

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 conformation traits are as follows:

EST (ALL) Decrease in information due to the pedigree correction and updated herd information
NOR (RDC) Decrease in information due to the rolling definition of hys.
DEA (BSW,SIM) Cow base group has been shifted by 4 month (rolling base), decrease in information due to herd changes regarding the movement of cows herds in the valleys back to alpine pasturing.
JPN (HOL) Decrease in information due to the poedigree changes.
AUS (ALL) Decrease in information due to pedigree updates and status changes of some bulls which then leads to no longer qualifying
CHE (ALL) Decrease in information due to the manual edits/ data correction in data base, change of hys assignment
SVN (All) Decrease in information due to the changes in database regarding pedigree completeness and pheontype improvement.
BEL (HOL) Decrease in information due to the pedigree correction
NZL(ALL) Decrease in information due to the continious parentage verification and some phenotypic records updates.
ESP (HOL) Base change.
GBR(ALL) Decrease in information due to the data updates and pedigree correction.

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 2023).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		148	8825	1753	821	
BEL			2306			
CAN	274	109	13894	881	877	
CHE	3209		3377	100		3633
CZE			4803			
DEA	6045					24858
DEU		24223			302	
DFS		14481		2347	8162	
ESP		4616				
EST		1380			485	
FRA	494		18543			481
FRM						4786
GBR	151	312	7576	773	596	109
HUN			3164			190
IRL			3064			
ISR			1718			
ITA	2175		9673	66		1814
JPN			7016			
KOR			1689			
LTU			898		362	
LVA			1373			674
NLD	232		17108	267	105	
NOR					4336	
NZL	75	57	8887	5091	1447	
POL			12671			
PRT			2965			
SVK			1186			
SVN	334		680			672
URY			2097			
USA	1187	744	42111	5243	766	107
ZAF			1205	616	125	

HRV		971			1056	
CAM				49		
No. Records	14176	1370	222500	17137	19107	38225
Pub. Proofs	11308	1059	159641	13883	17955	34338

^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	6.55										
FRA	0.91	1.02									
NLD	0.89	0.92	3.65								
USA	0.89	0.90	0.85	0.21							
CHE	0.90	0.93	0.94	0.81	10.54						
DEA	0.88	0.96	0.92	0.85	0.97	11.93					
NZL	0.71	0.77	0.79	0.67	0.74	0.67	0.37				
ITA	0.88	0.89	0.89	0.83	0.96	0.91	0.68	15.51			
GBR	0.93	0.96	0.95	0.91	0.93	0.95	0.81	0.89	11.54		
SVN	0.80	0.80	0.79	0.79	0.80	0.78	0.68	0.82	0.82	10.88	

BSW	mas	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN		6.45									
FRA	0.81		1.03								
NLD	0.79	0.73		4.09							
USA	0.81	0.83	0.76		2.73						
CHE	0.88	0.83	0.85	0.76		11.36					
DEA	0.90	0.70	0.87	0.71	0.90		11.93				
NZL	0.69	0.64	0.66	0.64	0.70	0.74		0.37			
ITA	0.85	0.73	0.80	0.68	0.88	0.92	0.70		15.51		
GBR	0.84	0.84	0.83	0.79	0.84	0.74	0.64	0.76		2.18	
SVN	0.79	0.72	0.73	0.72	0.71	0.83	0.76	0.84	0.76		10.89

GUE	SCS	CAN	GBR	USA	AUS	NZL
CAN		5.95				
GBR		0.93	13.56			
USA		0.93	0.90	0.25		
AUS		0.81	0.87	0.77	0.24	
NZL		0.76	0.81	0.70	0.89	0.62

HOL	SCS	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA
CAN		5.70										
CHE	0.90		10.81									
DEU	0.94	0.95		12.88								
DFS	0.93	0.93	0.97		11.75							
EST	0.89	0.89	0.94	0.92		18.88						
FRA	0.94	0.93	0.96	0.96	0.90		1.17					
GBR	0.94	0.94	0.96	0.94	0.90	0.95		12.85				
NLD	0.91	0.94	0.96	0.94	0.91	0.94	0.96		4.23			
USA	0.94	0.84	0.89	0.87	0.90	0.90	0.91	0.86		0.20		
ISR	0.86	0.83	0.85	0.82	0.85	0.83	0.81	0.80		0.87	0.24	
ITA	0.90	0.89	0.95	0.93	0.93	0.93	0.90	0.89		0.89	0.83	5.87
AUS	0.80	0.86	0.82	0.82	0.75	0.83	0.87	0.84		0.75	0.67	0.78
HUN	0.88	0.89	0.93	0.91	0.91	0.90	0.89	0.88		0.91	0.87	0.94
BEL	0.92	0.92	0.97	0.96	0.95	0.96	0.93	0.94		0.89	0.83	0.95
JPN	0.85	0.78	0.82	0.85	0.81	0.89	0.84	0.80		0.86	0.75	0.80

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	7.57																											
CHE	0.93	10.99																										
DEU	0.91	0.88	9.51																									
DFS	0.94	0.88	0.91	12.40																								
EST	0.80	0.87	0.84	0.84	18.86																							
FRA	0.96	0.93	0.91	0.94	0.83	1.18																						
GBR	0.88	0.90	0.82	0.84	0.77	0.88	2.37																					
NLD	0.84	0.91	0.81	0.86	0.84	0.87	0.83	5.07																				
USA	0.86	0.82	0.86	0.82	0.78	0.88	0.80	0.80	2.29																			
ISR	0.75	0.77	0.75	0.78	0.85	0.75	0.69	0.76	0.73	0.24																		
ITA	0.79	0.88	0.72	0.77	0.83	0.80	0.76	0.89	0.68	0.77	6.07																	
AUS	0.65	0.67	0.65	0.65	0.69	0.65	0.65	0.64	0.65	0.66	0.65	0.12																
HUN	0.84	0.87	0.77	0.82	0.90	0.82	0.82	0.87	0.74	0.86	0.89	0.69	1.36															
BEL	0.88	0.93	0.84	0.87	0.93	0.88	0.83	0.89	0.75	0.82	0.88	0.72	0.93	0.51														
JPN	0.73	0.83	0.68	0.71	0.77	0.73	0.69	0.79	0.68	0.76	0.83	0.68	0.80	0.84	0.45													
ESP	0.86	0.91	0.79	0.85	0.90	0.86	0.83	0.87	0.74	0.86	0.87	0.71	0.93	0.96	0.84	11.70												
ZAF	0.83	0.88	0.77	0.77	0.83	0.82	0.80	0.84	0.73	0.81	0.85	0.73	0.90	0.93	0.86	0.94	26.04											
NZL	0.62	0.70	0.63	0.62	0.72	0.62	0.62	0.63	0.62	0.72	0.66	0.72	0.71	0.78	0.77	0.77	0.82	0.41										
IRL	0.77	0.86	0.76	0.77	0.86	0.77	0.77	0.78	0.66	0.78	0.81	0.73	0.86	0.93	0.82	0.91	0.91	0.90	0.11									
CZE	0.83	0.87	0.75	0.81	0.85	0.82	0.79	0.84	0.71	0.79	0.88	0.69	0.90	0.91	0.85	0.92	0.90	0.72	0.84	15.55								
SVK	0.83	0.86	0.81	0.80	0.89	0.84	0.80	0.86	0.77	0.82	0.88	0.69	0.94	0.92	0.78	0.91	0.89	0.71	0.84	0.90	0.40							
POL	0.86	0.90	0.80	0.86	0.93	0.84	0.83	0.86	0.73	0.83	0.85	0.70	0.95	0.97	0.82	0.95	0.89	0.74	0.91	0.91	0.90	10.85						
LTU	0.79	0.82	0.78	0.82	0.88	0.82	0.76	0.79	0.70	0.79	0.77	0.68	0.87	0.92	0.76	0.87	0.83	0.71	0.83	0.86	0.88	0.89	0.36					
LVA	0.78	0.82	0.73	0.81	0.91	0.78	0.79	0.83	0.71	0.78	0.83	0.71	0.91	0.94	0.77	0.90	0.86	0.79	0.91	0.87	0.87	0.95	0.90	479.43				
PRT	0.74	0.80	0.70	0.74	0.79	0.75	0.70	0.75	0.68	0.77	0.74	0.68	0.82	0.84	0.77	0.82	0.82	0.71	0.82	0.83	0.77	0.82	0.82	0.81	0.46			
KOR	0.80	0.83	0.70	0.81	0.84	0.80	0.77	0.74	0.71	0.76	0.75	0.69	0.86	0.89	0.83	0.90	0.83	0.73	0.82	0.83	0.80	0.91	0.84	0.87	0.77	0.33		
SVN	0.77	0.81	0.74	0.78	0.80	0.79	0.77	0.75	0.68	0.74	0.76	0.69	0.79	0.88	0.76	0.83	0.78	0.73	0.89	0.79	0.78	0.86	0.82	0.88	0.79	0.77	10.57	
HRV	0.69	0.76	0.69	0.70	0.85	0.71	0.75	0.77	0.69	0.77	0.76	0.69	0.85	0.85	0.77	0.82	0.81	0.71	0.79	0.80	0.79	0.84	0.86	0.85	0.77	0.78	0.79	11.46
URY	0.70	0.75	0.74	0.70	0.80	0.70	0.70	0.71	0.69	0.76	0.72	0.69	0.79	0.83	0.77	0.80	0.83	0.77	0.84	0.78	0.81	0.82	0.77	0.81	0.77	0.77	0.20	

JER SCS

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	6.00									
DFS	0.91	12.35								
GBR	0.92	0.92	11.40							
NLD	0.91	0.95	0.94	3.99						
USA	0.90	0.83	0.88	0.84	0.17					
AUS	0.77	0.83	0.83	0.85	0.73	0.23				
ZAF	0.85	0.87	0.86	0.88	0.83	0.80	20.99			
NZL	0.67	0.72	0.76	0.77	0.66	0.89	0.74	0.39		
CHE	0.88	0.86	0.85	0.89	0.82	0.73	0.82	0.68	12.86	
ITA	0.87	0.91	0.86	0.87	0.85	0.71	0.83	0.65	0.85	6.99

JER mas

CAN	CAN 7-21	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
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RDC SCS

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	5.99													
DFS	0.94	12.93												
GBR	0.94	0.91	11.65											
NOR	0.86	0.90	0.80	13.60										
USA	0.92	0.86	0.88	0.79	0.23									
DEU	0.94	0.96	0.95	0.89	0.89	14.16								
AUS	0.81	0.84	0.87	0.82	0.72	0.84	0.26							
EST	0.89	0.89	0.89	0.84	0.85	0.93	0.81	18.94						
ZAF	0.83	0.85	0.85	0.88	0.86	0.91	0.75	0.87	25.31					
NZL	0.76	0.78	0.81	0.77	0.71	0.80	0.89	0.79	0.78	0.44				
LTU	0.82	0.88	0.83	0.90	0.79	0.89	0.80	0.88	0.86	0.75	0.37			
LVA	0.86	0.87	0.90	0.84	0.83	0.92	0.82	0.93	0.87	0.79	0.89	436.12		
NLD	0.91	0.95	0.95	0.88	0.86	0.96	0.84	0.89	0.88	0.81	0.85	0.88	3.91	
CAM	0.89	0.89	0.89	0.88	0.82	0.89	0.86	0.88	0.88	0.85	0.87	0.87	0.89	6.20

RDC mas

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	7.91												
DFS	0.89	13.50											
GBR	0.87	0.84	2.17										
NOR	0.81	0.71	0.72	13.60									
USA	0.79	0.73	0.78	0.79	0.23								
AUS	0.66	0.65	0.66	0.77	0.68	0.12							
EST	0.81	0.73	0.79	0.83	0.80	0.73	18.94						
ZAF	0.83	0.81	0.82	0.87	0.79	0.72	0.84	25.38					
NZL	0.64	0.63	0.66	0.75	0.70	0.73	0.83	0.77	0.43				
LTU	0.75	0.72	0.77	0.85	0.77	0.73	0.90	0.85	0.80	0.37			
LVA	0.78	0.72	0.80	0.86	0.75	0.71	0.94	0.86	0.83	0.91	435.89		
NLD	0.83	0.78	0.84	0.87	0.83	0.71	0.86	0.85	0.71	0.82	0.85	4.65	
CAM	0.83	0.84	0.84	0.88	0.81	0.85	0.88	0.88	0.88	0.87	0.88	0.85	6.20

SIM SCS

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.09										
FRA	0.88	1.01									
ITA	0.88	0.87	12.47								
NLD	0.92	0.93	0.84	3.96							
CHE	0.93	0.93	0.87	0.93	10.43						
DEA	0.92	0.93	0.85	0.91	0.89	12.24					
HUN	0.88	0.90	0.92	0.88	0.89	0.89	16.37				
SVN	0.84	0.82	0.82	0.81	0.84	0.80	0.82	9.22			
GBR	0.91	0.95	0.87	0.95	0.90	0.93	0.89	0.83	10.85		
HRV	0.86	0.79	0.79	0.79	0.80	0.78	0.83	0.78	0.80	9.67	
USA	0.84	0.90	0.87	0.87	0.85	0.81	0.91	0.78	0.90	0.79	0.20

STM mas

^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

CAN	0	97	58	187	150	159	32	144	68	32
FRA	89	0	93	135	196	258	29	229	64	52
NLD	53	80	0	91	112	167	30	144	41	46
USA	183	99	82	0	332	343	37	241	95	40
CHE	128	155	102	310	0	646	36	510	78	76
DEA	143	214	156	310	540	0	50	730	80	103
NZL	32	23	23	33	29	45	0	42	23	11
ITA	128	195	117	170	454	630	35	0	82	95
GBR	69	57	36	94	62	57	21	62	0	20
SVN	29	51	45	32	72	94	10	91	16	0

BSW

common bulls below diagonal

common three quarter sib group above diagonal

CAN FRA NLD USA CHE DEA NZL ITA GBR

CAN	0	86	55	58	74	157	32	142	32	32
FRA	79	0	69	26	79	220	23	198	31	51
NLD	48	60	0	20	54	149	30	132	21	45
USA	59	25	18	0	30	51	15	44	19	12
CHE	68	64	51	26	0	255	17	219	20	60
DEA	143	176	138	45	222	0	50	729	39	102
NZL	32	20	23	14	15	45	0	42	11	11
ITA	127	166	106	35	192	630	35	0	43	95
GBR	31	28	18	18	17	29	9	34	0	14
SVN	29	49	44	11	57	94	10	91	12	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

CAN GBR USA AUS NZL

CAN	0	35	78	54	14
GBR	30	0	92	43	13
USA	70	94	0	72	29
AUS	52	36	70	0	26
NZL	11	11	28	26	0

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common bulls below diagonal

common sibis below diagonal
common three quarter sib group above diagonal

CAN CHE DEU PES EST FRA GBR NLD USA

	CAN	CHE	DEU	DIV	EST	FRA	GER	GBR	IND	ISR	ITA	KOR	MEX	NED	PER	ESP	ZAF	NZL	PAK	SLV	SWE	VAT	COL	ECU	EVA	PRT	RON	SVN	HRV	CRI
CAN	0	944	2659	1761	325	1703	1839	1838	4024	166	2005	1627	1122	928	1519	1477	505	843	579	1307	468	1795	300	566	1260	802	231	348	884	
CHE	871	0	1218	795	194	784	749	996	1074	71	785	688	455	663	514	618	257	454	405	561	249	775	145	272	566	299	144	221	343	

DEU	2120	1153	0	2992	510	2734	2215	3736	3834	192	2808	1812	1322	1356	1549	1710	549	1075	851	2045	717	3055	554	814	1447	707	370	722	882
DFS	1585	754	2312	0	388	1915	1716	2494	2478	176	1767	1453	999	992	1103	1205	505	938	746	1453	443	2017	360	541	1125	569	276	486	738
EST	210	114	377	262	0	316	312	451	427	60	343	253	229	232	240	245	113	161	140	318	134	428	101	193	236	142	99	148	167
FRA	1267	726	1694	1203	172	0	1692	2305	2737	145	1775	1434	1038	1106	1330	1391	503	898	723	1424	472	2083	289	484	1145	608	227	389	688
GBR	2075	717	1722	1348	189	1169	0	1973	2454	172	1645	1536	931	952	1138	1184	507	988	943	1177	398	1607	319	474	1081	553	216	378	755
NLD	1805	996	3580	2258	332	1642	1751	0	2877	187	1959	1629	1059	1430	1213	1311	512	1183	884	1730	579	2323	368	576	1268	567	291	522	783
USA	4595	1009	2918	2040	307	1619	2247	2605	0	251	2900	2171	1429	1085	2161	1757	633	1205	809	1888	585	2678	403	768	1589	973	264	442	1287
ISR	118	42	145	132	36	91	122	143	241	0	169	134	124	94	131	124	66	131	107	154	57	186	56	86	124	75	51	77	106
ITA	1774	730	2089	1491	211	1146	1333	1735	2356	120	0	1254	1069	868	1234	1414	418	715	569	1389	417	2076	343	588	1158	660	280	440	745
AUS	1666	614	1399	1083	134	1027	1348	1440	2241	85	994	0	801	828	1004	993	481	1307	728	957	331	1245	264	432	940	514	179	331	759
HUN	1066	383	1077	832	138	776	814	915	1418	86	945	612	0	598	787	858	395	547	431	1015	333	1094	250	394	833	510	165	296	560
BEL	926	678	1403	937	146	1137	936	1652	975	59	878	734	520	0	613	761	337	569	504	740	316	953	186	313	760	342	174	306	395
JPN	861	362	753	651	94	554	624	700	1083	61	662	595	465	411	0	1004	428	621	438	948	336	1159	230	407	828	629	171	265	654
ESP	1028	518	1157	952	122	1169	948	1192	1213	76	1070	727	700	750	520	0	448	604	498	982	344	1310	244	424	981	553	207	330	587
ZAF	465	216	428	389	56	399	444	434	618	42	336	419	320	287	299	399	0	367	294	408	180	418	106	165	443	266	72	158	326
NZL	838	382	828	676	84	588	854	1080	1156	105	552	1316	423	462	348	463	298	0	737	693	270	776	190	279	652	340	128	249	601
IRL	513	388	692	589	74	568	897	781	691	80	473	599	347	468	274	449	246	605	0	521	211	640	146	212	480	227	105	192	371
CZE	1004	430	1632	1031	206	982	863	1581	1555	121	1060	658	942	597	478	737	287	518	383	0	530	1603	297	465	929	542	232	421	635
SVK	331	128	536	235	56	270	226	411	395	23	259	164	233	192	129	177	97	163	98	452	0	493	106	170	348	218	79	158	254
POL	1637	672	2868	1735	317	1552	1407	2228	2713	145	1787	985	1007	885	663	993	315	603	500	1378	348	0	417	695	1255	669	307	558	776
LTU	171	59	513	216	46	121	169	228	283	25	187	121	152	90	77	100	40	90	69	192	48	323	0	207	245	158	72	165	180
LVA	358	140	656	342	109	258	273	389	671	55	385	220	283	182	232	96	157	117	309	78	563	134	0	452	274	123	275	296	
PRT	1322	516	1354	1045	160	1043	1005	1281	1700	81	1121	792	835	772	531	955	396	530	402	782	233	1289	153	352	0	542	178	361	632
KOR	790	216	498	429	69	384	408	420	1114	40	555	379	410	255	401	398	197	249	150	391	131	568	71	165	466	0	114	168	435
SVN	177	104	361	223	59	171	157	254	213	36	240	121	122	134	96	150	51	86	79	168	36	271	31	71	140	72	0	126	103
HRV	213	147	747	393	107	281	270	481	340	53	341	210	218	248	126	253	108	149	131	318	79	509	113	213	298	81	101	0	206
URY	861	273	662	538	94	468	639	647	1587	64	565	610	462	315	398	476	292	502	287	468	154	661	103	171	548	349	57	124	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
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CAN	0	140	182	50	502	285	161	201	42	33
DFS	135	0	196	175	233	178	163	179	61	36
GBR	186	191	0	104	262	245	175	243	74	41
NLD	45	179	97	0	116	86	81	98	42	27
USA	531	216	288	122	0	532	300	407	74	42
AUS	293	149	250	77	580	0	243	469	60	41
ZAF	157	146	178	77	316	233	0	210	57	38
NZL	210	156	248	93	480	522	219	0	56	34
CHE	36	60	72	36	75	50	50	48	0	28
ITA	28	35	41	22	41	35	33	32	28	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	53	89	22	98	138	75	97	26	22
DFS	48	0	127	146	73	143	141	151	59	33
GBR	87	121	0	77	94	181	138	176	66	38
NLD	15	142	73	0	44	81	78	89	39	27
USA	89	62	95	43	0	177	127	135	41	26
AUS	126	109	185	74	187	0	238	464	57	40
ZAF	68	120	140	75	138	232	0	205	54	38
NZL	90	125	179	84	135	515	216	0	52	34
CHE	24	56	64	34	35	50	49	47	0	27
ITA	18	31	36	22	25	34	33	32	28	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	192	91	7	221	14	106	3	70	94	22	10	7	0
DFS	198	0	126	138	218	66	212	135	51	190	103	132	64	0
GBR	92	121	0	70	131	16	98	14	40	96	26	16	45	0
NOR	6	113	74	0	85	16	77	28	0	51	19	19	52	0
USA	208	216	126	86	0	25	150	26	59	136	37	25	49	31
DEU	13	57	16	15	23	0	44	32	1	22	28	36	18	0
AUS	107	186	93	66	153	43	0	42	34	166	43	40	43	13
EST	2	124	12	28	25	32	39	0	0	19	22	53	22	0
ZAF	72	48	35	0	53	1	34	0	0	35	5	2	3	0
NZL	92	187	91	51	137	22	167	18	30	0	22	19	27	13
LTU	21	89	24	18	33	27	40	22	5	22	0	44	15	0
LVA	10	91	16	17	22	30	36	46	2	16	40	0	17	0
NLD	7	62	44	51	48	17	41	21	3	27	14	16	0	0
CAM	0	0	0	0	31	0	13	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
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CAN	0	88	33	3	83	34	0	35	37	18	7	3	0
DFS	87	0	87	140	209	227	135	46	188	102	126	63	0
GBR	31	82	0	60	92	61	7	27	65	20	14	34	0
NOR	3	114	63	0	85	77	28	0	51	19	19	45	0
USA	82	207	90	86	0	139	26	54	133	37	25	47	31
AUS	34	204	59	66	143	0	42	31	157	40	38	41	12
EST	0	124	7	28	25	39	0	0	19	22	49	21	0
ZAF	36	46	26	0	52	33	0	0	33	5	2	2	0
NZL	37	183	63	51	137	159	18	30	0	22	18	24	13
LTU	17	88	18	18	33	38	22	5	22	0	44	14	0
LVA	7	84	14	17	22	35	42	2	15	40	0	14	0
NLD	3	61	34	44	47	39	20	2	24	13	13	0	0
CAM	0	0	0	0	31	12	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	2	186	132	240	275	2	11	66	2	86
FRA	1	0	142	80	14	259	4	50	0	102	3
ITA	211	125	0	258	101	1009	18	151	45	334	34
NLD	157	76	252	0	94	396	8	85	48	167	31
CHE	292	11	103	98	0	367	2	53	2	34	
DEA	314	216	920	417	333	0	37	261	48	726	39
HUN	0	3	15	8	1	24	0	10	0	19	0
SVN	10	48	143	79	2	246	9	0	0	131	1
GBR	83	0	49	48	60	51	0	0	0	0	20
HRV	1	92	317	163	2	760	17	120	0	0	4
USA	101	3	41	32	33	42	0	1	27	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

FRM	0	2	157	104	5	227	2	11	25	2	37
FRA	1	0	84	31	2	161	3	25	0	58	1
ITA	182	71	0	247	9	1008	18	151	18	334	34
NLD	127	30	241	0	8	362	8	78	18	158	31
CHE	5	2	9	8	0	97	0	0	1	0	5
DEA	275	124	920	381	90	0	37	261	20	726	39
HUN	0	2	15	8	0	24	0	10	0	19	0
SVN	10	22	143	73	0	246	9	0	0	131	1
GBR	34	0	23	20	1	25	0	0	0	0	17
HRV	1	51	317	155	0	760	17	120	0	0	4
USA	52	1	41	32	5	42	0	1	23	4	0