

Introduction

The latest routine international evaluation for **udder traits** took place as scheduled at the Interbull Centre. Data from twenty seven (27) countries were included in this evaluation.

International genetic evaluations for udder health traits of bulls from Australia, Austria-Germany, Belgium, Canada, 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 and Portugal were computed. Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed data were included in this evaluation.

Changes in national procedures

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

NOR (RDC) The rolling definition of hys is causing the daughters to distribute somewhat differently over hys-classes at each evaluation. Therefore some bulls occasionally may lose EDC although the number of daughters stay the same.
Reliability changes is a function of the EDC changes.

SVN (BSW,HOL,SIM) Changed the definition of genetic reference base. As genetic reference base we use population average.
Genetic parameters were recalculated

LTU (HOL,RDC) Base change

IRL (HOL) Base change

CHE (BSW,HOL,SIM) Base change

FRA (HOL) Inclusion of HOLFRR in HOLFRA, base change

FRA(BSW,SIM) Base change

FRM(SIM) Base change

NLD (ALL) Introduction of the 4th and 5th lactation.

ITA (HOL) Base change plus one year cut-off data

DEU (HOL,RDC) Base change

NZL (ALL) Continuous DNA parentage testing therefore daughter counts, herd counts, edc and reliability are subjected to changes

JPN (HOL) Little changes in proofs caused by additional records and modification of pedigree.

DEA (BSW,SIM) Base change

EST (HOL,RDC) Pedigree updates for some cows

GBR (ALL) Participating with MAS data for the first time

CAN (ALL) Base change

ITA (SIM) Base change, inclusion of Interbull pedigree in national one's so to have a deeper pedigree structure; new updated reliability software (accf90) which causes decreases in reliability

AUS (ALL) Base change

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

Sub-setting:

As decided by the ITC in Orlando, new sub-setting was introduced in the September test run. Sub-setting is necessary for operational purposes and restrictions of time scales. To minimize the effect of sub-setting, larger subsets with 10-12 countries and with 4 link providing countries have been applied.

Window:

According to the decision taken by ITC in Orlando, the following changes have been introduced in regards to the windows used for post processing:

The upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations. The lower values have been set to about the 25% percentile value. The largest changes are for the lower values for conformation traits, with the lowest window being 40% for OFL otherwise it is about 50% for all other conformation traits. It is anticipated that these low values may not have large impact on evaluations since there were very few countries combinations whose estimated correlations fell between the old limit of 0.30 and these new limits.

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 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 2017).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		124	7289	1465	645	
BEL			1084			
CAN	193	92	11339	648	760	
CHE	2779		3106			3024
CZE			3623			
DEA	5343					21176
DEU			26355		408	
DFS			12616	2023	7507	
ESP			3356			
EST			1024		393	
FRA	356		16445			423
FRM						4043
GBR	105	263	6166	648	468	81
HUN			2553			157
IRL			2215			
ISR			1295			
ITA	1798		9231			1362
JPN			5531			
KOR			1007			
LTU			709		408	
LVA			528		564	
NLD	170		14723	130	66	313
NOR					3935	
NZL	45	57	7005	4192	1224	
POL			9440			
PRT			2148			
SVK			1025			530
SVN	341		465			556
URY						
USA	1007	673	35321	4051	630	41
ZAF			1145	543	121	
HRV			674			762
MEX						
No. Records	12137	1209	187418	13700	17129	32468
Pub. Proofs	9943	949	146480	11388	16468	29300

^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	0.24									
FRA	0.94	1.02								
NLD	0.90	0.93	4.54							
USA	0.92	0.91	0.88	0.21						
CHE	0.92	0.95	0.93	0.88	10.39					
DEA	0.93	0.96	0.92	0.88	0.97	11.91				
NZL	0.87	0.87	0.87	0.85	0.87	0.87	0.37			
ITA	0.90	0.90	0.88	0.88	0.95	0.91	0.87	17.57		
GBR	0.93	0.96	0.96	0.91	0.94	0.95	0.89	0.89	12.90	
SVN	0.89	0.89	0.89	0.89	0.89	0.89	0.88	0.89	0.89	10.51

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0.24									
FRA	0.86	1.07								
NLD	0.86	0.86	3.58							
USA	0.87	0.86	0.88	0.21						
CHE	0.91	0.87	0.89	0.88	10.39					
DEA	0.91	0.82	0.88	0.87	0.97	11.91				
NZL	0.86	0.85	0.86	0.85	0.85	0.84	0.37			
ITA	0.89	0.88	0.89	0.88	0.95	0.91	0.86	17.57		
GBR	0.88	0.86	0.88	0.89	0.90	0.90	0.88	0.89	2.88	
SVN	0.90	0.89	0.89	0.89	0.89	0.89	0.88	0.89	0.89	10.51

GUE scs

	CAN	GBR	USA	AUS	NZL
CAN	0.24				
GBR	0.93	13.40			
USA	0.93	0.90	0.26		
AUS	0.88	0.93	0.87	29.19	
NZL	0.87	0.88	0.85	0.95	0.63

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										
CAN	7.61											
CHE	0.84	10.78										
DEU	0.85	0.93	12.69									
DFS	0.93	0.84	0.86	12.12								
EST	0.83	0.86	0.91	0.84	13.53							
FRA	0.95	0.83	0.86	0.93	0.82	1.21						
GBR	0.87	0.90	0.90	0.87	0.88	0.87	2.48					
NLD	0.87	0.87	0.93	0.87	0.89	0.87	0.88	4.82				
USA	0.87	0.87	0.88	0.87	0.87	0.87	0.89	0.89	0.21			
ISR	0.77	0.78	0.81	0.78	0.80	0.77	0.82	0.81	0.82	0.24		
ITA	0.85	0.88	0.94	0.86	0.90	0.86	0.88	0.90	0.89	0.81	5.81	
AUS	0.81	0.90	0.88	0.82	0.82	0.80	0.90	0.87	0.85	0.78	0.84	30.24
HUN	0.85	0.87	0.92	0.86	0.88	0.85	0.88	0.90	0.91	0.83	0.93	0.84
1.44												
BEL	0.86	0.92	0.96	0.86	0.92	0.86	0.90	0.94	0.89	0.79	0.94	0.87
0.92	0.50											
JPN	0.84	0.87	0.87	0.84	0.84	0.84	0.88	0.86	0.88	0.78	0.87	0.85
0.87	0.87	0.42										
ESP	0.86	0.91	0.95	0.87	0.90	0.87	0.90	0.92	0.91	0.83	0.95	0.85
0.93	0.96	0.87	11.57									
ZAF	0.85	0.88	0.90	0.85	0.84	0.85	0.89	0.88	0.89	0.82	0.91	0.87
0.90	0.91	0.87	0.94	26.46								
NZL	0.83	0.85	0.85	0.84	0.81	0.83	0.89	0.85	0.85	0.78	0.83	0.96
0.84	0.85	0.85	0.84	0.85	0.40							
IRL	0.84	0.92	0.92	0.85	0.85	0.84	0.92	0.89	0.86	0.78	0.87	0.94
0.85	0.93	0.85	0.91	0.90	0.91	0.11						
CZE	0.83	0.86	0.89	0.84	0.87	0.84	0.88	0.88	0.88	0.79	0.90	0.83
0.89	0.89	0.87	0.91	0.86	0.84	0.85	14.59					
SVK	0.82	0.86	0.89	0.83	0.84	0.83	0.87	0.87	0.86	0.76	0.87	0.82
0.93	0.88	0.86	0.89	0.86	0.82	0.83	0.87	0.41				
POL	0.87	0.91	0.96	0.88	0.91	0.88	0.89	0.92	0.88	0.82	0.94	0.86
0.94	0.95	0.88	0.95	0.90	0.86	0.89	0.91	0.89	9.96			
LTU	0.80	0.81	0.87	0.81	0.81	0.78	0.86	0.83	0.84	0.75	0.84	0.81
0.84	0.83	0.83	0.85	0.81	0.80	0.81	0.84	0.82	0.86	0.36		
LVA	0.81	0.85	0.92	0.82	0.90	0.81	0.87	0.87	0.85	0.75	0.89	0.83
0.85	0.91	0.85	0.86	0.83	0.81	0.85	0.84	0.83	0.90	0.85	0.48	
PRT	0.87	0.87	0.88	0.87	0.84	0.87	0.88	0.87	0.88	0.79	0.88	0.85
0.88	0.87	0.87	0.88	0.87	0.85	0.86	0.87	0.86	0.88	0.84	0.85	0.48
KOR	0.84	0.85	0.86	0.84	0.83	0.85	0.87	0.85	0.87	0.77	0.88	0.83
0.86	0.87	0.87	0.90	0.86	0.83	0.84	0.86	0.85	0.90	0.83	0.85	0.87
0.34												
SVN	0.83	0.85	0.86	0.84	0.84	0.83	0.87	0.85	0.85	0.79	0.86	0.83
0.85	0.86	0.86	0.86	0.84	0.82	0.84	0.85	0.83	0.86	0.81	0.83	0.85
0.83	10.44											
HRV	0.79	0.84	0.86	0.80	0.83	0.80	0.87	0.85	0.85	0.77	0.86	0.83
0.85	0.86	0.85	0.86	0.84	0.81	0.81	0.85	0.82	0.88	0.84	0.85	0.86
0.81	0.85	11.78										

JER scs

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0.22							
DFS	0.91	12.52						
GBR	0.92	0.91	11.33					
NLD	0.92	0.95	0.95	4.38				
USA	0.91	0.88	0.89	0.88	0.19			
AUS	0.87	0.88	0.89	0.92	0.86	29.03		
ZAF	0.89	0.88	0.89	0.91	0.88	0.90	21.31	
NZL	0.88	0.87	0.88	0.87	0.85	0.96	0.86	0.38

JER mas

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	7.28							
DFS	0.93	12.32						
GBR	0.86	0.87	1.84					
NLD	0.87	0.88	0.89	4.00				
USA	0.87	0.88	0.88	0.88	0.19			
AUS	0.82	0.83	0.89	0.88	0.86	29.04		
ZAF	0.85	0.85	0.88	0.90	0.88	0.90	21.32	
NZL	0.86	0.85	0.89	0.88	0.85	0.96	0.86	0.38

RDC scs

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA
NLD												
CAN	0.24											
DFS	0.94	12.68										
GBR	0.93	0.92	11.29									
NOR	0.92	0.94	0.89	13.98								
USA	0.93	0.88	0.89	0.89	0.24							
DEU	0.93	0.95	0.94	0.90	0.89	13.57						
AUS	0.89	0.93	0.92	0.92	0.86	0.90	30.93					
EST	0.89	0.94	0.91	0.90	0.91	0.94	0.91	11.59				
ZAF	0.89	0.90	0.90	0.93	0.89	0.92	0.88	0.90	25.19			
NZL	0.87	0.88	0.88	0.89	0.85	0.86	0.96	0.88	0.86	0.41		
LTU	0.90	0.88	0.89	0.90	0.89	0.89	0.86	0.91	0.91	0.87	0.34	
LVA	0.90	0.89	0.90	0.90	0.89	0.93	0.90	0.96	0.89	0.88	0.89	0.44
NLD	0.91	0.94	0.96	0.90	0.88	0.95	0.92	0.91	0.90	0.87	0.89	0.90

RDC mas

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA
NLD												
CAN	7.73											
DFS	0.91	13.16										
GBR	0.87	0.87	2.04									
NOR	0.91	0.88	0.90	13.98								
USA	0.88	0.88	0.89	0.89	0.24							
DEU	0.86	0.84	0.90	0.90	0.88	13.57						
AUS	0.83	0.80	0.90	0.90	0.85	0.88	30.99					
EST	0.84	0.82	0.88	0.89	0.88	0.92	0.86	11.59				
ZAF	0.88	0.88	0.89	0.93	0.89	0.91	0.87	0.88	25.26			
NZL	0.85	0.85	0.89	0.91	0.85	0.86	0.95	0.85	0.87	0.41		
LTU	0.83	0.81	0.89	0.89	0.87	0.88	0.87	0.90	0.88	0.85	0.33	
LVA	0.83	0.80	0.88	0.89	0.87	0.93	0.89	0.94	0.87	0.87	0.90	0.44
NLD	0.87	0.88	0.89	0.90	0.89	0.93	0.88	0.90	0.89	0.87	0.87	0.89

SIM scs

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	1.08											
FRA	0.93	1.01										
ITA	0.95	0.90	13.89									
NLD	0.92	0.93	0.88	4.65								
CHE	0.93	0.92	0.89	0.92	10.29							
DEA	0.92	0.93	0.88	0.90	0.89	12.13						
HUN	0.93	0.91	0.93	0.88	0.90	0.93	15.66					
SVK	0.89	0.89	0.89	0.90	0.89	0.87	0.94	0.38				
SVN	0.90	0.88	0.89	0.88	0.89	0.88	0.89	0.89	9.06			
GBR	0.92	0.96	0.89	0.95	0.91	0.92	0.89	0.88	0.88	11.15		
HRV	0.92	0.88	0.88	0.88	0.88	0.87	0.89	0.88	0.88	0.87	10.15	
USA	0.89	0.90	0.89	0.88	0.89	0.90	0.92	0.89	0.89	0.90	0.88	0.22

SIM mas

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	1.08											
FRA	0.91	1.00										
ITA	0.95	0.88	13.89									
NLD	0.88	0.88	0.89	3.79								
CHE	0.92	0.86	0.89	0.88	10.29							
DEA	0.92	0.92	0.88	0.88	0.89	12.13						
HUN	0.92	0.87	0.93	0.90	0.89	0.92	15.66					
SVK	0.88	0.88	0.90	0.88	0.89	0.87	0.93	0.38				
SVN	0.89	0.88	0.89	0.88	0.89	0.88	0.89	0.88	9.06			
GBR	0.91	0.87	0.89	0.89	0.90	0.90	0.89	0.89	0.88	2.54		
HRV	0.91	0.87	0.88	0.85	0.87	0.87	0.89	0.88	0.88	0.88	10.15	
USA	0.89	0.88	0.89	0.89	0.89	0.90	0.92	0.89	0.89	0.89	0.88	0.22

^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	69	42	138	102	107	17	93	53	24
FRA	50	0	78	117	146	190	19	166	49	49
NLD	37	63	0	72	85	129	19	112	34	37
USA	110	78	61	0	297	292	24	206	74	36
CHE	68	109	76	280	0	522	21	391	61	67
DEA	75	143	121	256	422	0	28	558	63	92
NZL	13	15	13	23	16	24	0	24	15	6
ITA	66	133	92	142	338	467	18	0	63	83
GBR	41	39	27	70	47	43	12	45	0	19
SVN	19	48	38	28	64	86	5	82	14	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	64	39	138	102	107	17	93	24	24
FRA	48	0	62	103	143	174	16	153	25	48
NLD	31	51	0	66	76	111	19	96	17	33
USA	110	70	51	0	297	292	24	206	33	36
CHE	68	108	68	280	0	522	21	391	30	67
DEA	75	132	98	256	422	0	28	558	29	92
NZL	13	13	13	23	16	24	0	24	9	6
ITA	66	125	74	142	338	467	18	0	31	83
GBR	17	19	13	31	24	21	6	23	0	11
SVN	19	47	33	28	64	86	5	82	8	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL
CAN	0	25	61	41	13
GBR	20	0	79	31	13
USA	52	81	0	56	29
AUS	39	26	52	0	26
NZL	11	11	29	26	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											
CAN	0	455	1097	548	107	618	632	577	1309	54	856	568	489	277	623	657	219	297	206
534	198	717	125	112	511	338	121	164											
CHE	365	0	1022	565	133	490	546	731	838	50	636	514	391	370	407	481	244	338	301
450	203	569	100	137	450	204	121	173											
DEU	750	867	0	2377	346	1747	1604	2899	3211	133	2354	1487	1104	709	1353	1350	548	861	673
1597	664	1998	424	305	1097	482	252	532											
DFS	484	475	1287	0	228	1105	1117	1578	1655	116	1354	1042	741	483	824	846	457	692	556
988	352	1247	248	202	778	357	200	319											
EST	62	73	234	126	0	175	180	290	282	43	224	180	164	101	171	163	89	112	100
214	99	253	63	89	161	83	74	101											
FRA	418	414	754	525	84	0	985	1292	1566	92	1325	863	709	485	825	831	356	552	463
910	297	1196	165	156	696	331	152	209											
GBR	584	519	1165	783	106	603	0	1303	1592	108	1260	1053	699	473	810	841	440	702	645
801	304	1016	193	160	777	370	170	262											
NLD	518	685	2373	1119	207	705	1044	0	2008	123	1453	1215	796	711	887	904	460	874	658
1175	463	1385	231	212	884	355	201	352											
USA	1260	741	1962	1010	181	681	1320	1533	0	135	2306	1597	1098	531	1724	1325	591	934	579
1364	475	1660	270	259	1125	648	196	307											
ISR	39	34	109	86	28	53	72	101	118	0	115	87	90	47	87	90	54	93	69
95	39	108	34	28	89	44	38	55											
ITA	601	558	1404	857	122	607	906	1010	1349	84	0	1074	898	493	1078	1118	464	682	502
1103	367	1338	235	223	895	470	207	324											
AUS	566	448	1002	641	82	563	859	982	1471	57	706	0	608	461	765	748	437	1032	540
707	267	842	171	162	674	329	152	238											
HUN	461	315	845	548	101	456	610	617	1035	69	739	446	0	323	629	656	365	439	334
765	283	801	161	138	627	359	139	215											
BEL	258	340	638	394	61	436	422	740	416	28	403	372	249	0	326	403	226	315	288
358	168	441	90	98	400	165	116	162											
JPN	397	261	513	404	60	324	431	431	729	42	462	407	364	196	0	796	394	486	336
702	277	842	158	147	621	421	142	182											
ESP	378	390	845	586	76	605	703	752	800	57	799	517	519	372	364	0	417	465	383
703	280	870	173	165	731	355	156	239											
ZAF	198	194	418	333	46	255	387	374	563	38	353	369	290	176	271	362	0	343	270
334	165	379	86	97	395	230	87	129											
NZL	264	284	649	453	59	322	560	781	867	77	483	1017	346	239	258	351	272	0	553
497	218	558	136	111	491	239	109	184											
IRL	197	277	519	396	50	347	608	543	455	51	378	426	266	256	194	345	217	432	0
356	156	433	106	94	366	144	86	135											
CZE	373	295	1105	550	134	462	500	945	956	69	685	408	664	239	291	452	209	316	217
0	394	1079	190	182	651	370	175	290											
SVK	133	101	497	173	46	147	177	304	311	17	211	133	204	89	106	139	88	131	76
298	0	386	76	94	281	163	69	110											
POL	578	448	1600	876	173	694	791	1137	1416	87	945	574	692	364	415	586	274	402	314
801	255	0	268	250	864	445	201	381											
LTU	69	35	397	121	27	40	89	112	169	16	113	62	93	30	42	70	31	57	41
119	38	197	0	73	165	104	42	118											
LVA	70	79	207	121	63	77	95	130	208	20	151	77	99	55	66	93	57	54	53
118	46	185	52	0	188	98	43	115											
PRT	495	385	994	650	108	587	717	860	1152	67	820	510	605	370	381	687	349	398	304
518	190	857	105	143	0	382	138	270											
KOR	316	139	321	237	43	193	273	227	759	30	379	240	307	96	261	253	175	173	89
261	99	358	47	59	321	0	80	106											
SVN	91	91	237	159	45	106	128	169	148	29	172	109	108	90	84	116	60	76	63
132	40	179	19	27	107	46	0	83											
HRV	96	114	545	229	73	127	192	307	227	40	246	146	163	130	85	188	88	106	92
210	55	331	81	90	219	48	68	0											

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	72	133	29	340	214	128	154
DFS	56	0	130	77	145	115	118	111
GBR	132	117	0	68	199	175	142	179
NLD	23	75	62	0	66	56	60	59
USA	350	116	215	71	0	421	248	319
AUS	216	78	178	47	450	0	193	367
ZAF	122	95	145	56	258	184	0	174
NZL	164	83	182	51	389	407	182	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	29	50	10	115	79	49	58
DFS	23	0	78	55	131	101	106	102
GBR	46	70	0	39	142	121	101	116
NLD	4	48	35	0	56	48	54	49
USA	108	92	150	61	0	421	248	319
AUS	70	62	120	43	450	0	193	366
ZAF	44	81	100	50	258	184	0	174
NZL	57	71	116	41	389	406	182	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
CAN	0	123	69	4	177	13	87	1	68	75	15	7	5
DFS	123	0	86	104	157	63	154	81	49	150	111	91	40
GBR	69	82	0	35	89	17	67	6	34	64	23	11	26
NOR	4	77	36	0	60	18	52	13	0	38	24	16	29
USA	162	153	84	62	0	25	101	13	57	99	32	14	30
DEU	12	53	16	18	25	0	37	24	2	19	37	29	14
AUS	87	128	64	43	101	36	0	22	30	118	42	27	23
EST	1	70	5	13	12	23	21	0	0	6	23	36	10
ZAF	70	46	30	0	51	2	30	0	0	31	5	1	3
NZL	73	147	60	37	99	19	120	5	27	0	26	13	14
LTU	14	94	21	19	26	34	38	22	5	22	0	37	13
LVA	7	59	11	14	11	23	25	28	1	10	32	0	9
NLD	5	40	24	28	29	14	21	9	3	14	12	8	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
CAN	0	60	21	3	64	7	28	0	34	28	11	4	3
DFS	58	0	53	106	148	63	171	81	44	147	110	92	37
GBR	21	51	0	30	56	15	41	4	20	41	16	9	17
NOR	3	78	31	0	60	18	52	13	0	38	24	16	26
USA	61	146	54	61	0	25	99	13	52	96	32	14	29
DEU	7	53	15	18	25	0	37	24	2	19	37	29	14
AUS	28	147	40	43	100	36	0	22	28	117	42	27	22
EST	0	70	4	13	12	23	21	0	0	6	23	36	9
ZAF	35	44	19	0	50	2	30	0	0	29	5	1	2
NZL	28	142	40	37	99	19	119	5	27	0	26	13	13
LTU	10	93	14	19	26	34	38	22	5	22	0	37	12
LVA	4	59	9	14	11	23	25	28	1	10	32	0	8
NLD	3	37	16	25	28	14	20	8	2	13	11	7	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	0	3	148	109	168	216	2	56	17	64	2	26
FRA	1	0	125	51	12	230	5	51	50	0	83	0
ITA	182	111	0	153	80	718	11	129	92	43	198	19
NLD	133	51	150	0	78	212	4	56	43	47	79	14
CHE	217	9	80	81	0	273	2	30	5	51	1	17
DEA	251	190	622	219	239	0	27	341	165	46	469	16
HUN	0	4	8	4	1	16	0	7	7	0	12	0
SVK	55	44	109	47	22	347	6	0	41	10	80	3
SVN	17	46	89	41	5	151	6	40	0	0	67	0
GBR	81	0	47	47	58	49	0	5	0	0	0	17
HRV	1	77	190	78	1	494	10	63	57	0	0	0
USA	41	0	26	17	18	23	0	3	0	24	0	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	0	2	147	93	162	207	2	56	17	23	2	26
FRA	1	0	86	29	8	159	3	39	34	0	58	0
ITA	181	75	0	133	80	718	11	129	92	18	198	19
NLD	113	28	131	0	70	180	4	51	35	17	70	14
CHE	211	5	80	71	0	273	2	30	5	19	1	17
DEA	246	122	622	188	239	0	27	341	165	18	469	16
HUN	0	2	8	4	1	16	0	7	7	0	12	0
SVK	55	31	109	42	22	347	6	0	41	3	80	3
SVN	17	29	89	35	5	151	6	40	0	0	67	0
GBR	28	0	20	18	22	22	0	3	0	0	0	16
HRV	1	51	190	70	1	494	10	63	57	0	0	0
USA	41	0	26	17	18	23	0	3	0	20	0	0