

Introduction

The latest routine international evaluation for **udder traits** took place as scheduled at the Interbull Centre. Data from thirty-two (32) 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 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:

BEL (HOL) Corrections in pedigree, improvement of program determining the type of proof for bulls.

FRA (BSW,HOL,SIM) Some animals changed from official to unofficial as they do not pass the publication rules anymore

EST (HOL,RDC) Decrease in number of daughters/herds of some bulls due to the update of field data.

SVN (HOL,BSW,SIM) Some decrease in information as consequence of changes in data base related to the pedigree completeness and phenotypic data improvement.

DEU (HOL) Data and pedigree corrections.

ZAF (HOL,JER,RDC) Clean-ups on data especially with regards to alias numbers of foreign bulls.

CHE (BSW,HOL,SIM) Some decrease in information due to continuous work on the raw data by herd-book organizations.

NZL (ALL) Decrease in information due to continuous parentage verification

IRL (HOL) Updated calculation of type of proof

ESP (HOL) Base change

NLD (ALL) A subroutine for scs was changed to adapt to previously changed base population. This resulted in large changes in SD for this trait

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 confirmation 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.

Table 1. National evaluation data considered in the Interbull evaluation for udder health (August Routine Evaluation 2017). Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		125	7370	1484	654	
BEL			1100			
CAN	198	94	11500	663	768	
CHE	2797		3150			3060
CZE			3679			
DEA	5370					21346
DEU			26600		412	
DFS			12786	2049	7599	
ESP			3489			
EST			1045		400	
FRA	360		16530			427
FRM						4081
GBR	106	265	6263	654	476	81
HUN			2596			157
IRL			2302			
ISR			1312			
ITA	1816		9386			1387
JPN			5693			
KOR			1125			
LTU			685		418	
LVA			528		564	
NLD	173		14872	136	66	321
NOR					3964	
NZL	45	57	7017	4194	1224	
POL			9630			
PRT			2148			
SVK			1060			545
SVN	344		475			561
URY						
USA	1018	678	35746	4158	643	43
ZAF			1147	544	122	
HRV			675			762
MEX						
=====						
No. Records	12227	1219	189909	13882	17310	32771
Pub. Proofs	10033	955	147957	11529	16656	29562

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APPENDIX 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	1.01								
NLD	0.90	0.93	3.83							
USA	0.92	0.91	0.88	0.21						
CHE	0.92	0.95	0.93	0.88	10.38					
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	17.41		
GBR	0.93	0.96	0.96	0.91	0.94	0.95	0.89	0.89	12.93	
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	1.08								
NLD	0.86	0.86	3.53							
USA	0.87	0.86	0.88	0.21						
CHE	0.91	0.87	0.89	0.88	10.38					
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	17.41		
GBR	0.88	0.86	0.88	0.89	0.90	0.90	0.88	0.89	2.89	
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	13.52			
USA	0.93	0.90	0.26		
AUS	0.88	0.93	0.87	28.99	
NZL	0.87	0.88	0.85	0.95	0.63

HOL	scs										
	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	
ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL
LTU	LVA	PRT	KOR	SVN	HRV						
CAN	0.27										
CHE	0.88	10.85									
DEU	0.93	0.93	12.67								
DFS	0.92	0.92	0.96	11.93							
EST	0.88	0.88	0.93	0.92	13.76						
FRA	0.94	0.93	0.95	0.97	0.90	1.19					
GBR	0.93	0.94	0.94	0.94	0.90	0.96	12.77				
NLD	0.91	0.93	0.95	0.94	0.90	0.94	0.96	4.19			
USA	0.94	0.88	0.88	0.88	0.90	0.90	0.90	0.88	0.21		
ISR	0.85	0.82	0.85	0.83	0.85	0.84	0.82	0.81	0.87	0.23	
ITA	0.89	0.88	0.94	0.92	0.93	0.92	0.89	0.88	0.89	0.84	
5.82											
AUS	0.86	0.91	0.88	0.89	0.85	0.90	0.93	0.92	0.86	0.81	
0.84	30.26										
HUN	0.88	0.89	0.92	0.90	0.90	0.91	0.89	0.88	0.92	0.87	
0.93	0.85	1.44									
BEL	0.91	0.93	0.97	0.96	0.94	0.96	0.94	0.94	0.89	0.83	
0.94	0.88	0.92	0.49								
JPN	0.88	0.87	0.87	0.89	0.86	0.90	0.88	0.88	0.88	0.81	
0.87	0.85	0.87	0.87	0.42							
ESP	0.92	0.91	0.95	0.94	0.93	0.96	0.93	0.91	0.91	0.87	
0.95	0.85	0.93	0.96	0.87	11.55						
ZAF	0.90	0.89	0.91	0.90	0.87	0.93	0.92	0.89	0.90	0.86	
0.92	0.88	0.91	0.91	0.87	0.95	26.55					
NZL	0.86	0.86	0.85	0.86	0.84	0.86	0.88	0.87	0.85	0.81	
0.83	0.96	0.84	0.85	0.85	0.85	0.86	0.40				
IRL	0.88	0.93	0.92	0.93	0.89	0.93	0.96	0.93	0.86	0.81	
0.88	0.95	0.86	0.93	0.86	0.92	0.90	0.92	0.11			
CZE	0.88	0.88	0.90	0.89	0.89	0.89	0.88	0.87	0.88	0.85	
0.90	0.86	0.90	0.90	0.88	0.91	0.88	0.86	0.86	14.36		
SVK	0.88	0.87	0.90	0.88	0.86	0.89	0.87	0.87	0.87	0.81	
0.89	0.83	0.94	0.89	0.87	0.91	0.88	0.84	0.85	0.88	0.42	
POL	0.91	0.92	0.96	0.95	0.94	0.93	0.91	0.91	0.91	0.88	0.85
0.94	0.86	0.94	0.95	0.88	0.95	0.91	0.86	0.89	0.90	0.90	9.93
LTU	0.88	0.85	0.88	0.86	0.85	0.85	0.86	0.86	0.86	0.87	0.80
0.86	0.83	0.86	0.86	0.86	0.87	0.85	0.83	0.84	0.88	0.86	0.88
0.35											
LVA	0.88	0.87	0.94	0.92	0.93	0.89	0.89	0.88	0.87	0.80	
0.91	0.85	0.87	0.93	0.87	0.89	0.86	0.84	0.89	0.88	0.85	0.93
0.88	0.48										
PRT	0.88	0.88	0.88	0.88	0.87	0.88	0.88	0.88	0.88	0.88	0.83
0.88	0.86	0.88	0.88	0.88	0.88	0.88	0.85	0.86	0.88	0.88	0.88
0.87	0.87	0.48									
KOR	0.88	0.87	0.87	0.89	0.87	0.88	0.87	0.87	0.87	0.88	0.81
0.89	0.84	0.87	0.88	0.87	0.90	0.87	0.84	0.85	0.88	0.86	0.92
0.86	0.88	0.88	0.34								
SVN	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.82
0.87	0.84	0.87	0.87	0.87	0.87	0.87	0.84	0.85	0.88	0.86	0.88
0.85	0.86	0.87	0.86	10.70							
HRV	0.88	0.86	0.87	0.87	0.86	0.86	0.86	0.86	0.87	0.87	0.81
0.87	0.83	0.87	0.87	0.87	0.87	0.86	0.83	0.83	0.88	0.85	0.89
0.86	0.87	0.88	0.85	0.87	11.78						

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	7.59										
CHE	0.84	10.84									
DEU	0.85	0.93	12.68								
DFS	0.93	0.84	0.86	12.09							
EST	0.83	0.86	0.91	0.84	13.77						
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	2.47				
NLD	0.87	0.87	0.93	0.87	0.89	0.87	0.88	4.83			
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	0.23	
ITA	0.85	0.88	0.94	0.86	0.90	0.86	0.88	0.90	0.89	0.81	
5.82											
AUS	0.81	0.90	0.88	0.82	0.82	0.80	0.90	0.87	0.85	0.78	
0.84	30.26										
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	0.49								
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	11.55						
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	14.36		
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	9.92
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
0.35											
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	10.70							
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						

^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	43	141	105	111	17	96	53	25
FRA	50	0	79	117	146	192	19	167	49	49
NLD	38	64	0	73	86	132	20	112	36	38
USA	114	78	62	0	297	293	24	207	75	36
CHE	71	109	77	281	0	527	21	394	62	67
DEA	78	143	123	258	425	0	28	564	64	93
NZL	13	15	14	23	16	24	0	24	15	6
ITA	68	133	92	142	340	470	18	0	63	85
GBR	41	39	28	70	47	43	12	45	0	19
SVN	20	48	39	28	64	87	5	84	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	141	105	111	17	96	25	25
FRA	48	0	63	103	144	176	16	154	26	48
NLD	31	51	0	66	77	112	19	97	18	33
USA	114	70	51	0	297	293	24	207	34	36
CHE	71	109	68	281	0	527	21	394	31	67
DEA	78	133	98	258	425	0	28	564	30	93
NZL	13	13	13	23	16	24	0	24	9	6
ITA	68	126	75	142	340	470	18	0	32	85
GBR	17	20	13	32	25	22	6	24	0	12
SVN	20	47	33	28	64	87	5	84	9	0

GUE

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL
CAN	0	27	63	42	13
GBR	22	0	80	32	13
USA	54	82	0	57	29
AUS	40	27	53	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							
CAN	0	731	2113	1174	202	1258	1309	1218	2743	91	1435	1156	823	435	1175	1110	446
610	397	885	382	1068	179	192	853	541	165	229							
CHE	570	0	1036	633	141	583	594	781	852	51	644	522	397	377	420	496	245
343	307	457	209	579	95	139	455	215	123	174							
DEU	1274	883	0	2585	356	2367	1854	3165	3280	136	2389	1513	1127	720	1381	1398	552
873	692	1622	687	2037	411	307	1108	521	257	532							
DFS	863	551	1554	0	248	1501	1355	1879	1819	123	1466	1136	802	515	884	905	471
739	586	1071	387	1365	249	210	825	404	210	334							
EST	103	77	242	144	0	222	209	311	293	43	232	187	170	106	179	173	93
118	104	220	104	261	63	90	167	86	76	104							
FRA	746	508	1126	715	100	0	1366	1789	2282	112	1625	1132	841	577	1114	1015	444
718	576	1067	388	1403	185	187	813	424	173	239							
GBR	1417	545	1272	946	117	796	0	1515	1822	109	1371	1185	745	506	918	936	475
790	711	857	338	1090	200	179	828	405	179	277							
NLD	1037	756	2743	1503	223	1019	1236	0	2191	129	1582	1297	850	747	958	986	482
911	683	1254	501	1497	234	228	937	398	213	379							
USA	2705	757	2027	1240	187	1132	1487	1796	0	139	2348	1627	1127	539	1762	1366	597
946	596	1387	494	1692	262	259	1137	707	198	306							
ISR	58	36	112	100	28	60	73	108	124	0	117	88	92	48	90	93	54
93	68	97	43	112	35	28	89	48	39	55							
ITA	954	570	1445	995	128	782	961	1195	1409	86	0	1095	923	505	1098	1151	469
687	514	1126	379	1367	226	224	902	501	208	325							
AUS	1075	458	1025	759	86	719	966	1085	1515	60	725	0	623	467	790	766	440
1043	553	719	281	866	166	163	680	354	155	238							
HUN	712	321	866	608	105	540	645	686	1065	72	761	461	0	327	644	682	366
443	340	779	293	817	153	139	634	381	141	216							
BEL	387	349	654	438	62	531	447	800	423	29	418	380	255	0	328	414	226
321	292	366	179	450	83	99	401	172	119	163							
JPN	540	271	526	455	64	375	452	480	753	45	474	419	370	200	0	821	396
495	346	718	290	867	150	149	628	460	145	182							
ESP	620	403	874	650	82	717	744	862	833	60	828	532	536	386	376	0	419
474	390	719	295	900	166	166	734	383	163	239							
ZAF	374	196	420	350	46	301	407	403	565	38	355	372	291	177	273	363	0
344	271	335	168	383	82	99	397	235	87	130							
NZL	598	291	656	497	62	400	665	824	872	78	487	1028	348	246	261	359	273
0	567	504	230	567	129	113	496	254	111	184							
IRL	319	283	536	435	52	401	652	581	472	49	388	439	268	259	203	352	216
447	0	365	166	450	100	93	368	156	89	134							
CZE	563	303	1138	634	138	592	523	1049	984	73	710	423	671	247	299	468	210
323	223	0	407	1104	183	182	656	396	178	290							
SVK	257	106	513	199	49	204	191	339	321	19	220	141	208	93	109	148	90
138	83	311	0	397	74	96	290	178	71	114							
POL	758	461	1654	1018	181	815	838	1272	1473	90	972	596	704	376	434	610	278
409	326	833	263	0	262	250	870	469	206	381							
LTU	83	38	379	130	29	49	90	124	170	17	110	63	92	29	44	71	32
55	39	114	34	193	0	68	157	103	42	113							
LVA	110	79	207	130	63	87	102	150	207	20	152	78	99	55	66	93	58
55	50	118	47	185	48	0	190	99	43	115							
PRT	834	391	996	706	110	668	751	922	1154	67	824	511	608	372	382	696	351
398	304	520	195	864	99	143	0	399	139	272							
KOR	486	145	338	276	45	238	296	264	798	31	401	255	320	104	277	269	177
181	98	274	107	381	48	59	329	0	84	108							
SVN	116	93	241	176	45	121	131	181	150	31	174	112	109	93	85	124	60
77	63	134	41	186	19	27	107	49	0	83							
HRV	113	116	545	254	74	141	196	339	228	40	247	147	164	131	85	190	88
106	89	210	58	332	78	90	219	48	68	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	466	1127	569	116	635	652	593	1349	55	884	587	507	287	644	683	220
303	216	553	206	742	123	112	512	359	123	165							
CHE	379	0	1033	579	138	494	554	740	850	51	643	521	397	377	419	495	245
342	306	457	207	579	95	137	453	214	123	174							
DEU	775	882	0	2411	354	1766	1633	2940	3270	136	2388	1508	1127	720	1379	1394	549
867	692	1621	677	2036	409	305	1098	516	257	532							
DFS	514	493	1334	0	235	1118	1141	1614	1683	118	1378	1060	756	493	840	869	459
703	569	998	360	1278	239	202	782	377	204	320							
EST	67	77	242	131	0	180	190	296	290	43	230	185	169	104	176	171	90
115	102	219	101	260	63	89	164	85	76	103							
FRA	433	420	772	539	86	0	997	1303	1582	92	1337	874	719	489	840	849	357
555	473	918	304	1211	160	156	697	355	154	209							
GBR	611	528	1192	808	110	613	0	1325	1625	109	1283	1073	713	479	827	873	441
709	659	818	309	1040	187	160	778	383	173	263							
NLD	544	696	2430	1165	211	728	1066	0	2032	125	1467	1234	809	722	906	934	462
882	666	1186	473	1417	222	212	885	381	204	352							
USA	1316	757	2025	1061	187	700	1355	1566	0	139	2346	1624	1126	539	1760	1364	593
938	596	1386	486	1691	260	258	1124	701	198	306							
ISR	41	36	112	90	28	53	73	103	124	0	117	88	92	48	90	93	54
93	68	97	42	112	34	28	89	48	39	55							
ITA	632	570	1445	887	128	619	927	1040	1409	86	0	1094	923	504	1098	1151	467
687	514	1124	373	1366	225	223	895	500	208	325							
AUS	587	458	1025	666	86	576	879	1003	1515	60	725	0	622	467	790	766	439
1039	553	718	272	866	164	162	675	350	155	238							
HUN	477	321	866	562	105	463	626	631	1065	72	761	461	0	327	644	682	365
442	340	778	290	817	153	138	629	380	141	216							
BEL	269	349	654	409	62	443	430	755	423	29	418	380	255	0	328	414	226
321	292	366	174	450	83	98	401	172	119	163							
JPN	412	271	526	413	64	328	443	442	753	45	474	419	370	200	0	821	395
492	346	717	284	867	149	147	622	457	145	182							
ESP	400	403	874	606	82	621	722	784	833	60	828	532	536	386	376	0	419
473	390	718	290	900	164	165	733	383	163	239							
ZAF	200	196	420	335	46	257	391	377	565	38	355	372	291	177	273	363	0
343	271	335	165	381	81	98	396	233	87	129							
NZL	271	291	655	462	61	325	573	788	872	78	487	1028	348	246	261	359	273
0	566	503	225	566	129	111	492	251	111	184							
IRL	210	283	536	409	52	355	623	551	472	49	388	439	268	259	203	352	216
447	0	365	164	449	100	92	368	156	89	134							
CZE	385	303	1138	563	138	473	514	965	984	73	710	423	671	247	299	468	210
323	223	0	404	1103	182	182	652	393	178	290							
SVK	140	106	512	180	49	154	183	319	321	19	219	140	208	93	109	148	90
138	83	310	0	394	74	95	286	178	71	113							
POL	599	461	1654	914	181	710	820	1175	1473	90	972	596	704	376	434	610	278
409	326	833	263	0	261	250	867	469	206	381							
LTU	71	38	379	120	29	45	88	109	170	17	110	63	92	29	44	71	32
55	39	114	34	193	0	67	155	101	42	112							
LVA	70	79	207	121	63	77	95	130	207	20	152	78	99	55	66	93	58
54	50	118	47	185	48	0	188	99	43	115							
PRT	496	390	996	654	110	589	719	863	1152	67	822	511	608	372	382	696	351
398	304	520	195	864	99	143	0	396	139	270							
KOR	338	145	338	251	45	207	285	243	798	31	401	255	320	104	277	269	177
181	98	274	107	381	48	59	329	0	84	108							
SVN	91	93	241	162	45	106	131	172	150	31	174	112	109	93	85	124	60
77	63	134	41	186	19	27	107	49	0	83							
HRV	96	116	545	230	74	127	193	307	228	40	247	147	164	131	85	190	88
106	89	210	58	332	78	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	73	135	30	348	218	128	155
DFS	57	0	130	83	146	117	118	111
GBR	133	118	0	69	202	178	144	181
NLD	24	81	64	0	68	59	61	60
USA	359	117	216	72	0	428	248	321
AUS	221	81	182	50	460	0	197	373
ZAF	122	95	146	57	258	188	0	176
NZL	165	83	184	52	391	417	184	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	30	53	10	123	86	52	60
DFS	24	0	80	55	132	103	107	102
GBR	47	71	0	39	146	122	102	118
NLD	4	48	35	0	56	49	54	49
USA	115	93	153	61	0	428	248	321
AUS	76	65	121	45	460	0	197	372
ZAF	47	82	101	50	258	188	0	176
NZL	59	71	118	41	391	416	184	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	132	71	4	179	13	87	1	69	75	15	7	5
DFS	132	0	88	105	164	64	155	83	50	150	109	91	40
GBR	71	83	0	37	92	18	68	6	35	65	25	11	26
NOR	4	78	38	0	62	18	52	14	0	38	26	16	29
USA	164	157	87	63	0	26	105	14	58	99	34	14	32
DEU	12	54	17	18	26	0	40	24	2	19	38	29	14
AUS	87	128	64	43	105	39	0	22	31	118	42	27	23
EST	1	73	5	14	13	23	21	0	0	6	24	36	12
ZAF	71	47	31	0	52	2	31	0	0	32	5	1	3
NZL	73	147	61	37	99	19	120	5	28	0	27	13	14
LTU	14	92	23	21	28	35	38	23	5	23	0	37	14
LVA	7	59	11	14	11	23	25	28	1	10	31	0	9
NLD	5	40	24	28	31	14	21	11	3	14	13	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	62	21	3	64	7	28	0	35	28	11	4	3
DFS	61	0	56	107	155	64	173	83	45	147	108	92	38
GBR	21	53	0	33	59	15	42	4	21	42	18	9	18
NOR	3	79	34	0	62	18	52	14	0	38	26	16	26
USA	62	152	57	64	0	26	103	14	53	96	34	14	31
DEU	7	54	15	18	26	0	40	24	2	19	38	29	14
AUS	28	148	40	43	104	39	0	22	29	117	42	27	22
EST	0	73	4	14	13	23	21	0	0	6	24	36	10
ZAF	36	45	20	0	51	2	31	0	0	30	5	1	2
NZL	28	142	41	37	99	19	119	5	28	0	27	13	13
LTU	10	91	16	21	28	35	38	23	5	23	0	37	13
LVA	4	59	9	14	11	23	25	28	1	10	31	0	8
NLD	3	38	17	25	30	14	20	9	2	13	12	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	150	109	172	216	2	56	17	64	2	28
FRA	1	0	127	53	12	232	5	52	51	0	83	0
ITA	184	113	0	156	82	732	11	131	94	43	199	20
NLD	133	53	153	0	79	219	4	57	44	47	81	15
CHE	221	9	82	82	0	277	2	30	5	51	1	18
DEA	252	192	633	224	243	0	27	351	165	46	469	17
HUN	0	4	8	4	1	16	0	7	7	0	12	0
SVK	55	45	111	48	22	358	6	0	43	10	82	3
SVN	17	47	91	42	5	152	6	42	0	0	67	0
GBR	81	0	47	47	58	49	0	5	0	0	0	17
HRV	1	77	191	80	1	494	10	65	57	0	0	0
USA	43	0	27	18	19	24	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	149	94	166	207	2	56	17	24	2	28
FRA	1	0	86	29	8	159	3	39	34	0	58	0
ITA	183	75	0	133	82	732	11	131	94	18	199	20
NLD	114	28	131	0	72	180	4	52	35	17	70	15
CHE	215	5	82	73	0	277	2	30	5	20	1	18
DEA	247	122	633	188	243	0	27	351	165	18	469	17
HUN	0	2	8	4	1	16	0	7	7	0	12	0
SVK	55	31	111	43	22	358	6	0	43	4	82	3
SVN	17	29	91	35	5	152	6	42	0	0	67	0
GBR	29	0	20	18	23	22	0	4	0	0	0	16
HRV	1	51	191	70	1	494	10	65	57	0	0	0
USA	43	0	27	18	19	24	0	3	0	20	0	0