

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 number 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.

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

ZAF (HOL) The changes observed on a few Holstein bulls born in 1989, 1992 and 1998 are due to changes in the genetic groups on the sire and dam lines of the pedigrees due to some new pedigree lines entering the evaluation.

genetic value Therefore some genetic groups gained quite a few animals with a resultant change in the group's genetic value

ZAF (RDC) Data since December 2011 has now been included for herds participating in Milk Recording at the ARC.

SVN (HOL, BSW, SIM) Some bulls losing informations (herds/daughters/EDC). These changes are mostly consequences of changes in data base related to the pedigree completeness as well as phenotypic data improvement.

IRL (HOL) Introduced the new genetic base as tested in January.

NZL (ALL) Base change, decrease in information due to parentage testing

EST (HOL, RDC) Decrease in number of daughters/herds and reliability of some bulls is due to the pedigree check for cows and to additional data checks.

CHE (HOL, BSW, SIM) Decrease in information due to continuous work on the raw data by herd-book organizations. For HOL, some bulls changed from TOP 12 to 11. This is related to changes in the database by the herdbook organizations resulting in a lower number of daughters of these bulls

CAN (HOL, JER, RDC) Some mastitis records were previously included in the EDC calculation while they were excluded from breeding value calculation, this has been fixed.

HRV (HOL, SIM) Data cleaning is in the final stage, especially the pedigree part related to the old unsolved animals.

of bulls due The consequence of these changes is, among others, decreased reliability for certain number to reduction of number of daughters

INTERBULL CHANGES COMPARED TO THE APRIL ROUTINE RUN

None

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.

^aLTable 1. National evaluation data considered in the Interbull evaluation for udder health (August Routine Evaluation 2016).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		122	7146	1438	629	
BEL			1049			
CAN	206	91	11035	614	748	
CHE	2733		3015			2966
CZE			3534			
DEA	5264					20795
DEU			25922		399	
DFS			12450	1994	7419	
ESP			3263			
EST			982		388	
FRA	346		16000			408
FRM						3949
FRR			234			
GBR	103	261	6036	639	433	80
HUN			2471			152
IRL			2201			
ISR			1262			
ITA	1769		9292			1299
JPN			5447			
KOR			1033			
LTU			672		396	
LVA			528		564	
NLD	163		14433	123	62	302
NOR					3846	
NZL	38	57	6697	3991	1152	
POL			9059			
PRT			2088			
SVK			992			520
SVN	321		435			533
URY						
USA	983	667	34526	3912	613	37
ZAF		16	1124	524	121	
HRV			650			741
No. Records	11926	1214	183576	13235	16770	31782
Pub. Proofs	9768	952	144211	11006	16221	28768

^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	0.24										
FRA	0.94	1.02									
NLD	0.91	0.93	4.12								
USA	0.92	0.91	0.88	0.21							
CHE	0.92	0.95	0.92	0.88	10.31						
DEA	0.93	0.96	0.91	0.88	0.97	11.94					
NZL	0.87	0.86	0.87	0.84	0.87	0.86	0.36				
ITA	0.91	0.90	0.88	0.88	0.95	0.91	0.87	17.91			
GBR	0.93	0.96	0.96	0.91	0.94	0.95	0.87	0.89	13.06		
SVN	0.90	0.87	0.88	0.89	0.89	0.87	0.85	0.89	0.88	10.38	

BSW	mas	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0.24										
FRA	0.75	1.08									
NLD	0.84	0.81	3.68								
USA	0.87	0.83	0.87	0.21							
CHE	0.91	0.85	0.89	0.88	10.31						
DEA	0.90	0.70	0.87	0.86	0.96	11.94					
NZL	0.81	0.76	0.79	0.82	0.83	0.77	0.36				
ITA	0.89	0.87	0.89	0.88	0.96	0.91	0.84	17.91			
GBR	0.85	0.72	0.88	0.88	0.90	0.91	0.84	0.88	13.06		
SVN	0.77	0.68	0.79	0.78	0.85	0.85	0.69	0.87	0.77	10.38	

GUE	SCS	CAN	GBR	USA	AUS	NZL	ZAF
CAN	0.24						
GBR	0.93	13.43					
USA	0.94	0.90	0.25				
AUS	0.88	0.92	0.87	29.00			
NZL	0.87	0.87	0.84	0.96	0.63		
ZAF	0.90	0.91	0.90	0.88	0.86	24.10	

HOL	mas																
	CAN	CHE	DEU	DFS	EST	FRA	FRR	GBR	NLD	USA	ISR	ITA	AUS				
HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN			
HRV																	
CAN	7.77																
CHE	0.81	10.84															
DEU	0.83	0.92	12.71														
DFS	0.92	0.80	0.85	12.19													
EST	0.78	0.82	0.90	0.80	13.18												
FRA	0.95	0.81	0.84	0.93	0.78	1.21											
FRR	0.64	0.63	0.70	0.65	0.65	0.65	1.00										
GBR	0.79	0.92	0.94	0.82	0.86	0.80	0.57	12.79									
NLD	0.86	0.87	0.93	0.87	0.88	0.87	0.72	0.90	4.85								
USA	0.87	0.87	0.88	0.87	0.85	0.87	0.49	0.89	0.88	0.21							
ISR	0.71	0.71	0.76	0.73	0.74	0.73	0.54	0.75	0.77	0.78	0.23						
ITA	0.83	0.87	0.94	0.85	0.88	0.85	0.64	0.89	0.90	0.89	0.78	5.84					
AUS	0.74	0.89	0.87	0.76	0.79	0.74	0.52	0.92	0.86	0.85	0.75	0.82	30.18				
HUN	0.83	0.86	0.91	0.85	0.85	0.84	0.60	0.88	0.89	0.91	0.79	0.92	0.83				
1.44																	
BEL	0.84	0.91	0.96	0.85	0.90	0.85	0.68	0.94	0.94	0.88	0.75	0.94	0.86				
0.91	0.49																
JPN	0.80	0.86	0.86	0.81	0.81	0.81	0.50	0.87	0.84	0.88	0.74	0.86	0.84				
0.86	0.86	0.42															
ESP	0.84	0.90	0.95	0.86	0.88	0.87	0.64	0.93	0.92	0.91	0.79	0.95	0.84				
0.92	0.95	0.87	11.54														
ZAF	0.82	0.86	0.89	0.82	0.80	0.83	0.55	0.91	0.87	0.88	0.78	0.90	0.86				
0.90	0.90	0.86	0.93	26.42													
NZL	0.78	0.85	0.85	0.81	0.77	0.79	0.53	0.87	0.82	0.83	0.75	0.81	0.96				
0.83	0.84	0.84	0.83	0.84	0.40												
IRL	0.80	0.91	0.92	0.82	0.82	0.81	0.58	0.96	0.88	0.85	0.75	0.87	0.94				
0.85	0.93	0.85	0.91	0.89	0.91	0.11											
CZE	0.80	0.85	0.89	0.81	0.85	0.82	0.62	0.85	0.87	0.87	0.75	0.90	0.81				
0.89	0.88	0.86	0.90	0.85	0.82	0.84	14.58										
SVK	0.78	0.83	0.88	0.80	0.79	0.80	0.58	0.84	0.86	0.84	0.66	0.86	0.79				
0.92	0.86	0.84	0.88	0.84	0.80	0.81	0.87	0.41									
POL	0.87	0.90	0.96	0.88	0.90	0.88	0.78	0.91	0.93	0.88	0.79	0.94	0.85				
0.93	0.95	0.88	0.95	0.90	0.86	0.89	0.91	0.88	9.97								
LTU	0.74	0.75	0.85	0.76	0.75	0.72	0.56	0.81	0.80	0.81	0.66	0.82	0.77				
0.80	0.79	0.80	0.83	0.76	0.76	0.77	0.81	0.78	0.85	0.38							
LVA	0.75	0.81	0.90	0.78	0.87	0.76	0.64	0.84	0.85	0.83	0.68	0.87	0.80				
0.82	0.88	0.83	0.85	0.79	0.77	0.82	0.82	0.78	0.89	0.81	0.48						
PRT	0.86	0.87	0.88	0.87	0.82	0.87	0.53	0.88	0.86	0.88	0.75	0.87	0.84				
0.87	0.87	0.87	0.88	0.87	0.84	0.85	0.87	0.84	0.89	0.81	0.48						
KOR	0.81	0.83	0.85	0.81	0.79	0.84	0.60	0.85	0.84	0.87	0.70	0.87	0.81				
0.85	0.85	0.86	0.89	0.85	0.81	0.82	0.84	0.82	0.90	0.78	0.81	0.86	0.34				
SVN	0.75	0.80	0.82	0.78	0.77	0.76	0.60	0.81	0.81	0.80	0.68	0.82	0.77				
0.81	0.82	0.82	0.82	0.79	0.77	0.79	0.81	0.75	0.85	0.69	0.73	0.81	0.75				
10.84																	
HRV	0.73	0.81	0.85	0.75	0.80	0.74	0.60	0.83	0.83	0.83	0.71	0.84	0.80				
0.84	0.84	0.82	0.84	0.80	0.78	0.78	0.83	0.78	0.88	0.81	0.82	0.84	0.76				
0.79	11.95																

JER	scs							
	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0.22							
DFS	0.92	12.51						
GBR	0.92	0.91	11.36					
NLD	0.92	0.94	0.96	4.32				
USA	0.91	0.88	0.89	0.88	0.19			
AUS	0.86	0.87	0.88	0.92	0.86	29.02		
ZAF	0.90	0.87	0.88	0.91	0.88	0.90	20.98	
NZL	0.86	0.84	0.86	0.86	0.83	0.96	0.86	0.38

JER	mas							
	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	7.53							
DFS	0.89	12.34						
GBR	0.72	0.77	11.37					
NLD	0.85	0.86	0.90	4.18				
USA	0.86	0.86	0.88	0.88	0.19			
AUS	0.69	0.72	0.88	0.86	0.85	29.05		
ZAF	0.74	0.79	0.87	0.89	0.88	0.88	20.98	
NZL	0.76	0.77	0.85	0.82	0.84	0.95	0.85	0.38

RDC	scs	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD
CAN		0.25												
DFS	0.94	12.67												
GBR	0.94	0.92	11.40											
NOR	0.92	0.94	0.90	14.43										
USA	0.93	0.88	0.89	0.89	0.24									
DEU	0.93	0.94	0.94	0.90	0.89	13.63								
AUS	0.89	0.92	0.91	0.92	0.86	0.90	31.38							
EST	0.89	0.94	0.91	0.90	0.91	0.94	0.90	11.76						
ZAF	0.89	0.90	0.90	0.93	0.89	0.91	0.88	0.90	25.07					
NZL	0.86	0.87	0.86	0.87	0.84	0.86	0.96	0.87	0.85	0.41				
LTU	0.90	0.87	0.89	0.90	0.89	0.88	0.85	0.91	0.91	0.86	0.34			
LVA	0.90	0.88	0.89	0.90	0.89	0.93	0.90	0.95	0.89	0.87	0.89	0.44		
NLD	0.92	0.94	0.96	0.91	0.88	0.95	0.92	0.91	0.90	0.87	0.88	0.89	4.03	

RDC	mas	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD
CAN		7.77												
DFS	0.87	13.18												
GBR	0.78	0.79	11.42											
NOR	0.89	0.88	0.89	14.43										
USA	0.87	0.87	0.89	0.89	0.24									
DEU	0.81	0.81	0.93	0.90	0.88	13.63								
AUS	0.72	0.73	0.89	0.90	0.85	0.87	31.44							
EST	0.75	0.77	0.82	0.89	0.86	0.91	0.84	11.76						
ZAF	0.86	0.86	0.89	0.91	0.89	0.89	0.85	0.82	25.16					
NZL	0.77	0.82	0.86	0.91	0.84	0.85	0.95	0.83	0.85	0.41				
LTU	0.71	0.75	0.84	0.89	0.85	0.86	0.86	0.88	0.79	0.84	0.34			
LVA	0.72	0.74	0.83	0.89	0.84	0.91	0.87	0.93	0.79	0.85	0.88	0.44		
NLD	0.85	0.87	0.89	0.90	0.88	0.93	0.86	0.87	0.88	0.82	0.83	0.85	3.74	

SIM	scs	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM		1.09											
FRA	0.92	1.01											
ITA	0.96	0.90	13.94										
NLD	0.92	0.94	0.88	4.42									
CHE	0.93	0.92	0.90	0.91	10.35								
DEA	0.93	0.92	0.88	0.90	0.90	12.16							
HUN	0.93	0.91	0.93	0.88	0.89	0.93	15.66						
SVK	0.88	0.89	0.89	0.89	0.89	0.87	0.93	0.38					
SVN	0.89	0.87	0.89	0.88	0.89	0.87	0.89	0.88	8.89				
GBR	0.92	0.96	0.89	0.95	0.90	0.92	0.89	0.87	0.87	0.87	11.17		
HRV	0.92	0.87	0.88	0.87	0.87	0.86	0.89	0.87	0.87	0.86	10.16		
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	0.90	1.00											
ITA	0.96	0.88	13.94										
NLD	0.88	0.88	0.88	3.79									
CHE	0.92	0.84	0.90	0.87	10.35								
DEA	0.92	0.92	0.88	0.88	0.89	12.16							
HUN	0.91	0.87	0.93	0.90	0.88	0.92	15.66						
SVK	0.88	0.87	0.90	0.88	0.88	0.86	0.93	0.38					
SVN	0.88	0.86	0.89	0.85	0.88	0.87	0.88	0.87	8.89				
GBR	0.92	0.82	0.89	0.90	0.90	0.90	0.89	0.86	0.86	0.85	11.17		
HRV	0.90	0.85	0.88	0.83	0.86	0.86	0.88	0.87	0.87	0.84	10.16		
USA	0.89	0.88	0.89	0.89	0.89	0.90	0.92	0.89	0.89	0.90	0.89	0.22	

^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	76	46	145	110	110	16	103	56	22
FRA	69	0	76	117	145	188	14	164	49	46
NLD	42	62	0	71	83	126	15	111	34	35
USA	143	78	61	0	296	284	20	204	74	32
CHE	89	108	74	278	0	511	17	386	60	57
DEA	95	142	116	250	407	0	22	543	62	82
NZL	16	10	8	18	13	17	0	19	10	3
ITA	90	131	91	141	334	450	14	0	62	73
GBR	56	39	27	69	47	42	8	44	0	17
SVN	20	46	36	25	58	76	2	74	13	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	65	43	145	110	110	16	103	56	22
FRA	59	0	59	101	139	168	11	146	45	43
NLD	36	49	0	65	73	108	15	94	32	31
USA	143	68	51	0	296	284	20	204	74	32
CHE	89	104	65	278	0	511	17	386	60	57
DEA	95	126	93	250	407	0	22	543	62	82
NZL	16	8	8	18	13	17	0	19	10	3
ITA	90	119	72	141	334	450	14	0	62	73
GBR	56	39	24	69	47	42	8	44	0	17
SVN	20	43	31	25	58	76	2	74	13	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL	ZAF
--	-----	-----	-----	-----	-----	-----

CAN	0	25	60	41	13	1
GBR	20	0	79	31	13	3
USA	51	81	0	55	29	6
AUS	39	26	51	0	26	3
NZL	11	11	29	26	0	2
ZAF	0	2	3	2	0	0

HOL

common bulls below diagonal																																					
common three quarter sib group above diagonal																																					
SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	CAN	CHE	DEU	DFS	EST	FRA	FRR	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE									
354	992	172	191	831	505	148	216	0	686	1997	1108	185	1185	15	1244	1129	2567	82	1360	1080	769	409	1125	1049	432	577	380	832									
192	537	94	138	440	198	113	167	518	0	989	597	128	523	38	566	744	806	47	615	496	373	353	391	465	237	324	291	432									
650	1919	399	306	1078	492	236	514	1151	824	0	2485	334	2185	131	1780	3016	3132	124	2327	1445	1064	690	1329	1328	536	825	666	1552									
366	1291	244	210	806	385	194	315	775	511	1427	0	231	1425	50	1301	1776	1753	115	1423	1083	763	490	851	869	455	700	564	1032									
97	246	58	90	158	82	70	95	EST	94	70	223	132	0	195	21	192	294	275	42	219	173	160	97	166	159	87	111	100	206								
347	1259	180	177	788	400	154	221	FRA	679	452	971	643	83	0	31	1306	1669	2191	104	1602	1075	789	534	1062	959	426	682	552	1013								
25	88	1	23	13	2	16	16	FRR	7	26	101	32	18	24	0	25	94	31	4	28	25	9	37	7	16	12	11	9	37								
318	1025	194	179	812	386	169	266	GBR	1339	520	1198	885	109	737	18	0	1444	1741	103	1324	1133	707	485	882	882	463	755	684	817								
470	1394	231	225	917	370	193	361	NLD	929	712	2546	1377	210	917	54	1157	0	2089	118	1531	1237	806	713	909	931	466	863	664	1192								
464	1590	254	259	1107	667	178	294	USA	2438	703	1866	1142	176	1046	15	1389	1665	0	127	2301	1542	1066	516	1704	1294	582	904	571	1325								
37	104	33	103	91	27	55	52	ISR	51	33	103	91	27	55	3	70	98	111	0	112	83	83	45	80	87	54	87	66	89								
277	771	154	139	616	363	133	209	ITA	844	536	1361	932	117	733	23	912	1103	1277	83	0	1050	873	481	1077	1104	461	658	499	1081								
165	424	84	98	387	155	110	157	364	1299	228	225	892	480	193	314	AUS	982	424	952	701	80	665	17	912	1023	1395	56	679	0	586	447	742	720	428	995	535	689
272	808	151	149	615	431	132	174	HUN	649	303	816	572	99	511	8	609	651	992	67	716	427	0	309	612	638	357	421	326	745								
275	844	168	165	717	359	145	230	BEL	352	321	606	403	58	482	30	416	752	394	27	383	350	234	0	313	389	220	304	280	346								
161	365	85	98	386	228	83	125	JPN	506	251	494	433	58	354	5	430	449	707	39	448	394	353	184	0	777	385	472	331	690								
377	1046	178	182	641	372	162	277	ESP	570	366	809	605	75	664	8	698	795	775	57	767	497	502	346	351	0	405	449	377	688								
0	372	73	95	276	159	63	106	ZAF	364	188	406	336	43	288	7	395	389	551	38	345	362	287	169	268	354	0	332	263	324								
212	529	125	110	482	239	99	171	NZL	569	267	602	461	58	373	8	628	773	830	72	463	975	333	229	247	333	261	0	542	477								
155	427	97	95	363	145	83	131	IRL	300	266	505	412	50	377	7	624	559	448	49	374	419	263	244	191	332	209	424	0	352								
377	1046	178	182	641	372	162	277	CZE	513	282	1069	590	130	543	29	493	973	917	64	658	386	644	224	278	427	200	302	211	0								
36	184	0	73	161	103	38	114	SVK	230	96	478	181	45	178	13	174	307	294	16	199	124	196	86	97	131	86	126	75	283								
46	185	52	0	190	99	44	114	POL	669	426	1509	937	167	672	92	765	1150	1314	83	905	535	657	342	394	556	262	371	303	765								
183	821	101	143	0	384	133	257	LTU	78	32	373	124	24	42	0	83	119	155	15	108	56	87	28	38	69	31	53	38	110								
94	345	45	59	312	0	77	103	LVA	109	78	207	130	63	78	19	102	147	207	20	152	77	99	55	66	92	57	54	53	118								
36	168	17	27	101	44	0	81	PRT	809	375	955	684	104	648	13	731	901	1113	67	806	496	586	356	368	670	341	384	298	503								
53	314	79	91	210	46	66	0	KOR	451	132	313	257	42	217	0	281	242	747	28	380	235	301	89	258	245	172	168	89	257								
36	104	109	531	239	70	128	0	SVN	107	81	220	161	46	107	15	123	163	139	27	160	100	103	85	77	105	57	70	60	123								
53	314	79	91	210	46	66	0	HRV	104	109	531	239	70	128	15	189	322	214	39	238	141	156	128	83	180	85	100	90	203								

HOL

		common bulls below diagonal																		common three quarter sib group above diagonal																					
		CAN	CHE	DEU	DFS	EST	FRA	FRR	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE																			
SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV																																		
190	710	120	113	511	342	111	157	3	665	578	1389	51	886	562	490	266	634	665	210	280	205	546																			
	CHE	354	0	986	541	128	448	24	565	703	804	47	613	495	373	353	390	464	237	323	290	432																			
190	537	94	136	438	197	113	167																																		
	DEU	745	823	0	2329	334	1644	71	1777	2817	3123	124	2325	1441	1064	690	1327	1325	533	822	666	1552																			
641	1918	398	304	1069	487	236	514																																		
	DFS	470	451	1221	0	216	1059	29	1223	1531	1618	110	1337	1013	718	469	802	826	442	666	548	959																			
336	1202	236	202	763	357	186	302																																		
	EST	61	70	223	118	0	158	15	192	281	274	42	219	173	160	97	165	159	86	110	100	206																			
96	246	58	90	157	82	70	95																																		
	FRA	390	377	678	485	70	0	15	1006	1214	1509	88	1288	819	679	456	801	793	342	523	452	877																			
271	1090	154	145	674	331	140	191																																		
	FRR	2	21	52	24	14	12	0	17	57	20	3	19	18	5	23	3	10	9	5	5	28																			
18	75	0	18	12	1	13	15																																		
	GBR	605	520	1198	784	109	583	13	0	1375	1739	103	1324	1133	707	485	882	882	460	753	684	817																			
311	1025	193	177	805	383	169	266																																		
	NLD	507	652	2262	1064	197	643	37	1069	0	1951	115	1435	1180	770	689	867	883	448	841	650	1138																			
444	1326	216	211	867	360	188	340																																		
	USA	1326	703	1864	965	176	638	12	1389	1469	0	127	2300	1539	1065	516	1702	1292	578	899	571	1325																			
457	1589	253	258	1095	661	178	294																																		
	ISR	37	33	103	83	27	49	3	70	94	111	0	112	83	83	45	80	87	54	87	66	89																			
36	104	33	28	88	43	33	52																																		
	ITA	584	536	1361	835	117	571	18	912	977	1277	83	0	1049	873	480	1077	1104	459	658	499	1081																			
359	1297	228	224	886	478	193	314																																		
	AUS	558	424	952	613	80	529	13	912	945	1395	56	679	0	585	447	742	720	427	993	535	689																			
254	804	159	162	662	331	141	230																																		
	HUN	448	303	816	528	99	438	5	609	599	992	67	716	427	0	309	612	638	356	420	326	745																			
275	771	154	138	612	362	133	209																																		
	BEL	243	321	606	371	58	401	21	416	712	394	27	383	350	234	0	313	389	220	304	280	346																			
161	424	84	97	387	155	110	157																																		
	JPN	389	251	494	390	58	309	3	430	419	707	39	448	394	353	184	0	777	384	469	331	690																			
266	808	151	147	610	428	132	174																																		
	ESP	371	366	809	564	75	571	7	698	722	775	57	767	497	502	346	351	0	405	449	377	688																			
271	844	167	164	716	359	145	230																																		
	ZAF	193	188	406	323	43	248	6	395	361	551	38	345	362	287	169	268	354	0	332	263	324																			
159	363	85	97	385	226	83	124																																		
	NZL	254	267	601	427	57	301	4	628	741	830	72	463	975	333	229	247	333	261	0	541	476																			
209	529	125	109	479	237	99	171																																		
	IRL	197	266	505	387	50	335	5	624	531	448	49	374	419	263	244	191	332	209	424	0	352																			
153	426	97	94	363	145	83	131																																		
	CZE	363	282	1069	523	130	431	22	493	896	917	64	658	386	644	224	278	427	200	302	211	0																			
376	1046	178	182	637	369	162	277																																		
	SVK	120	96	477	164	45	133	11	174	287	294	16	198	123	196	86	97	131	86	126	75	283																			
0	370	73	94	274	159	63	106																																		
	POL	543	426	1509	839	167	588	82	765	1068	1314	83	905	535	657	342	394	556	262	371	303	765																			
239	0	246	250	835	436	187	362																																		
	LTU	64	32	373	114	24	36	0	83	102	155	15	108	56	87	28	38	69	31	53	38	110																			
36	184	0	72	160	102	38	114																																		
	LVA	71	78	207	121	63	68	16	102	129	207	20	152	77	99	55	66	92	57	54	53	118																			
46	185	52	0	189	99	44	114																																		
	PRT	489	374	955	630	104	564	12	731	841	1111	67	804	496	586	356	368	670	341</																						

JER

common bulls below diagonal

common three quarter sib group above diagonal
CAN DFS GBR NLD USA AUS ZAF NZL

CAN	0	68	128	28	321	210	119	138
DFS	52	0	128	71	143	112	110	110
GBR	129	114	0	65	195	170	137	173
NLD	22	69	59	0	66	56	56	59
USA	328	114	213	71	0	417	235	302
AUS	210	75	174	47	446	0	188	350
ZAF	113	87	139	52	245	179	0	166
NZL	152	82	178	51	371	392	174	0

JER

common bulls below diagonal

common three quarter sib group above diagonal
CAN DFS GBR NLD USA AUS ZAF NZL

CAN	0	30	64	10	141	91	52	54
DFS	24	0	123	52	131	101	102	101
GBR	61	109	0	52	193	170	136	172
NLD	4	45	47	0	56	47	50	49
USA	128	92	213	60	0	417	235	302
AUS	79	62	174	43	446	0	188	349
ZAF	45	77	139	45	245	179	0	166
NZL	54	70	178	41	371	391	174	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	120	63	4	171	11	86	1	68	70	14	7	5
DFS	118	0	57	101	149	58	149	79	49	139	108	90	37
GBR	63	56	0	23	73	5	49	2	33	46	13	5	17
NOR	4	74	24	0	56	17	50	13	0	34	24	16	28
USA	157	145	69	57	0	21	100	13	57	91	30	14	28
DEU	10	48	5	17	21	0	37	23	2	15	32	28	14
AUS	86	125	47	41	101	36	0	20	31	113	40	26	22
EST	1	69	2	13	12	22	20	0	0	4	22	35	9
ZAF	70	46	29	0	51	2	31	0	0	30	5	1	3
NZL	68	136	44	32	91	15	114	3	26	0	24	12	12
LTU	13	92	12	19	24	30	36	21	5	20	0	37	12
LVA	7	59	5	14	11	23	25	28	1	10	32	0	9
NLD	5	37	16	27	27	14	20	8	3	12	11	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	69	31	3	69	5	29	0	35	29	10	4	3
DFS	67	0	53	103	142	58	166	79	45	137	107	91	34
GBR	31	51	0	23	71	5	47	2	30	45	13	5	15
NOR	3	75	24	0	56	17	50	13	0	34	24	16	26
USA	70	141	69	58	0	21	98	13	53	89	30	14	25
DEU	5	48	5	17	21	0	37	23	2	15	32	28	14
AUS	29	144	46	41	100	36	0	20	29	112	40	26	20
EST	0	69	2	13	12	22	20	0	0	4	22	35	9
ZAF	37	44	28	0	51	2	31	0	0	28	5	1	2
NZL	28	132	44	32	91	15	113	3	26	0	24	12	10
LTU	9	91	12	19	24	30	36	21	5	20	0	37	11
LVA	4	59	5	14	11	23	25	28	1	10	32	0	7
NLD	3	34	14	25	24	14	18	8	2	10	10	6	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	146	105	161	209	2	55	17	63	2	23
FRA	1	0	118	48	12	218	4	49	46	0	82	0
ITA	178	105	0	148	77	675	10	125	85	42	190	19
NLD	128	48	145	0	75	205	3	51	40	46	75	14
CHE	210	10	78	77	0	264	2	31	5	50	1	17
DEA	248	179	579	213	231	0	27	334	155	46	450	16
HUN	0	3	7	3	1	15	0	6	6	0	9	0
SVK	55	42	107	42	23	340	5	0	40	10	79	3
SVN	17	43	81	38	5	141	5	39	0	0	64	0
GBR	80	0	46	45	57	49	0	5	0	0	0	17
HRV	1	76	182	75	1	473	9	62	53	0	0	0
USA	37	0	26	17	18	22	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	145	93	159	205	2	55	17	63	2	23
FRA	1	0	86	29	9	159	3	39	34	0	58	0
ITA	177	75	0	127	77	675	10	125	85	42	190	19
NLD	113	28	125	0	69	167	3	44	32	42	66	14
CHE	208	6	78	70	0	264	2	31	5	50	1	17
DEA	245	122	579	176	231	0	27	334	155	46	450	16
HUN	0	2	7	3	1	15	0	6	6	0	9	0
SVK	55	31	107	37	23	340	5	0	40	10	79	3
SVN	17	29	81	32	5	141	5	39	0	0	64	0
GBR	80	0	46	41	57	49	0	5	0	0	0	17
HRV	1	51	182	66	1	473	9	62	53	0	0	0
USA	37	0	26	17	18	22	0	3	0	24	0	0
