74	0.80	0.77	0.77	0.77	0.77	0.45				
KOR	0.88	0.82	0.87	0.89	0.85	0.86	0.89	0.84	0.86	0.80	0.87	0.78	0.84	0.86	0.81	0.87	0.82	0.73	0.72	0.84	0.78	0.85	0.80	0.87	0.77	0.33			
SVN	0.80	0.82	0.87	0.86	0.83	0.84	0.84	0.82	0.77	0.74	0.84	0.75	0.82	0.88	0.77	0.83	0.79	0.66	0.86	0.78	0.82	0.84	0.83	0.87	0.77	0.78	10.41		
HRV	0.77	0.78	0.80	0.78	0.83	0.77	0.78	0.78	0.78	0.76	0.79	0.66	0.83	0.82	0.77	0.80	0.78	0.58	0.74	0.78	0.78	0.82	0.82	0.84	0.77	0.78	0.78	11.63	
URY	0.77	0.80	0.83	0.80	0.78	0.81	0.78	0.79	0.77	0.75	0.78	0.76	0.79	0.82	0.77	0.79	0.82	0.74	0.76	0.77	0.80	0.82	0.79	0.78	0.77	0.77	0.79	0.77	0.20

HOL	mas																												
	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	7.74																												
CHE	0.93	11.15																											
DEU	0.90	0.88	9.42																										
DFS	0.94	0.88	0.89	12.25																									
EST	0.80	0.86	0.82	0.85	17.79																								
FRA	0.95	0.94	0.91	0.93	0.81	1.14																							
GBR	0.88	0.89	0.82	0.84	0.76	0.88	2.35																						
NLD	0.84	0.91	0.80	0.85	0.81	0.87	0.82	5.03																					
USA	0.87	0.83	0.85	0.83	0.77	0.89	0.82	0.79	2.50																				
ISR	0.74	0.74	0.74	0.78	0.85	0.74	0.69	0.75	0.72	0.24																			
ITA	0.85	0.90	0.75	0.80	0.83	0.86	0.79	0.90	0.75	0.73	7.48																		
AUS	0.67	0.74	0.63	0.66	0.75	0.64	0.66	0.63	0.63	0.68	0.63	0.13																	
HUN	0.84	0.87	0.75	0.82	0.90	0.82	0.81	0.85	0.75	0.84	0.89	0.73	1.35																
BEL	0.87	0.94	0.83	0.87	0.92	0.88	0.82	0.89	0.76	0.81	0.89	0.82	0.93	0.52															
JPN	0.74	0.82	0.68	0.72	0.76	0.73	0.69	0.79	0.68	0.75	0.73	0.74	0.80	0.84	0.45														
ESP	0.85	0.91	0.76	0.84	0.87	0.86	0.82	0.87	0.75	0.83	0.88	0.78	0.93	0.96	0.84	11.88													
ZAF	0.83	0.89	0.77	0.78	0.81	0.83	0.79	0.84	0.75	0.79	0.85	0.83	0.90	0.93	0.85	0.94	26.03												
NZL	0.62	0.68	0.62	0.62	0.71	0.62	0.62	0.62	0.62	0.72	0.62	0.87	0.71	0.76	0.76	0.80	0.40												
IRL	0.77	0.86	0.75	0.77	0.85	0.77	0.76	0.78	0.65	0.78	0.78	0.89	0.86	0.93	0.82	0.91	0.89	0.11											
CZE	0.85	0.90	0.77	0.82	0.90	0.83	0.81	0.86	0.73	0.81	0.88	0.74	0.94	0.95	0.82	0.94	0.92	0.71	0.87	18.41									
SVK	0.82	0.86	0.79	0.80	0.88	0.83	0.78	0.86	0.76	0.79	0.90	0.72	0.92	0.92	0.78	0.90	0.89	0.71	0.84	0.92	0.39								
POL	0.84	0.88	0.75	0.83	0.92	0.82	0.80	0.82	0.72	0.79	0.85	0.75	0.93	0.95	0.79	0.93	0.86	0.71	0.89	0.92	0.87	13.39							
LTU	0.78	0.78	0.73	0.79	0.88	0.78	0.74	0.75	0.68	0.78	0.78	0.69	0.86	0.90	0.77	0.86	0.81	0.71	0.82	0.89	0.87	0.87	0.33						

FRA	0.89	1.11									
ITA	0.87	0.88	12.07								
NLD	0.91	0.93	0.84	3.99							
CHE	0.93	0.93	0.86	0.93	10.40						
DEA	0.92	0.96	0.84	0.92	0.89	12.27					
HUN	0.87	0.91	0.91	0.88	0.88	0.88	16.38				
SVN	0.81	0.80	0.79	0.80	0.82	0.79	0.82	9.34			
GBR	0.91	0.95	0.87	0.95	0.90	0.93	0.89	0.83	10.74		
HRV	0.86	0.78	0.78	0.78	0.79	0.77	0.82	0.78	0.78	9.71	
USA	0.85	0.90	0.86	0.86	0.84	0.81	0.91	0.78	0.90	0.79	0.20

SIM mas

	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
ITA	12.04								
NLD	0.79	4.31							
CHE	0.87	0.83	10.14						
DEA	0.84	0.89	0.73	12.27					
HUN	0.88	0.85	0.84	0.87	16.38				
SVN	0.78	0.76	0.80	0.80	0.82	9.34			
GBR	0.75	0.82	0.88	0.75	0.81	0.76	2.48		
HRV	0.77	0.70	0.77	0.77	0.82	0.78	0.73	9.71	
USA	0.76	0.81	0.82	0.80	0.76	0.71	0.80	0.73	0.20

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0	99	60	200	159	171	36	153	70	37
FRA	91	0	105	140	205	274	32	243	71	56
NLD	55	91	0	99	127	185	37	156	47	53
USA	198	103	90	0	341	361	41	251	97	46
CHE	136	162	116	319	0	687	40	540	83	87
DEA	153	223	173	329	578	0	58	774	87	120
NZL	36	25	30	38	31	52	0	50	25	14
ITA	135	206	130	180	484	673	40	0	88	111
GBR	69	58	38	94	63	58	22	63	0	24
SVN	33	53	52	36	82	108	13	104	17	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0	88	56	57	85	169	36	151	33	37
FRA	81	0	77	28	84	234	26	210	35	55
NLD	49	66	0	21	66	165	37	145	26	51
USA	58	27	19	0	31	52	16	46	18	12
CHE	78	69	61	27	0	292	21	248	22	71
DEA	153	184	153	46	257	0	58	773	44	119
NZL	36	22	30	15	17	52	0	50	13	14
ITA	134	175	119	37	220	673	40	0	47	111
GBR	32	29	20	17	19	30	10	35	0	16
SVN	33	51	50	11	67	108	13	104	13	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	GBR	USA	AUS
CAN	0	36	81	57

GBR	31	0	95	48
USA	73	97	0	78
AUS	55	41	76	0

GUE

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	0	1005	2819	1894	373	1760	1950	2000	4301	185	2133	1720	1264	973	1577	1543	506	907	609	1260	479	1910	338	592	1362	831	246	355	944
CHE	931	0	1283	846	216	806	794	1055	1134	73	822	715	483	690	536	636	257	467	420	514	251	795	147	278	605	312	152	225	365
DEU	2303	1219	0	3203	577	2784	2336	4004	4043	207	2942	1892	1495	1444	1606	1799	550	1139	889	2004	737	3245	607	854	1555	732	407	731	948
DFS	1723	799	2539	0	448	1982	1819	2671	2650	187	1884	1526	1130	1062	1161	1287	506	991	779	1382	456	2119	409	567	1226	590	303	494	782
EST	253	131	438	315	0	332	353	505	487	68	396	281	271	247	256	267	113	181	151	343	143	481	122	207	266	152	109	153	193
FRA	1334	756	1762	1279	183	0	1738	2341	2785	150	1789	1460	1099	1139	1355	1452	501	916	730	1307	473	2131	302	495	1200	624	236	391	704
GBR	2207	758	1854	1456	218	1226	0	2067	2597	183	1704	1616	1016	1000	1178	1218	508	1045	993	1102	407	1715	353	492	1148	575	231	387	820
NLD	1981	1055	3878	2451	376	1715	1866	0	3073	203	2076	1700	1183	1519	1269	1390	515	1262	933	1654	596	2458	413	600	1366	593	316	529	837
USA	4936	1064	3172	2231	367	1677	2422	2827	0	298	3053	2286	1617	1145	2235	1825	634	1296	851	1843	603	2880	454	806	1713	1009	284	453	1379
ISR	132	43	157	140	38	92	134	157	292	0	182	144	145	103	140	131	66	137	116	149	59	205	67	92	134	81	53	78	112
ITA	1970	766	2329	1662	257	1243	1449	1924	2698	130	0	1272	1261	926	1268	1457	401	729	575	1414	429	2283	389	616	1248	688	313	447	791
AUS	1760	634	1479	1156	151	1059	1429	1512	2362	93	1037	0	847	868	1037	1022	482	1364	757	882	337	1306	281	448	992	532	189	338	804
HUN	1212	406	1242	958	166	832	883	1033	1633	101	1168	651	0	633	834	922	393	571	456	1007	358	1265	289	423	907	535	189	303	601
BEL	974	708	1496	1010	158	1181	988	1749	1037	66	943	770	557	0	637	797	339	595	529	682	325	1006	202	323	810	360	189	312	415
JPN	918	375	806	702	101	576	657	753	1163	70	709	619	503	434	0	1035	429	642	443	903	342	1203	249	422	867	648	182	270	684
ESP	1089	534	1229	1037	133	1229	979	1276	1284	79	1113	756	761	785	543	0	449	628	509	920	351	1398	263	431	1048	571	222	340	618
ZAF	465	216	428	389	56	398	444	439	618	42	323	420	314	288	299	400	0	368	295	332	180	408	103	163	448	267	73	158	328
NZL	892	394	890	728	95	606	909	1158	1257	111	588	1370	440	486	364	486	298	0	776	620	271	822	203	287	679	349	141	255	634
IRL	539	403	729	616	76	574	951	833	737	89	492	625	364	487	282	457	246	644	0	450	212	661	157	215	502	234	113	194	393
CZE	952	361	1558	978	219	859	739	1472	1489	118	1112	583	894	522	462	624	215	432	302	0	457	1605	320	460	891	526	243	414	600
SVK	337	129	555	246	59	273	237	428	412	25	276	168	249	199	134	182	97	163	100	363	0	505	114	171	361	222	83	159	259
POL	1786	697	3098	1857	362	1628	1541	2384	2982	161	2084	1051	1182	944	712	1087	316	645	519	1388	365	0	471	727	1343	694	338	566	831
LTU	208	64	563	256	62	132	201	266	335	34	219	135	188	101	90	114	39	105	80	211	51	368	0	214	265	171	88	163	200
LVA	383	145	700	362	115	267	285	416	712	60	408	232	313	190	192	241	94	162	118	305	81	596	143	0	478	284	125	278	312
PRT	1424	550	1472	1151	177	1098	1060	1384	1844	87	1236	843	906	825	554	1026	401	558	423	737	246	1375	166	378	0	568	197	372	669
KOR	811	223	518	447	74	400	423	441	1141	42	580	389	430	270	412	413	198	259	156	373	133	591	77	173	488	0	122	173	453
SVN	192	110	399	247	66	179	169	277	232	38	277	131	144	149	102	160	52	98	86	178	39	301	40	73	156	77	0	129	113
HRV	218	149	755	398	110	285	276	485	350	54	350	214	225	250	129	260	108	153	131	310	79	525	109	215	309	82	103	0	216
URY	913	287	718	569	111	480	684	696	1673	63	612	636	480	326	417	489	295	531	306	403	153	698	105	179	575	352	64	133	0

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	0	326	847	1058	252	1031	1120	446	1552	126	1351	1038	854	646	976	1033	251	522	347	869	268	1342	249	373	890	594	204	250	574
CHE	290	0	306	302	93	303	289	192	287	29	300	277	156	252	204	236	66	174	136	183	74	317	69	89	213	133	84	74	120
DEU	684	277	0	1136	294	968	883	661	818	104	1025	726	657	651	608	785	201	447	336	794	242	1507	309	428	666	336	301	431	377
DFS	1083	279	1016	0	409	1511	1531	896	1259	174	1314	1395	1040	945	1093	1196	489	923	697	1267	373	1880	368	470	1125	541	279	451	659
EST	175	53	214	288	0	282	328	220	306	67	312	275	263	235	250	262	110	176	137	337	125	463	116	186	255	147	107	151	179
FRA	841	279	740	989	157	0	1343	615	1001	125	1228	1173	970	976	1087	1250	412	732	589	1163	353	1872	253	402	1018	532	218	334	541
GBR	1144	267	737	1248	210	993	0	666	1336	182	1348	1472	971	930	1078	1152	466	960	866	1060	353	1623	321	418	1065	534	225	362	711
NLD	432	181	605	914	158	519	654	0	460	101	581	560	436	629	420	526	208	542	372	741	187	1014	194	252	542	230	166	305	310
USA	1784	253	697	1282	242	813	1457	422	0	225	1567	1180	1051	646	1142	1015	351	663	439	1061	302	1762	293	500	1063	714	217	252	815
ISR	83	14	70	124	38	76	132	79	222	0	151	140	142	102	138	131	64	136	97	149	56	200	63	77	134	80	52	76	105
ITA	1194	262	801	1191	206	896	1193	537	1620	101	0	1036	1059	759	1052	1198	322	589	431	1128	326	1750	315	434	1031	590	255	349	607
AUS	1114	244	589	1033	154	881	1320	488	1295	92	891	0	834	841	1035	1023	465	1333	700	875	307	1278	262	396	966	512	191	325	729
HUN	822	121	523	884	166	724	860	371	1120	99	1001	649	0	614	824	912	381	566	415	1000	332	1234	276	375	881	515	185	290	536
BEL	677	247	665	902	156	999	946	658	625	66	785	767	553	0	614	779	331	577	490	666	292	968	186	296	784	350	189	300	385
JPN	694	153	391	643	101	511	643	319	916	70	645	619	503	434	0	1035	426	635	432	903	315	1184	233	390	843	622	181	258	607
ESP	734	186	567	957	133	1029	955	501	843	79	928	756	759	785	543	0	442	627	480	919	320	1381	246	400	1028	557	219	330	561
ZAF	236	52	155	373	56	325	429	184	393	42	276	414	314	288	299	399	0	364	284	328	168	399	97	162	436	254	73	149	304
NZL	466	149	365	666	94	506	814	491	638	111	495	1335	438	482	364	485													

POL	1292	271	1541	1627	357	1424	1500	1015	1999	160	1634	1048	1169	930	712	1086	315	639	475	1388	345	0	442	620	1286	665	333	542	748
LTU	165	28	253	239	61	119	197	123	225	34	184	137	187	100	90	114	39	103	69	211	50	359	0	192	245	154	84	151	179
LVA	229	34	340	284	105	202	250	156	419	49	269	196	279	176	177	223	94	147	107	272	78	500	130	0	436	258	117	267	274
PRT	922	185	594	1054	176	936	1024	547	1173	87	1046	837	897	821	554	1025	400	555	403	737	238	1341	164	341	0	548	196	351	613
KOR	583	103	246	412	74	358	407	171	776	42	521	383	426	270	412	413	197	255	158	373	130	577	74	157	483	0	121	161	405
SVN	161	60	296	220	66	168	167	134	175	37	220	134	144	149	102	160	52	98	76	178	39	299	40	68	156	77	0	127	109
HRV	163	46	420	366	110	246	273	273	204	54	268	212	225	246	129	260	108	153	127	310	79	518	108	214	306	81	102	0	199
URY	559	88	292	509	111	393	648	253	899	63	511	633	466	324	417	488	291	527	295	403	151	680	105	167	567	343	64	132	0

JER

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	0	163	203	64	545	303	165	230	48	28
DFS	158	0	222	199	256	189	169	202	65	33
GBR	206	217	0	123	286	261	180	275	79	37
NLD	58	203	116	0	130	92	87	114	45	25
USA	576	240	312	134	0	554	306	451	80	37
AUS	311	161	265	82	604	0	248	501	65	36
ZAF	161	152	183	83	322	238	0	218	58	34
NZL	239	179	278	108	524	553	226	0	62	30
CHE	42	64	76	38	81	55	51	53	0	25
ITA	23	33	37	20	35	30	30	28	24	0

JER

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	0	58	97	25	113	148	76	109	30	21
DFS	54	0	148	163	82	151	148	166	62	30
GBR	96	142	0	91	103	195	142	207	69	37
NLD	19	160	87	0	52	85	82	105	41	25
USA	105	73	104	48	0	193	131	162	46	23
AUS	137	118	199	78	204	0	243	495	62	35
ZAF	69	128	144	79	142	237	0	213	55	34
NZL	101	139	210	100	161	545	223	0	58	30
CHE	28	59	66	36	40	55	50	52	0	24
ITA	16	29	35	20	22	29	30	28	24	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	0	204	99	8	228	14	112	3	70	99	22	10	8	0
DFS	211	0	134	151	231	74	229	150	51	207	111	134	70	0
GBR	99	128	0	82	138	16	107	15	40	101	30	16	50	0
NOR	7	126	86	0	88	18	83	33	0	57	27	22	57	0
USA	217	229	133	89	0	31	158	30	59	140	43	27	53	32
DEU	13	65	16	17	29	0	50	36	1	25	26	37	21	0
AUS	112	201	103	72	161	49	0	49	34	179	48	41	50	14
EST	2	138	13	33	29	35	44	0	0	24	25	55	27	0
ZAF	72	48	35	0	53	1	34	0	0	35	5	2	3	0
NZL	97	202	96	57	141	24	178	22	30	0	29	20	31	13
LTU	21	98	28	24	38	26	45	24	5	27	0	46	20	0
LVA	10	93	16	20	24	31	37	47	2	17	41	0	19	0
NLD	8	68	49	56	52	20	48	26	3	30	19	18	0	0
CAM	0	0	0	0	32	0	14	0	0	13	0	0	0	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

CAN	0	91	34	3	86	36	0	35	41	18	7	3	0
DFS	91	0	98	152	224	241	150	46	205	110	126	68	0
GBR	33	95	0	71	98	70	12	27	69	25	14	40	0
NOR	3	126	75	0	88	83	33	0	57	27	19	51	0
USA	86	222	97	89	0	146	30	54	137	43	25	50	32
AUS	36	217	70	72	150	0	49	31	169	45	38	48	13
EST	0	138	11	33	29	44	0	0	24	25	49	25	0
ZAF	36	46	26	0	52	33	0	0	33	5	2	2	0
NZL	41	198	69	57	141	169	22	30	0	29	17	29	13
LTU	17	97	23	24	38	43	24	5	27	0	46	19	0
LVA	7	84	14	17	22	35	41	2	14	41	0	14	0
NLD	3	66	40	50	50	46	24	2	28	18	13	0	0
CAM	0	0	0	0	32	13	0	0	13	0	0	0	0

SIM

common bulls below diagonal											
common three quarter sib group above diagonal											
	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	0	1	164	139	245	233	2	1	67	0	95
FRA	1	0	155	89	15	274	6	61	0	111	3
ITA	191	140	0	288	106	1107	25	179	46	346	39
NLD	165	84	283	0	95	435	13	98	49	178	33
CHE	297	12	108	99	0	382	2	2	53	3	33
DEA	272	231	1016	457	349	0	50	307	49	739	41
HUN	0	5	22	12	1	34	0	14	0	26	1
SVN	1	57	165	91	2	291	12	0	0	137	2
GBR	84	0	50	49	60	52	0	0	0	0	20
HRV	0	99	329	172	3	774	23	127	0	0	6
USA	110	3	46	34	32	43	1	2	27	6	0

SIM

common bulls below diagonal									
common three quarter sib group above diagonal									
	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
ITA	0	273	11	1103	25	179	17	346	39
NLD	268	0	9	404	12	93	19	169	33
CHE	11	9	0	111	0	0	1	0	5
DEA	1015	423	105	0	50	307	21	739	40
HUN	22	10	0	34	0	14	0	26	1
SVN	165	86	0	291	12	0	0	137	2
GBR	23	21	1	26	0	0	0	0	17
HRV	329	164	0	774	23	127	0	0	6
USA	46	34	5	43	1	2	23	6	0