

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
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 conformation traits are as follows:

ITA (JER) First time with scs and mas using scs as predictor. Change in direction of scale compared to test run due to the correction of a bug.
DEU (RDC) No longer participating in the mas evaluation with scs as predictor.
NLD (HOL) Send Clinical mastitis instead of Udder health index for mas.
HRV (HOL, SIM) Data now provided by the new organization HAPIH
ITA (BSW) Base change. Updated data and pedigree editing procedures and fixed effects.
BEL (HOL) Few bulls missing due to no longer having enough daughters. Some bulls changed in ToP due to the new program assigning such values.
AUS (ALL) Change in information due to data clean up: pedigree changes or changes in status of a bull causing a good number of bulls to be no longer qualified.
DFS (JER) Few bulls missing due to update in pedigree
JPN (HOL) Small decrease in information due to pedigree's update
FRA (BSW, HOL) Base change
ITA (SIM) Base change
SVN (ALL) Base change
GBR (ALL) Base change
EST (HOL, RDC) Small changes in information due to pedigree updates
DEA (ALL) Change of base to cow base group instead of the former defined bull base group.
CHE (ALL) Base change. EDC calculated following the multi-trait approach as implemented in Pete Sullivan\200\231s MT-EDC software.
USA (HOL, JER) MAS: very large submission of new / corrected data from one of data suppliers (over 1mln new records, over +25k corrections of existing cow health events records)
ITA (HOL) Cut-off of one year of data causing decrease in information. Base change
NLD (HOL) Sent in Clinical mastitis instead of Udder health index
IRL (ALL) Changes in number of daughters, edc and herd numbers due to pedigree changes
DEU (ALL) Base change, few bulls lost daughters/herds/EDC due to data editing. MAS RDC no longer providing scs data as predictor
NZL (ALL) Drops in information due to continuous DNA parentage testing
CAN (ALL) Base change
LTU (HOL) Base change

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

Post-processing Windows:

According to the decision taken by ITC in Orlando (2015) to review the post-processing windows every 5 years, during the 2020 the relative working group has been re-activated and new windows have been identified.

As before, the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while the lower values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the real estimated ones. Over the past five years, in fact, the previous adopted lower value (25th percentile) had been found too high

causing estimated and post-processed correlations to differ significantly from each other.
The new lower values have been applied to all breeds and traits.

The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more in consideration the value of the new estimated ones even when no changes are applied by the countries.

The new weights are as follows:

No changes :: 2; Small changes:: 1; Big changes :: 0

More information can be read on https://interbull.org/ib/rG_procedure

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

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>.

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.

^aLTable 1. National evaluation data considered in the Interbull evaluation for udder health (April Routine Evaluation 2021).

Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		140	8437	1687	767	
BEL			2152			
CAN	265	102	13145	807	844	
CHE	3075		3602	95		3417
CZE			4469			
DEA	5818					23550
DEU			22994		280	
DFS			13734	2247	7987	
ESP			4143			
EST			1235		459	
FRA	414		17578			482
FRM						4539
GBR	140	294	7149	723	544	83
HUN			3081			190
IRL			2715			
ISR			1557			
ITA	2026		9535	76		1684
JPN			6493			
KOR			1457			
LTU			1278		435	
LVA			527		564	
NLD	207		16344	197	93	453
NOR					4223	
NZL	59	57	8280	4802	1371	
POL			11448			
PRT			2459			
SVK			1141			
SVN	400		633			681
URY			1884			
USA	1120	714	40149	4892	716	77

ZAF		1207	596	124		
HRV		864				956
CAM				43		
<hr/>						
No. Records	13524	1307	209690	16122	18450	36112
Pub. Proofs	10932	1016	155086	13205	17535	32444

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

BSW	SCS	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN		6.51									
FRA		0.92	1.03								
NLD		0.90	0.92	3.99							
USA		0.91	0.90	0.87	0.21						
CHE		0.91	0.94	0.94	0.85	10.46					
DEA		0.91	0.96	0.92	0.87	0.97	11.93				
NZL		0.79	0.83	0.84	0.77	0.82	0.79	0.33			
ITA		0.89	0.89	0.88	0.86	0.95	0.91	0.78	16.09		
GBR		0.92	0.96	0.95	0.91	0.93	0.94	0.84	0.89	12.03	
SVN		0.86	0.86	0.86	0.86	0.85	0.85	0.77	0.85	0.87	10.37

BSW	mas	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.50										
FRA	0.86	1.06									
NLD	0.83	0.81	4.09								
USA	0.85	0.80	0.83	0.21							
CHE	0.89	0.84	0.89	0.81	11.22						
DEA	0.92	0.77	0.88	0.85	0.91	11.93					
NZL	0.69	0.66	0.74	0.69	0.73	0.74	0.33				
ITA	0.87	0.79	0.83	0.81	0.88	0.92	0.71	16.09			
GBR	0.86	0.87	0.84	0.81	0.89	0.81	0.65	0.81	2.13		
SVN	0.82	0.77	0.78	0.81	0.77	0.82	0.76	0.83	0.81	10.37	

GUE	SCS				
	CAN	GBR	USA	AUS	NZL
CAN	6.15				
GBR	0.92	13.50			
USA	0.92	0.90	0.25		
AUS	0.84	0.89	0.82	0.23	
NZL	0.80	0.83	0.77	0.89	0.63

HOL	SCS	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ES
CAN		5.68															
CHE	0.89		10.88														
DEU	0.94	0.95		12.87													
DFS	0.93	0.93	0.97		11.70												
EST	0.88	0.90	0.93	0.93		19.64											
FRA	0.94	0.94	0.96	0.97	0.92		1.18										
GBR	0.94	0.94	0.95	0.94	0.90	0.95		12.78									
NLD	0.91	0.94	0.96	0.94	0.92	0.93	0.96		4.59								
USA	0.94	0.87	0.89	0.88	0.90	0.90	0.90	0.90	0.87	0.20							
ISR	0.85	0.85	0.86	0.84	0.87	0.85	0.83	0.83	0.88	0.24							
ITA	0.90	0.90	0.95	0.93	0.94	0.93	0.90	0.89	0.89	0.85	5.80						
AUS	0.83	0.87	0.84	0.84	0.82	0.85	0.88	0.86	0.82	0.73	0.83	0.25					
HUN	0.88	0.89	0.93	0.90	0.91	0.90	0.89	0.88	0.91	0.89	0.94	0.82	1.36				
BEL	0.91	0.93	0.96	0.96	0.96	0.95	0.93	0.93	0.89	0.84	0.94	0.83	0.92	0.52			

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	7.54																												
CHE	0.92	10.55																											
DEU	0.93	0.89	9.92																										
DFS	0.94	0.89	0.92	12.61																									
EST	0.82	0.84	0.83	0.85	19.66																								
FRA	0.96	0.92	0.92	0.94	0.83	1.19																							
GBR	0.88	0.89	0.83	0.85	0.79	0.88	2.41																						
NLD	0.85	0.90	0.82	0.87	0.86	0.87	0.82	5.05																					
USA	0.85	0.81	0.84	0.81	0.76	0.86	0.80	0.81	2.36																				
ISR	0.76	0.76	0.75	0.79	0.83	0.76	0.72	0.77	0.71	0.24																			
ITA	0.83	0.87	0.80	0.82	0.84	0.83	0.82	0.88	0.76	0.78	6.03																		
AUS	0.75	0.73	0.74	0.75	0.70	0.75	0.75	0.72	0.75	0.67	0.75	0.75	0.12																
HUN	0.83	0.85	0.78	0.82	0.90	0.82	0.82	0.87	0.74	0.87	0.90	0.71	1.36																
BEL	0.87	0.92	0.86	0.88	0.93	0.87	0.85	0.89	0.74	0.82	0.88	0.72	0.93	0.52															
JPN	0.76	0.83	0.73	0.76	0.80	0.76	0.75	0.80	0.71	0.77	0.84	0.71	0.81	0.86	0.42														
ESP	0.86	0.91	0.82	0.86	0.90	0.87	0.85	0.87	0.72	0.86	0.87	0.72	0.93	0.96	0.86	11.60													
ZAF	0.83	0.87	0.78	0.77	0.83	0.82	0.79	0.84	0.72	0.81	0.85	0.71	0.90	0.92	0.86	0.94	26.01												
NZL	0.64	0.71	0.65	0.64	0.71	0.64	0.64	0.66	0.63	0.70	0.68	0.70	0.71	0.78	0.81	0.77	0.82	0.37											
IRL	0.75	0.78	0.78	0.79	0.77	0.75	0.78	0.80	0.70	0.71	0.76	0.72	0.81	0.82	0.74	0.78	0.76	0.78	0.11										
CZE	0.84	0.86	0.78	0.82	0.86	0.84	0.82	0.84	0.72	0.79	0.88	0.71	0.90	0.91	0.85	0.92	0.90	0.72	0.74	16.14									
SVK	0.84	0.84	0.80	0.81	0.88	0.84	0.81	0.86	0.77	0.80	0.88	0.71	0.94	0.91	0.82	0.90	0.89	0.70	0.76	0.89	0.40								
POL	0.86	0.88	0.83	0.86	0.93	0.85	0.84	0.87	0.73	0.84	0.85	0.71	0.95	0.97	0.84	0.95	0.89	0.75	0.80	0.91	0.90	10.80							
LTU	0.81	0.78	0.82	0.83	0.88	0.83	0.79	0.76	0.70	0.76	0.79	0.70	0.87	0.90	0.80	0.86	0.81	0.71	0.80	0.83	0.86	0.90	0.35						
LVA	0.78	0.79	0.76	0.81	0.91	0.79	0.77	0.82	0.71	0.76	0.83	0.71	0.88	0.92	0.81	0.87	0.84	0.77	0.79	0.85	0.84	0.92	0.89	0.48					
PRT	0.73	0.81	0.72	0.74	0.79	0.74	0.71	0.76	0.70	0.76	0.74	0.70	0.81	0.85	0.79	0.82	0.82	0.71	0.76	0.82	0.79	0.81	0.81	0.45					
KOR	0.85	0.84	0.76	0.85	0.84	0.84	0.81	0.79	0.73	0.77	0.80	0.71	0.87	0.89	0.82	0.90	0.83	0.71	0.73	0.85	0.84	0.92	0.84	0.85	0.79	0.35			
SVN	0.79	0.82	0.78	0.84	0.81	0.81	0.81	0.80	0.70	0.76	0.80	0.71	0.82	0.89	0.80	0.86	0.81	0.72	0.80	0.83	0.80	0.87	0.84	0.83	0.80	0.80	10.44		
HRV	0.75	0.75	0.75	0.76	0.84	0.76	0.78	0.79	0.71	0.78	0.78	0.71	0.84	0.86	0.80	0.84	0.80	0.71	0.73	0.83	0.81	0.85	0.84	0.86	0.79	0.80	0.81	11.57	
URY	0.77	0.75	0.77	0.77	0.80	0.77	0.77	0.73	0.71	0.77	0.77	0.71	0.80	0.84	0.81	0.82	0.82	0.78	0.74	0.82	0.82	0.83	0.81	0.81	0.79	0.82	0.80	0.81	0.20

JER SCS

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	6.23									
DFS	0.91	12.40								
GBR	0.92	0.91	11.18							
NLD	0.92	0.95	0.94	4.03						
USA	0.90	0.85	0.89	0.86	0.17					
AUS	0.81	0.84	0.85	0.86	0.78	0.24				
ZAF	0.86	0.87	0.87	0.88	0.85	0.83	21.29			
NZL	0.77	0.78	0.81	0.82	0.76	0.89	0.81	0.35		
CHE	0.89	0.88	0.88	0.91	0.85	0.80	0.85	0.77	12.21	
ITA	0.87	0.92	0.86	0.87	0.85	0.71	0.83	0.65	0.85	7.43

JTB mas

CAN DES GBR NLD USA AUS ZAF NZL CHE ITA

RDC	SCS	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN		5.72													
DFS		0.94	12.91												
GBR		0.93	0.92	11.49											
NOR		0.90	0.91	0.87	14.17										
USA		0.92	0.87	0.89	0.86	0.23									
DEU		0.94	0.96	0.95	0.91	0.89	13.96								
AUS		0.84	0.87	0.88	0.87	0.81	0.87	0.27							
EST		0.89	0.90	0.90	0.88	0.89	0.94	0.85	19.35						
ZAF		0.87	0.88	0.88	0.92	0.87	0.92	0.83	0.89	25.35					
NZL		0.83	0.83	0.84	0.85	0.80	0.84	0.90	0.85	0.83	0.38				
LTU		0.87	0.90	0.88	0.90	0.86	0.90	0.83	0.90	0.89	0.82	0.34			
LVA		0.88	0.88	0.90	0.88	0.87	0.93	0.85	0.96	0.88	0.85	0.90	0.44		
NLD		0.91	0.95	0.95	0.89	0.87	0.96	0.87	0.91	0.88	0.85	0.88	0.90	4.18	
CAM		0.92	0.92	0.92	0.92	0.87	0.92	0.92	0.92	0.91	0.88	0.91	0.91	0.92	6.37

RDC	mas	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN		7.76												
DFS	0.90	13.71												
GBR	0.87	0.86	2.09											
NOR	0.86	0.79	0.80	14.17										
USA	0.81	0.77	0.80	0.83	0.23									
AUS	0.76	0.75	0.76	0.77	0.73	0.12								
EST	0.83	0.77	0.82	0.85	0.82	0.74	19.35							
ZAF	0.84	0.84	0.82	0.90	0.80	0.74	0.86	25.40						
NZL	0.66	0.64	0.69	0.79	0.70	0.72	0.81	0.78	0.38					
LTU	0.82	0.78	0.83	0.88	0.82	0.76	0.90	0.86	0.79	0.34				
LVA	0.81	0.78	0.82	0.87	0.81	0.75	0.95	0.86	0.84	0.91	0.44			
NLD	0.86	0.82	0.84	0.86	0.84	0.77	0.88	0.86	0.75	0.85	0.87	4.49		
CAM	0.87	0.87	0.88	0.90	0.84	0.85	0.90	0.89	0.88	0.90	0.91	0.88	6.37	

SIM	SCS	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM		1.09										
FRA		0.91	1.01									
ITA		0.89	0.88	12.79								
NLD		0.91	0.93	0.87	4.21							
CHE		0.93	0.93	0.89	0.93	10.36						
DEA		0.92	0.93	0.87	0.90	0.89	12.23					
HUN		0.91	0.91	0.93	0.88	0.89	0.92	16.36				
SVN		0.89	0.86	0.85	0.86	0.87	0.85	0.88	9.04			
GBR		0.91	0.95	0.89	0.95	0.90	0.93	0.89	0.86	11.44		
HRV		0.89	0.83	0.84	0.83	0.84	0.83	0.86	0.83	0.83	9.95	
USA		0.86	0.90	0.88	0.88	0.87	0.86	0.91	0.85	0.90	0.83	0.20

^aLAPPENDIX 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

0	87	54	182	142	151	26	134	62	37
78	0	84	120	162	217	23	191	53	62
50	69	0	81	98	154	28	134	41	52
179	81	72	0	321	325	30	232	84	45
122	119	92	298	0	601	28	467	69	89
136	160	148	289	499	0	40	659	70	117
26	18	21	27	22	35	0	32	18	14
119	150	112	162	406	556	25	0	72	109
59	42	30	73	50	46	15	48	0	23
34	60	53	37	85	109	13	108	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	80	52	182	67	151	26	134	29	37
FRA	73	0	71	106	66	204	20	180	25	62
NLD	46	60	0	75	44	140	28	122	19	49
USA	179	73	65	0	87	324	30	232	36	45
CHE	62	50	44	64	0	212	12	178	15	54
DEA	136	151	132	289	182	0	40	659	32	117
NZL	26	16	21	27	12	35	0	32	11	14
ITA	119	145	102	162	148	556	25	0	34	109
GBR	27	20	14	33	11	22	8	24	0	13
SVN	34	60	50	37	51	109	13	108	10	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

CAN GBR USA AUS NZL

CAN	0	30	72	48	14
GBR	25	0	87	37	13
USA	63	89	0	65	29
AUS	46	31	62	0	26
NZL	11	11	29	26	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

CAN 0 925 2395 1532 270 1527 1655 1628 3572 140 1811 1479 1087 850 1393 1338 507 766 509 1174 440 1526 327 207 1040 703 226 323 803

CAN 0 925 2395 1532 270 1527 1655 1628 3572 140 1811 1479 1087 850 1393 1338 507 766 509 1174 440 1526 327 207 1040 703 226 323 803

CHE	790	0	1186	757	172	710	718	944	1048	66	763	644	457	626	500	589	270	415	365	557	243	726	195	138	512	275	149	216	330
DEU	1805	1056	0	2663	429	2393	2009	3345	3506	169	2589	1670	1284	1246	1439	1549	551	966	765	1874	689	2627	649	299	1216	630	337	657	796
DFS	1325	675	1960	0	306	1682	1559	2208	2177	156	1637	1341	955	904	1014	1070	506	855	674	1315	418	1728	393	206	946	496	269	428	673
EST	165	95	310	190	0	268	255	384	356	51	289	222	211	202	217	215	108	140	121	273	121	345	120	87	196	121	99	131	142
FRA	1026	619	1253	898	128	0	1533	2021	2533	128	1669	1302	966	961	1231	1186	474	806	650	1272	430	1746	312	187	940	523	211	309	616
GBR	1878	654	1522	1189	145	950	0	1769	2221	150	1547	1417	891	878	1056	1084	509	910	843	1078	384	1391	328	180	942	498	223	344	679
NLD	1564	919	3117	1965	276	1261	1543	0	2609	166	1805	1522	1020	1327	1102	1170	516	1059	793	1580	554	2006	430	227	1064	491	289	469	691
USA	4003	937	2503	1675	241	1347	1976	2310	0	197	2646	1983	1389	1005	2010	1590	635	1095	709	1714	554	2234	441	260	1308	864	261	409	1149
ISR	99	39	131	113	32	66	102	124	184	0	148	118	119	86	112	112	65	112	90	133	52	153	60	28	104	62	50	70	98
ITA	1498	685	1783	1276	165	918	1208	1517	1921	98	0	1219	1074	843	1187	1298	466	717	567	1296	397	1739	360	220	998	604	260	409	687
AUS	1502	556	1242	979	113	870	1222	1332	1991	74	915	0	767	777	931	920	482	1222	656	891	315	1099	274	167	792	451	187	309	694
HUN	1028	368	1031	773	129	652	781	875	1359	81	932	583	0	572	754	808	396	515	398	965	323	1041	250	140	719	465	176	271	534
BEL	850	630	1283	849	127	943	866	1537	900	55	829	680	498	0	576	708	339	528	462	688	303	219	144	669	307	192	284	372	
JPN	747	329	654	569	82	451	563	604	949	51	585	535	434	376	0	944	427	579	406	877	325	1050	238	149	721	565	181	242	606
ESP	874	471	1011	809	102	860	864	1053	1040	66	953	657	647	691	459	0	450	554	454	897	325	1119	254	167	842	490	206	299	543
ZAF	467	220	430	389	55	334	446	439	620	42	367	420	321	287	299	401	0	365	291	407	180	418	118	99	435	263	100	155	325
NZL	774	342	739	606	73	481	784	970	1042	90	537	1229	399	429	318	423	298	0	655	634	258	680	192	114	570	315	136	226	547
IRL	450	342	605	521	60	462	793	693	592	65	448	532	322	435	248	410	238	531	0	472	193	556	153	94	418	202	114	170	342
CZE	880	408	1461	903	175	801	785	1437	1366	100	944	604	888	555	420	657	287	468	342	0	509	1418	341	191	802	485	229	382	583
SVK	311	124	511	221	54	231	220	388	370	22	240	158	228	186	122	166	96	156	93	436	0	464	140	96	323	205	91	148	246
POL	1329	591	2385	1424	248	1146	1172	1879	2148	116	1375	836	939	795	568	796	316	517	425	1183	324	0	476	251	1028	584	282	495	668
LTU	176	86	600	227	62	115	166	271	300	29	195	123	153	112	80	105	48	90	71	229	71	369	0	101	245	153	84	176	183
LVA	131	78	204	126	62	87	103	149	208	20	150	79	100	91	66	95	58	55	52	126	47	186	72	0	189	99	43	115	121
PRT	1085	452	1113	840	138	792	874	1067	1367	75	931	636	717	677	450	810	391	464	352	671	224	1029	155	142	0	466	170	326	559
KOR	674	190	424	359	61	304	363	347	974	37	486	326	376	225	345	341	197	227	133	349	126	486	67	59	389	0	107	152	395
SVN	168	108	326	217	59	147	166	251	201	36	221	133	132	154	102	155	73	97	87	173	49	255	45	26	135	65	0	123	116
HRV	191	137	680	336	96	191	245	429	309	48	317	194	201	233	115	229	106	132	113	283	74	445	122	91	266	69	95	0	189
URY	770	245	569	477	85	365	561	558	1424	56	504	540	436	297	357	435	284	445	262	426	150	554	103	80	497	311	68	117	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

<tbl_r cells="27" ix="5" maxcspan="1" max

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	0	109	160	40	449	264	150	180	39	37
DFS	100	0	170	129	195	155	149	150	59	40
GBR	160	161	0	88	235	219	165	218	71	48
NLD	36	130	80	0	89	74	75	75	40	29
USA	474	173	255	96	0	499	283	369	69	48
AUS	271	123	222	66	544	0	229	438	56	46
ZAF	146	131	164	71	299	220	0	198	56	44
NZL	186	126	218	68	439	485	206	0	53	39
CHE	32	56	67	34	69	45	48	43	0	33
ITA	32	39	48	24	47	40	39	36	32	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	42	71	17	80	117	67	82	24	24
DFS	37	0	108	103	51	126	128	126	56	38
GBR	67	99	0	62	76	152	124	150	64	43
NLD	12	98	57	0	29	69	71	68	37	29
USA	73	42	75	26	0	149	109	107	35	26
AUS	106	91	155	63	158	0	220	432	52	45
ZAF	61	106	124	68	120	217	0	194	53	44
NZL	74	98	150	61	107	478	204	0	49	39
CHE	21	52	59	32	28	44	47	42	0	32
ITA	20	36	42	24	24	39	39	36	32	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	174	80	7	205	14	103	2	69	90	17	7	7	0
DFS	179	0	105	130	199	52	194	111	50	167	103	91	57	0
GBR	81	99	0	54	111	14	85	8	38	83	26	11	38	0
NOR	6	104	57	0	77	14	69	22	0	41	25	17	44	0
USA	191	195	105	77	0	23	135	22	58	122	34	14	44	24
DEU	13	43	14	13	22	0	37	23	1	17	29	28	15	0
AUS	104	167	82	59	136	37	0	32	33	145	43	28	33	12
EST	2	100	7	22	21	23	30	0	0	10	25	36	17	0
ZAF	71	47	34	0	52	1	32	0	0	33	5	1	3	0
NZL	88	165	78	41	123	17	145	9	29	0	27	13	21	12
LTU	16	98	24	22	29	28	42	25	5	25	0	36	15	0
LVA	7	59	11	15	10	22	25	28	1	10	32	0	9	0
NLD	7	55	37	43	43	14	31	16	3	21	14	8	0	0
CAM	0	0	0	0	24	0	12	0	0	12	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	74	28	3	73	33	0	35	34	13	4	3	0
DFS	73	0	73	132	190	208	111	45	165	102	92	54	0
GBR	27	68	0	49	77	54	5	25	58	21	9	29	0
NOR	3	105	52	0	77	69	22	0	41	25	17	40	0
USA	73	185	75	77	0	124	22	53	120	34	14	41	24
AUS	33	185	52	59	127	0	32	30	138	40	27	30	10
EST	0	100	5	22	21	30	0	0	10	25	36	17	0
ZAF	36	45	24	0	51	32	0	0	31	5	1	2	0
NZL	34	161	56	41	123	139	9	29	0	27	13	19	12
LTU	12	97	19	22	29	40	25	5	25	0	36	14	0
LVA	4	59	9	15	10	25	28	1	10	32	0	8	0
NLD	3	52	29	39	41	28	16	2	19	13	7	0	0

CAM 0 0 0 0 24 10 0 0 12 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	3	172	124	213	270	2	17	65	2	58
FRA	1	0	152	74	12	272	6	58	0	105	2
ITA	206	137	0	227	94	932	18	131	44	296	31
NLD	149	71	223	0	91	341	8	66	48	142	24
CHE	265	9	97	95	0	343	2	5	51	2	29
DEA	315	230	848	361	311	0	37	223	48	641	33
HUN	0	5	15	8	1	24	0	12	0	19	0
SVN	17	55	126	63	5	206	11	0	0	108	1
GBR	82	0	48	48	58	51	0	0	0	0	19
HRV	1	95	285	139	2	672	17	96	0	0	3
USA	73	2	36	26	28	39	0	1	26	3	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	2	158	104	4	228	2	17	25	2	36
FRA	1	0	85	31	1	161	3	34	0	58	1
ITA	192	75	0	216	4	932	18	131	18	296	31
NLD	127	30	211	0	4	314	8	63	18	136	23
CHE	4	1	4	4	0	73	0	0	1	0	2
DEA	276	124	848	333	64	0	37	223	20	641	33
HUN	0	2	15	8	0	24	0	12	0	19	0
SVN	17	29	126	60	0	206	11	0	0	108	1
GBR	34	0	23	20	1	25	0	0	0	0	16
HRV	1	51	285	134	0	672	17	96	0	0	3
USA	51	1	36	25	2	39	0	1	22	3	0