

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:

ISR (HOL) Drops in information due to pedigree corrections and edits.
AUS (HOL, JER, RDC) Decreasing in information due to pedigree changes, changes in status of bull which leads to a good number of bulls no longer being qualified.
MAS: This is a new trait for which they are still collecting historic data from various sources.
JPN (HOL) Some changes in proofs caused by additional records and in EDCs caused by modification of pedigree.
ITA (HOL) Drops in information for some bulls due to data edits.
USA (ALL) Drops in information for most traits are due to pedigree corrections and herd-year minimum edits.
NZL (BSW, GUE, HOL, JER, RDC) Continuous DNA parentage testing affected daughter counts, herd count, EDCs, and reliabilities.
DEU (HOL) Changes in data caused decrease in number of daughters.
SVN (BSW, HOL, SIM) Some bulls losing information (herds/daughters/EDC), due to changes in data base, related to the pedigree completeness as well as phenotypic data improvement.
HRV (SIM) Decrease in information due to changes related to the pedigree completeness and additional pedigree changes.
ESP (HOL) Change in base definition. Some Bulls lost some EDC, due to some daughters that were assigned as culled but did contribute more information now.
ITA (BSW) For some traits, new information cause low correlation with previous evaluation for some years.
IRL (BSW) MAS: Bull change publish status due to the lost of herd record. High number of bulls with lacking of pedigree. Majority of them old bulls and the rest non-pedigree stock bulls.
FRA (HOL, SIM, MON) The reliability from the singlestep is now used as a factor for the publication rule.
As the single step reliability showed differences between traits, even belonging to the same trait group, there are a different amount of bulls no more qualifying for publication across all traits due to the fact that such bulls do not meet anymore the new threshold set by the organisation.

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

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>.

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 (August Routine Evaluation 2022). Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		146	8675	1730	806	
BEL			2240			
CAN	270	105	13590	852	864	
CHE	3145		3296	98		3526
CZE			4645			
DEA	5957				24255	
DEU			23750		293	
DFS			14183	2306	8104	
ESP			4432			
EST			1318		472	
FRA	432		18336			470
FRM						4669
GBR	147	305	7403	756	573	85
HUN			3163			190
IRL			2927			
ISR			1644			
ITA	2109		9521	73		1761
JPN			6810			
KOR			1600			
LTU			1341		436	
LVA			1275		596	
NLD	221		16827	240	98	494
NOR					4293	
NZL	71	57	8618	4949	1410	
POL			12160			
PRT			2468			
SVK			1166			
SVN	411		694		742	
URY			2018			
USA	1162	733	41352	5120	754	92
ZAF			1204	609	125	
HRV			931		1036	

No. Records	13925	1346	217587	16733	18869	37320
Pub. Proofs	11181	1045	157934	13613	17854	33545

^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	0.89	0.91	3.96							
USA	0.90	0.90	0.85	0.21						
CHE	0.90	0.94	0.94	0.82	10.50					
DEA	0.90	0.96	0.92	0.85	0.97	11.93				
NZL	0.71	0.79	0.81	0.67	0.77	0.72	0.36			
ITA	0.88	0.89	0.88	0.84	0.95	0.91	0.69	15.80		
GBR	0.92	0.96	0.95	0.91	0.93	0.95	0.82	0.89	11.70	
SVN	0.82	0.82	0.82	0.82	0.81	0.81	0.69	0.82	0.84	10.31

BSW	mas	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN		6.51									
FRA		0.83	1.04								
NLD		0.81	0.76	3.84							
USA		0.84	0.78	0.82	0.21						
CHE		0.89	0.84	0.88	0.79	11.41					
DEA		0.91	0.73	0.88	0.84	0.90	11.94				
NZL		0.69	0.64	0.71	0.68	0.70	0.74	0.36			
ITA		0.85	0.75	0.82	0.77	0.88	0.92	0.70	15.79		
GBR		0.84	0.85	0.83	0.79	0.87	0.76	0.63	0.77	2.26	
SVN		0.81	0.74	0.74	0.79	0.74	0.80	0.75	0.82	0.78	10.31

GUE	scs	CAN	GBR	USA	AUS	NZL
CAN	6.23					
GBR	0.92	13.42				
USA	0.93	0.90	0.25			
AUS	0.82	0.88	0.78	0.24		
NZL	0.77	0.82	0.72	0.89	0.62	

HOL	SCS	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA
CAN		5.69										
CHE	0.90		10.76									
DEU	0.94	0.95		12.87								
DFS	0.93	0.92	0.97		11.79							
EST	0.88	0.89	0.93	0.93		19.38						
FRA	0.94	0.93	0.96	0.96	0.91		1.18					
GBR	0.94	0.94	0.95	0.94	0.90	0.95		12.79				
NLD	0.91	0.94	0.96	0.94	0.91	0.93	0.96		4.61			
USA	0.94	0.85	0.89	0.87	0.90	0.90	0.91	0.87		0.20		
ISR	0.85	0.84	0.85	0.82	0.86	0.84	0.81	0.81	0.87		0.24	
ITA	0.90	0.89	0.95	0.93	0.93	0.93	0.90	0.89	0.89	0.84		5.82
AUS	0.81	0.86	0.83	0.82	0.77	0.83	0.87	0.85	0.77	0.69		0.79
HUN	0.88	0.89	0.93	0.90	0.91	0.90	0.89	0.88	0.91	0.88		0.94
BEL	0.92	0.92	0.97	0.96	0.95	0.95	0.93	0.94	0.89	0.83		0.99
JPN	0.87	0.83	0.85	0.87	0.84	0.90	0.86	0.84	0.87	0.78		0.83
ESP	0.93	0.91	0.96	0.94	0.93	0.96	0.93	0.91	0.91	0.88		0.99

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	10.83																											
DEU	0.92	0.88	9.73																										
DFS	0.94	0.88	0.91	12.55																									
EST	0.81	0.85	0.83	0.85	19.36																								
FRA	0.96	0.92	0.91	0.94	0.83	1.18																							
GBR	0.88	0.90	0.82	0.84	0.78	0.88	2.40																						
NLD	0.85	0.90	0.81	0.86	0.84	0.86	0.82	4.93																					
USA	0.85	0.81	0.85	0.81	0.77	0.86	0.80	0.80	2.36																				
ISR	0.74	0.76	0.74	0.77	0.84	0.75	0.70	0.76	0.71	0.24																			
ITA	0.81	0.88	0.74	0.79	0.84	0.81	0.78	0.88	0.69	0.78	6.02																		
AUS	0.68	0.68	0.68	0.68	0.69	0.68	0.68	0.67	0.68	0.65	0.68	0.12																	
HUN	0.84	0.86	0.78	0.82	0.90	0.81	0.82	0.87	0.74	0.87	0.89	0.69	1.36																
BEL	0.88	0.93	0.85	0.88	0.93	0.87	0.84	0.89	0.74	0.82	0.88	0.70	0.93	0.52															
JPN	0.74	0.83	0.70	0.74	0.78	0.73	0.72	0.80	0.69	0.77	0.84	0.70	0.82	0.85	0.42														
ESP	0.86	0.91	0.80	0.85	0.90	0.86	0.84	0.87	0.73	0.86	0.87	0.70	0.93	0.96	0.86	11.61													
ZAF	0.83	0.88	0.78	0.78	0.83	0.82	0.79	0.84	0.72	0.81	0.85	0.70	0.90	0.93	0.86	0.94	26.03												
NZL	0.63	0.70	0.63	0.63	0.72	0.63	0.63	0.64	0.62	0.72	0.66	0.66	0.71	0.78	0.80	0.77	0.82	0.41											
IRL	0.77	0.85	0.75	0.77	0.85	0.76	0.77	0.78	0.65	0.78	0.80	0.67	0.86	0.93	0.84	0.92	0.91	0.90	0.11										
CZE	0.83	0.86	0.75	0.81	0.86	0.82	0.80	0.84	0.71	0.79	0.88	0.69	0.90	0.92	0.85	0.92	0.90	0.72	0.84	15.73									
SVK	0.83	0.85	0.80	0.80	0.88	0.83	0.80	0.86	0.76	0.81	0.88	0.69	0.94	0.92	0.80	0.91	0.89	0.71	0.84	0.89	0.40								
POL	0.85	0.89	0.81	0.86	0.93	0.84	0.84	0.86	0.73	0.84	0.85	0.69	0.95	0.97	0.84	0.95	0.89	0.74	0.91	0.91	0.90	10.81							
LTU	0.81	0.80	0.80	0.82	0.88	0.82	0.77	0.76	0.69	0.76	0.78	0.69	0.87	0.91	0.78	0.86	0.83	0.71	0.83	0.84	0.87	0.90	0.35						
LVA	0.78	0.82	0.73	0.81	0.91	0.78	0.79	0.84	0.70	0.78	0.82	0.68	0.91	0.94	0.78	0.90	0.88	0.78	0.91	0.87	0.88	0.95	0.89	479.42					
PRT	0.73	0.80	0.70	0.74	0.79	0.74	0.71	0.76	0.69	0.76	0.74	0.69	0.82	0.85	0.78	0.83	0.82	0.71	0.82	0.82	0.78	0.82	0.82	0.45					
KOR	0.83	0.83	0.72	0.84	0.84	0.83	0.79	0.79	0.73	0.76	0.78	0.69	0.86	0.89	0.81	0.90	0.83	0.71	0.81	0.84	0.83	0.92	0.84	0.88	0.78	0.33			
SVN	0.79	0.81	0.76	0.83	0.81	0.79	0.79	0.79	0.69	0.75	0.78	0.69	0.82	0.89	0.78	0.86	0.81	0.71	0.88	0.82	0.80	0.88	0.85	0.89	0.82	0.79	10.30		
HRV	0.71	0.74	0.71	0.72	0.85	0.72	0.75	0.77	0.69	0.77	0.76	0.69	0.85	0.85	0.78	0.82	0.81	0.71	0.79	0.81	0.80	0.84	0.84	0.86	0.78	0.78	11.42		
URY	0.72	0.74	0.75	0.72	0.79	0.72	0.72	0.71	0.69	0.76	0.74	0.70	0.79	0.83	0.79	0.80	0.83	0.77	0.84	0.79	0.82	0.82	0.78	0.81	0.79	0.78	0.20		

JEB SCS

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	6.06									
DFS	0.91	12.50								
GBR	0.92	0.91	11.34							
NLD	0.91	0.95	0.94	4.33						
USA	0.90	0.83	0.89	0.85	0.17					
AUS	0.78	0.83	0.83	0.86	0.74	0.23				
ZAF	0.85	0.87	0.86	0.88	0.84	0.81	21.11			
NZL	0.70	0.73	0.78	0.79	0.69	0.89	0.76	0.39		
CHE	0.88	0.87	0.86	0.90	0.83	0.76	0.83	0.70	12.90	
ITA	0.87	0.92	0.86	0.87	0.85	0.71	0.83	0.65	0.85	7.23

JER mas

RDC SCS

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	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	5.96													
DFS	0.94	12.91												
GBR	0.93	0.92	11.59											
NOR	0.87	0.90	0.82	13.68										
USA	0.92	0.86	0.88	0.81	0.23									
DEU	0.94	0.96	0.95	0.89	0.89	14.21								
AUS	0.81	0.84	0.87	0.82	0.74	0.84	0.27							
EST	0.88	0.89	0.90	0.85	0.86	0.94	0.81	19.35						
ZAF	0.84	0.86	0.86	0.89	0.86	0.92	0.76	0.88	25.38					
NZL	0.78	0.79	0.82	0.80	0.73	0.81	0.90	0.80	0.79	0.44				
LTU	0.85	0.90	0.87	0.89	0.82	0.90	0.78	0.90	0.87	0.77	0.34			
LVA	0.87	0.89	0.91	0.85	0.83	0.93	0.83	0.95	0.88	0.81	0.90	428.45		
NLD	0.91	0.95	0.95	0.89	0.87	0.96	0.85	0.90	0.88	0.83	0.87	0.89	4.13	
CAM	0.89	0.90	0.90	0.89	0.83	0.90	0.88	0.90	0.89	0.86	0.89	0.88	0.90	6.29

RDC mas

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	7.72												
DFS	0.90	13.56											
GBR	0.86	0.85	2.09										
NOR	0.82	0.73	0.74	13.68									
USA	0.79	0.74	0.78	0.80	0.23								
AUS	0.70	0.69	0.69	0.74	0.70	0.12							
EST	0.82	0.75	0.80	0.83	0.81	0.72	19.35						
ZAF	0.84	0.83	0.82	0.88	0.79	0.72	0.85	25.40					
NZL	0.65	0.63	0.67	0.77	0.70	0.69	0.82	0.77	0.44				
LTU	0.79	0.75	0.81	0.88	0.80	0.74	0.91	0.86	0.79	0.34			
LVA	0.78	0.72	0.81	0.87	0.75	0.71	0.94	0.87	0.84	0.91	435.86		
NLD	0.85	0.79	0.84	0.86	0.84	0.71	0.87	0.85	0.72	0.83	0.86	4.60	
CAM	0.85	0.85	0.85	0.88	0.82	0.84	0.89	0.88	0.88	0.89	0.88	0.86	6.29

SIM SCS

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.09										
FRA	0.89	1.01									
ITA	0.88	0.87	12.58								
NLD	0.91	0.93	0.85	4.31							
CHE	0.93	0.93	0.88	0.93	10.40						
DEA	0.92	0.93	0.85	0.91	0.89	12.25					
HUN	0.89	0.90	0.92	0.88	0.89	0.90	16.37				
SVN	0.88	0.83	0.83	0.83	0.85	0.82	0.85	9.17			
GBR	0.91	0.95	0.88	0.95	0.90	0.93	0.89	0.84	11.64		
HRV	0.87	0.80	0.80	0.80	0.81	0.80	0.84	0.80	0.81	9.74	
USA	0.84	0.90	0.87	0.87	0.86	0.82	0.91	0.81	0.90	0.81	0.20

STM 2008

SIM mas

APPENDIX 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	88	56	185	145	155	31	140	68	39
FRA	78	0	85	120	166	220	27	197	58	63
NLD	52	69	0	88	105	161	30	137	43	53
USA	182	82	79	0	328	338	35	235	95	49
CHE	124	125	97	305	0	623	34	490	78	93
DEA	140	167	153	302	519	0	47	694	82	121
NZL	31	21	23	32	27	42	0	39	23	14
ITA	124	158	114	165	432	596	32	0	83	113
GBR	69	50	37	94	62	58	21	63	0	25
SVN	36	61	54	39	89	113	13	112	22	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	82	53	185	71	155	31	140	31	39
FRA	73	0	71	105	73	207	23	186	30	63
NLD	47	59	0	79	48	144	30	127	21	50
USA	182	73	69	0	95	337	35	235	41	49
CHE	65	56	47	73	0	233	17	200	19	58
DEA	140	158	134	302	201	0	47	694	39	121
NZL	31	19	23	32	15	42	0	39	10	14
ITA	124	152	104	165	171	596	32	0	42	113
GBR	30	26	18	41	16	28	8	33	0	15
SVN	36	61	51	39	55	113	13	112	13	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

CAN GBR USA AUS NZL

	CAN	GBR	USA	AUS	NZL
CAN	0	30	74	51	14
GBR	25	0	88	40	13
USA	66	91	0	69	29
AUS	49	34	67	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	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
0	916	2561	1668	299	1674	1766	1764	3863	150	1903	1577	1119	887	1471	1416	504	815	556	1243	456	1686	350	535	1062	759	247	337	858
840	0	1170	759	183	765	725	969	1043	69	768	666	450	639	497	599	258	431	388	548	246	749	195	258	499	290	160	214	337
1996	1105	0	2862	472	2674	2143	3597	3713	176	2682	1758	1320	1304	1508	1616	548	1032	822	1966	704	2888	685	749	1228	677	376	694	857

DFS	1475	712	2168	0	350	1865	1660	2394	2357	165	1688	1409	993	945	1070	1143	504	903	717	1387	433	1894	410	503	954	534	295	463	710
EST	185	103	341	226	0	308	283	417	393	55	314	242	225	221	232	237	112	153	136	299	128	387	134	183	204	135	107	143	158
FRA	1237	707	1634	1159	168	0	1668	2254	2710	143	1769	1411	1030	1077	1317	1347	502	877	707	1387	467	2003	347	464	1012	584	254	373	674
GBR	1996	690	1650	1292	167	1144	0	1896	2355	158	1607	1497	927	918	1108	1146	506	962	910	1129	392	1523	353	450	951	533	239	363	730
NLD	1721	966	3410	2161	303	1591	1671	0	2782	176	1879	1591	1058	1383	1175	1260	514	1131	853	1663	572	2195	461	537	1075	538	310	498	754
USA	4370	980	2760	1891	275	1595	2125	2501	0	218	2763	2102	1428	1042	2096	1685	632	1162	771	1805	569	2482	469	718	1327	923	282	426	1238
ISR	110	40	136	121	33	90	110	135	206	0	150	127	123	88	120	119	65	121	98	139	55	163	61	78	110	70	54	72	99
ITA	1633	712	1914	1387	184	1108	1285	1630	2131	105	0	1242	1083	848	1219	1359	442	729	578	1336	405	1894	382	537	993	639	278	427	730
AUS	1606	590	1344	1040	125	1008	1306	1407	2156	81	961	0	798	807	980	961	480	1273	704	927	326	1185	293	404	807	488	199	320	738
HUN	1059	380	1067	820	136	774	807	917	1417	84	957	607	0	587	780	849	395	538	428	1001	331	1083	259	381	729	494	186	287	557
BEL	886	652	1345	893	137	1110	904	1604	935	56	857	714	515	0	595	735	337	551	489	710	312	912	229	302	677	327	197	296	386
JPN	816	350	717	625	88	543	599	668	1027	53	636	578	461	395	0	980	427	611	423	917	330	1115	249	391	735	605	196	254	637
ESP	964	499	1092	889	116	1124	915	1145	1143	71	1034	700	692	728	498	0	448	582	478	944	335	1225	265	404	856	527	220	318	574
ZAF	464	216	427	388	56	399	443	437	617	42	356	418	320	287	298	399	0	366	294	405	180	417	118	164	431	265	100	156	326
NZL	814	364	791	645	78	571	829	1035	1110	98	552	1282	418	445	342	446	297	0	707	667	266	733	205	263	586	334	146	241	580
IRL	489	371	665	564	71	550	863	751	650	71	472	578	345	451	264	433	246	577	0	502	208	608	161	202	442	213	120	186	361
CZE	950	420	1553	970	187	949	824	1519	1467	107	1008	634	927	576	452	701	285	500	365	0	520	1522	357	442	811	518	249	400	618
SVK	322	127	524	230	54	270	225	404	382	22	251	162	233	191	127	172	97	161	97	443	0	481	142	163	321	212	95	152	251
POL	1512	640	2669	1606	279	1468	1315	2097	2469	129	1573	926	998	848	633	910	315	566	474	1300	337	0	510	638	1041	632	306	531	741
LTU	197	90	633	245	69	157	187	301	327	29	209	133	158	123	89	116	47	99	77	244	72	404	0	222	246	163	87	183	191
LVA	336	132	593	308	100	245	257	359	620	49	346	205	272	178	175	221	96	147	107	290	76	510	147	0	391	264	131	265	284
PRT	1101	448	1117	850	137	909	875	1070	1393	76	927	649	725	675	462	812	386	476	369	675	222	1042	155	293	0	488	173	333	570
KOR	748	209	474	401	66	374	394	397	1058	38	531	361	399	245	385	378	196	244	140	373	128	533	70	159	405	0	120	161	419
SVN	183	117	363	238	62	187	173	270	219	38	237	139	139	157	110	164	72	104	92	186	51	275	44	71	136	73	0	130	120
HRV	203	141	721	371	103	272	262	459	326	50	336	203	213	242	120	245	107	144	126	301	76	482	130	204	268	74	103	0	198
URY	833	270	633	514	89	459	609	620	1535	57	554	588	452	310	388	465	291	481	278	453	152	621	111	162	500	336	71	121	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
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CAN	0	262	708	864	186	954	971	354	1274	97	1256	903	725	565	881	928	251	446	341	771	251	1133	230	364	653	539	180	232	503

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CAN	0	127	172	47	479	277	157	194	42	36
DFS	120	0	185	163	216	170	159	164	61	40
GBR	176	180	0	101	253	236	171	236	75	46
NLD	42	165	94	0	104	81	79	87	41	29
USA	506	197	277	111	0	523	295	392	72	46
AUS	284	140	240	72	569	0	239	451	59	44
ZAF	153	142	172	75	311	229	0	204	58	43
NZL	201	141	241	82	464	499	214	0	56	37
CHE	36	60	72	35	73	50	51	48	0	32
ITA	31	40	47	24	45	38	38	35	32	0

JER

common bulls below diagonal

common three quarter sib group above diagonal

CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
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CAN	0	48	84	20	91	130	70	92	25	23
DFS	43	0	119	127	67	138	136	139	59	37
GBR	80	112	0	70	89	171	130	166	66	42
NLD	13	122	66	0	38	76	74	79	37	29
USA	83	56	88	37	0	165	121	124	38	26
AUS	118	104	174	69	175	0	232	445	55	43
ZAF	64	115	131	71	132	228	0	200	55	43
NZL	83	113	168	74	126	492	211	0	52	37
CHE	23	56	63	32	32	49	50	47	0	31
ITA	19	35	41	24	25	37	38	35	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
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CAN	0	186	86	7	219	14	105	3	70	92	17	9	7	0
DFS	191	0	116	137	214	62	204	123	51	178	110	74	60	0
GBR	87	111	0	63	120	15	93	12	39	90	27	10	42	0
NOR	6	111	66	0	82	15	74	26	0	47	25	12	48	0
USA	205	211	115	83	0	24	144	24	59	129	34	12	48	25
DEU	13	53	15	14	22	0	42	25	1	19	29	26	15	0
AUS	106	178	89	63	146	41	0	38	34	156	45	21	39	11
EST	2	112	10	26	23	25	35	0	0	14	26	23	19	0
ZAF	72	48	35	0	53	1	34	0	0	35	5	2	3	0
NZL	90	175	86	47	131	19	156	13	30	0	28	13	23	12
LTU	16	98	25	22	29	28	42	25	5	25	0	31	15	0
LVA	9	30	10	10	9	20	17	15	2	10	26	0	6	0
NLD	7	58	41	47	47	14	37	18	3	23	14	5	0	0
CAM	0	0	0	0	25	0	11	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
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CAN	0	80	30	3	77	34	0	35	36	13	7	3	0
DFS	79	0	80	139	206	219	123	46	176	109	126	58	0
GBR	29	76	0	54	83	58	7	26	61	21	14	31	0
NOR	3	112	57	0	82	74	26	0	47	25	19	43	0
USA	77	203	82	83	0	134	24	54	126	34	25	46	25
AUS	34	196	56	63	137	0	38	31	148	42	38	36	10
EST	0	112	7	26	23	35	0	0	14	26	49	18	0
ZAF	36	46	25	0	52	33	0	0	33	5	2	2	0
NZL	36	171	60	47	131	149	13	30	0	28	17	21	12
LTU	12	97	19	22	29	40	25	5	25	0	53	14	0
LVA	7	84	14	17	22	35	42	2	14	47	0	14	0
NLD	3	56	31	42	46	34	17	2	21	13	13	0	0
CAM	0	0	0	0	25	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
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FRM	0	2	177	129	232	270	2	17	67	2	72
FRA	1	0	141	77	10	255	4	59	0	100	3
ITA	203	126	0	245	96	980	18	156	46	324	33
NLD	154	74	241	0	91	376	8	72	49	158	28
CHE	284	8	99	95	0	356	2	5	53	2	32
DEA	315	212	897	397	322	0	37	265	49	706	36
HUN	0	3	15	8	1	24	0	12	0	19	0
SVN	17	54	147	67	5	243	11	0	0	129	1
GBR	84	0	50	49	60	52	0	0	0	0	19
HRV	1	90	311	155	2	740	17	117	0	0	4
USA	87	3	40	30	31	42	0	1	26	4	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
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FRM	0	2	157	104	5	228	2	17	25	2	36
FRA	1	0	85	31	1	161	3	34	0	59	1
ITA	183	74	0	228	7	979	18	156	18	324	33
NLD	127	30	225	0	6	334	8	68	18	150	26
CHE	5	1	7	6	0	86	0	0	1	0	4
DEA	276	124	897	354	77	0	37	265	20	706	36
HUN	0	2	15	8	0	24	0	12	0	19	0
SVN	17	29	147	65	0	243	11	0	0	129	1
GBR	34	0	23	20	1	25	0	0	0	0	16
HRV	1	51	311	148	0	740	17	117	0	0	4
USA	51	1	40	28	4	42	0	1	22	4	0