

Introduction

The latest routine international evaluation for udder traits took place as scheduled at the Interbull Centre. Data from twentyseven (27) 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 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:

EST HOL/RDC Updates in our database between two evaluation runs cause most of changes in Daughters/Herds/EDC.

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 loose EDC although the number of daughters stay the same. Reliability changes is a function of the EDC changes.

DEA SIM/BSW Continuous shift of the base group in each evaluation. Genetic parameter and model from DEA evaluation including CZESIM data, adjustments regarding genetic groups and fixed effects for CZE data was done.

CAN HOL,RDC Participating in the mastitis evaluation for the first time
JER

SVN BSW,HOL Changed time period for data inclusion, average cut was 4 years. Changed the definition of genetic reference base to year 2010. Genetic parameters were recalculated for all breeds and traits. Changed herd to herd-year effect. Performed cleaning data based on genomic parentage test as a consequence the pedigree changed for some animals

ISR (HOL) Changes in the procedure for computation of records

GBR(SIM) First time

HRV HOL,SIM Participating for the first time

USA ALL Used new genetic evaluation software and changed the base

ZAF HOL,JER Data since 2011/11 from ARC herds were included

INTERBULL CHANGES COMPARED TO THE PREVIOUS RUN

No changes made.

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 in the 01x-proof file.

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 (December Routine Evaluation 2014). Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
ARG						
AUS		118	6664	1340	586	
BEL			946			
CAN	193	90	10283	555	706	
CHE	2740		1169			3155
CHR			1912			
CZE			3277			
DEA	5047					19956
DEU			24852		385	
DFS			11827	1898	7109	
ESP			2869			
EST			870		356	
FRA	322		15403			345
FRM						3741
FRR			216			
GBR	89	251	5663	602	401	74
HUN			2280			143
IRL			1946			
ISR			1170			
ITA	1605		9224			1188
JPN			4916			
KOR			911			
LTU			560		367	
LVA			527		562	
NLD	152		13699	109	53	264
NOR					3621	
NZL	39	57	6468	3845	1125	
POL			7056			
PRT			2207			
SVK			936			495
SVN	295		355			418
URY						
USA	932	639	32454	3597	557	
ZAF		16	1076	501	116	
HRV			559			690
No. Records	11414	1171	172295	12447	15944	30469
Pub. Proofs	9381	919	136801	10378	15547	27834

^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	0.25									
FRA	0.92	1.03								
NLD	0.89	0.93	4.10							
USA	0.90	0.91	0.86	0.22						
CHE	0.93	0.96	0.93	0.85	10.44					
DEA	0.92	0.96	0.92	0.85	0.98	11.91				
NZL	0.77	0.82	0.86	0.75	0.82	0.78	0.39			
ITA	0.92	0.91	0.87	0.87	0.96	0.93	0.76	13.12		
GBR	0.92	0.96	0.96	0.90	0.95	0.95	0.86	0.90	13.64	
SVN	0.87	0.86	0.86	0.87	0.86	0.86	0.77	0.86	0.87	10.76

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0.25									
FRA	0.65	1.08								
NLD	0.83	0.73	3.54							
USA	0.84	0.61	0.86	0.22						
CHE	0.92	0.52	0.86	0.85	10.44					
DEA	0.92	0.48	0.88	0.85	0.98	11.91				
NZL	0.74	0.53	0.74	0.76	0.82	0.77	0.39			
ITA	0.91	0.62	0.86	0.87	0.96	0.93	0.76	13.12		
GBR	0.90	0.62	0.89	0.90	0.95	0.94	0.85	0.90	13.64	
SVN	0.84	0.53	0.74	0.86	0.86	0.86	0.77	0.86	0.86	10.76

GUE scs

	CAN	GBR	USA	AUS	NZL	ZAF
CAN	0.25					
GBR	0.92	13.17				
USA	0.93	0.90	0.25			
AUS	0.84	0.92	0.81	29.48		
NZL	0.78	0.86	0.76	0.96	0.63	
ZAF	0.89	0.90	0.88	0.88	0.85	24.04

HOL	scs											
	CAN	CHE	DEU	DFS	EST	FRA	FRR	GBR	NLD	USA	ISR	POL
ITA	AUS	CHR	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	
LTU	LVA	PRT	KOR	SVN	HRV							
CAN	0.27											
CHE	0.91	11.30										
DEU	0.92	0.96	0.49									
DFS	0.92	0.95	0.96	11.92								
EST	0.86	0.89	0.93	0.92	13.48							
FRA	0.93	0.95	0.95	0.97	0.90	1.20						
FRR	0.90	0.92	0.93	0.93	0.89	0.95	1.10					
GBR	0.93	0.95	0.94	0.94	0.91	0.96	0.92	12.86				
NLD	0.91	0.95	0.95	0.95	0.91	0.94	0.95	0.97	4.70			
USA	0.93	0.86	0.88	0.87	0.90	0.89	0.83	0.89	0.86	0.21		
ISR	0.82	0.80	0.81	0.80	0.83	0.83	0.75	0.77	0.76	0.84	0.24	
ITA	0.91	0.92	0.94	0.93	0.93	0.93	0.89	0.90	0.88	0.89	0.84	
5.90												
AUS	0.83	0.93	0.88	0.89	0.82	0.90	0.85	0.93	0.93	0.77	0.73	
0.80	30.00											
CHR	0.86	0.97	0.91	0.91	0.85	0.91	0.89	0.91	0.92	0.85	0.75	
0.85	0.91	10.37										
HUN	0.89	0.90	0.91	0.90	0.90	0.91	0.86	0.89	0.87	0.92	0.85	
0.93	0.79	0.87	1.28									
BEL	0.92	0.96	0.96	0.95	0.93	0.96	0.93	0.95	0.94	0.89	0.78	
0.95	0.88	0.91	0.93	0.49								
JPN	0.87	0.85	0.85	0.88	0.85	0.90	0.86	0.86	0.87	0.87	0.75	
0.85	0.82	0.85	0.85	0.85	0.42							
ESP	0.92	0.93	0.95	0.94	0.94	0.95	0.90	0.93	0.90	0.91	0.84	
0.95	0.83	0.88	0.93	0.95	0.85	11.24						
ZAF	0.89	0.91	0.90	0.90	0.89	0.91	0.83	0.91	0.88	0.89	0.84	
0.91	0.87	0.86	0.91	0.91	0.85	0.94	26.35					
NZL	0.77	0.87	0.82	0.85	0.81	0.85	0.79	0.88	0.88	0.75	0.73	
0.75	0.97	0.87	0.76	0.83	0.82	0.78	0.84	0.40				
IRL	0.88	0.96	0.93	0.93	0.88	0.93	0.90	0.96	0.94	0.83	0.74	
0.88	0.96	0.93	0.86	0.94	0.85	0.90	0.90	0.92	0.11			
CZE	0.86	0.86	0.89	0.88	0.89	0.88	0.89	0.85	0.85	0.85	0.80	
0.91	0.76	0.85	0.90	0.89	0.85	0.90	0.87	0.75	0.84	16.45		
SVK	0.85	0.88	0.90	0.89	0.87	0.90	0.86	0.86	0.85	0.86	0.77	
0.88	0.77	0.86	0.95	0.90	0.85	0.92	0.88	0.75	0.84	0.88	0.42	
POL	0.89	0.90	0.92	0.92	0.90	0.92	0.91	0.89	0.87	0.87	0.78	
0.92	0.82	0.86	0.89	0.93	0.85	0.92	0.88	0.79	0.89	0.88	0.86	
10.27												
LTU	0.85	0.87	0.88	0.86	0.85	0.85	0.83	0.85	0.85	0.84	0.73	
0.85	0.78	0.86	0.85	0.86	0.85	0.88	0.83	0.76	0.83	0.85	0.86	
0.85	0.37											
LVA	0.87	0.90	0.94	0.92	0.92	0.89	0.87	0.89	0.88	0.85	0.74	
0.91	0.85	0.86	0.87	0.94	0.85	0.89	0.85	0.83	0.90	0.87	0.85	
0.94	0.87	0.48										
PRT	0.85	0.85	0.85	0.85	0.85	0.85	0.84	0.85	0.85	0.85	0.78	
0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.82	0.85	0.85	
0.85	0.85	0.85	0.50									
KOR	0.88	0.86	0.86	0.90	0.88	0.89	0.85	0.88	0.85	0.85	0.73	
0.88	0.81	0.84	0.85	0.88	0.85	0.90	0.85	0.78	0.83	0.85	0.85	
0.89	0.85	0.89	0.85	0.34								
SVN	0.84	0.84	0.85	0.85	0.85	0.84	0.81	0.84	0.84	0.84	0.72	
0.85	0.75	0.83	0.84	0.84	0.84	0.85	0.83	0.74	0.82	0.84	0.83	
0.84	0.80	0.83	0.84	0.83	10.50							
HRV	0.84	0.84	0.85	0.85	0.84	0.85	0.82	0.85	0.85	0.85	0.73	
0.85	0.77	0.84	0.86	0.85	0.84	0.85	0.84	0.74	0.78	0.85	0.83	
0.85	0.84	0.86	0.85	0.83	0.84	12.09						

HOL mas

	CAN	CHE	DEU	DFS	EST	FRA	FRR	GBR	NLD	USA	ISR	POL
ITA	AUS	CHR	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	
LTU	LVA	PRT	KOR	SVN	HRV							
CAN	9.14											
CHE	0.75	11.30										
DEU	0.78	0.96	0.49									
DFS	0.92	0.75	0.81	12.32								
EST	0.80	0.88	0.93	0.82	13.48							
FRA	0.95	0.76	0.80	0.93	0.80	1.22						
FRR	0.73	0.58	0.59	0.77	0.64	0.79	1.04					
GBR	0.74	0.95	0.94	0.78	0.90	0.76	0.57	12.85				
NLD	0.85	0.90	0.94	0.85	0.90	0.84	0.70	0.90	4.59			
USA	0.79	0.85	0.88	0.82	0.90	0.81	0.59	0.89	0.88	0.21		
ISR	0.64	0.77	0.80	0.66	0.81	0.70	0.56	0.76	0.77	0.83	0.24	
ITA	0.79	0.92	0.94	0.81	0.92	0.83	0.66	0.90	0.90	0.89	0.84	
5.90												
AUS	0.61	0.93	0.88	0.64	0.82	0.60	0.45	0.93	0.80	0.77	0.71	
0.80	30.00											
CHR	0.70	0.97	0.91	0.69	0.84	0.70	0.56	0.91	0.85	0.85	0.73	
0.85	0.90	10.35										
HUN	0.76	0.90	0.92	0.82	0.89	0.79	0.63	0.89	0.89	0.92	0.83	
0.93	0.79	0.87	1.28									
BEL	0.82	0.95	0.96	0.84	0.93	0.84	0.64	0.95	0.94	0.89	0.76	
0.94	0.87	0.90	0.92	0.49								
JPN	0.69	0.85	0.85	0.71	0.84	0.72	0.56	0.86	0.80	0.87	0.73	
0.85	0.82	0.85	0.85	0.85	0.42							
ESP	0.83	0.93	0.95	0.85	0.93	0.87	0.65	0.93	0.92	0.91	0.83	
0.95	0.83	0.88	0.93	0.95	0.85	11.22						
ZAF	0.78	0.90	0.90	0.77	0.88	0.80	0.55	0.91	0.87	0.89	0.84	
0.91	0.87	0.87	0.90	0.90	0.85	0.94	26.24					
NZL	0.54	0.87	0.82	0.62	0.79	0.56	0.47	0.88	0.76	0.75	0.72	
0.75	0.97	0.87	0.76	0.82	0.82	0.78	0.83	0.40				
IRL	0.73	0.96	0.93	0.77	0.88	0.75	0.61	0.96	0.89	0.83	0.74	
0.88	0.95	0.92	0.86	0.94	0.84	0.90	0.89	0.92	0.11			
CZE	0.76	0.85	0.89	0.77	0.89	0.78	0.71	0.85	0.87	0.85	0.79	
0.90	0.76	0.85	0.89	0.89	0.85	0.90	0.87	0.75	0.84	16.45		
SVK	0.73	0.87	0.90	0.78	0.86	0.78	0.63	0.86	0.86	0.87	0.73	
0.88	0.77	0.86	0.94	0.90	0.85	0.92	0.87	0.75	0.84	0.88	0.41	
POL	0.80	0.91	0.93	0.80	0.90	0.84	0.67	0.89	0.89	0.86	0.78	
0.93	0.83	0.86	0.89	0.93	0.85	0.92	0.88	0.79	0.90	0.88	0.87	
10.27												
LTU	0.68	0.86	0.88	0.74	0.83	0.74	0.58	0.85	0.80	0.84	0.70	
0.85	0.78	0.83	0.84	0.85	0.84	0.87	0.81	0.75	0.82	0.85	0.85	
0.85	0.37											
LVA	0.70	0.88	0.93	0.77	0.92	0.75	0.60	0.87	0.88	0.84	0.72	
0.90	0.82	0.84	0.86	0.92	0.84	0.88	0.83	0.81	0.88	0.86	0.84	
0.93	0.87	0.48										
PRT	0.66	0.85	0.85	0.72	0.84	0.76	0.64	0.85	0.79	0.85	0.78	
0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.81	0.85	0.85	
0.85	0.84	0.84	0.50									
KOR	0.78	0.86	0.86	0.80	0.86	0.84	0.65	0.88	0.83	0.85	0.73	
0.88	0.80	0.84	0.85	0.89	0.85	0.90	0.85	0.77	0.84	0.85	0.85	
0.89	0.83	0.86	0.85	0.34								
SVN	0.69	0.82	0.84	0.76	0.84	0.72	0.56	0.84	0.77	0.84	0.69	
0.84	0.74	0.82	0.84	0.83	0.83	0.84	0.82	0.73	0.81	0.84	0.81	
0.84	0.77	0.82	0.84	0.80	10.50							
HRV	0.62	0.83	0.85	0.67	0.83	0.66	0.47	0.84	0.78	0.84	0.71	
0.84	0.75	0.82	0.85	0.85	0.83	0.85	0.82	0.73	0.76	0.84	0.82	
0.84	0.83	0.85	0.84	0.82	0.83	12.09						

SIM	scs										
	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV
FRM	1.08										
FRA	0.92	0.99									
ITA	0.96	0.90	14.81								
NLD	0.92	0.94	0.87	4.32							
CHE	0.92	0.93	0.90	0.92	10.19						
DEA	0.94	0.91	0.91	0.92	0.92	12.13					
HUN	0.92	0.91	0.92	0.88	0.90	0.92	16.32				
SVK	0.88	0.88	0.90	0.87	0.87	0.85	0.92	0.38			
SVN	0.88	0.86	0.86	0.86	0.87	0.86	0.87	0.86	9.03		
GBR	0.90	0.95	0.88	0.95	0.90	0.90	0.89	0.86	0.85	11.13	
HRV	0.91	0.86	0.85	0.86	0.86	0.85	0.87	0.86	0.86	0.85	10.35

SIM	mas										
	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV
FRM	1.08										
FRA	0.90	1.00									
ITA	0.96	0.87	14.81								
NLD	0.87	0.85	0.86	3.60							
CHE	0.92	0.82	0.90	0.84	10.19						
DEA	0.93	0.91	0.91	0.87	0.92	12.13					
HUN	0.89	0.84	0.92	0.87	0.90	0.89	16.32				
SVK	0.86	0.85	0.90	0.81	0.87	0.85	0.91	0.38			
SVN	0.86	0.84	0.85	0.74	0.85	0.85	0.85	0.86	9.03		
GBR	0.90	0.76	0.88	0.89	0.90	0.88	0.89	0.84	0.83	11.13	
HRV	0.88	0.83	0.85	0.65	0.83	0.85	0.86	0.86	0.86	0.82	10.35

^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	72	44	136	100	107	18	91	52	22
FRA	65	0	72	114	132	173	16	148	42	40
NLD	40	59	0	66	71	117	17	97	28	31
USA	133	75	57	0	277	277	22	186	66	28
CHE	83	95	65	259	0	490	16	348	53	51
DEA	91	131	110	244	390	0	25	487	55	71
NZL	18	12	10	20	14	20	0	17	12	4
ITA	79	116	79	127	299	391	13	0	50	65
GBR	55	37	25	68	45	40	10	39	0	14
SVN	20	40	31	23	51	66	3	66	12	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	61	40	136	100	107	18	91	52	22
FRA	55	0	50	96	127	153	12	133	38	33
NLD	34	40	0	56	59	93	16	79	26	28
USA	133	64	45	0	277	277	22	186	66	28
CHE	83	92	54	259	0	490	16	348	53	51
DEA	91	113	83	244	390	0	25	487	55	71
NZL	18	9	9	20	14	20	0	17	12	4
ITA	79	104	60	127	299	391	13	0	50	65
GBR	55	36	22	68	45	40	10	39	0	14
SVN	20	33	27	23	51	66	3	66	12	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL	ZAF
CAN	0	26	60	41	13	1
GBR	21	0	71	32	13	3
USA	51	74	0	53	29	6
AUS	38	25	49	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

ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	CAN	CHE	DEU	DFS	EST	FRA	FRR	GBR	NLD	USA	ISR	ITA	AUS	CHR	HUN	BEL	JPN	ESP	
												CAN	0	423	1841	990	151	1064	13	1147	1011	2319	71	1265	959	367	675	359	998	946
401	551	335	744	319	825	132	189	793	439	111	178	CHE	289	0	530	364	57	355	11	377	397	457	35	373	322	410	247	230	251	325
183	233	211	263	101	300	56	89	318	140	60	106	DEU	937	427	0	2328	294	2057	125	1668	2824	2942	115	2257	1323	602	981	621	1209	1222
507	804	614	1448	606	1636	320	307	1091	435	185	437	DFS	627	300	1215	0	194	1346	45	1199	1619	1621	105	1354	993	335	703	433	757	787
428	675	520	933	336	1095	197	210	819	346	155	266	EST	78	25	197	109	0	167	19	162	261	240	38	189	147	71	132	79	135	128
77	97	86	175	85	206	45	87	144	68	55	77	FRA	568	316	865	561	67	0	23	1240	1579	2087	96	1573	997	286	718	485	978	871
402	659	515	930	318	1104	145	177	794	354	117	187	FRR	7	9	98	30	16	18	0	22	86	29	4	26	23	36	9	33	6	14
11	10	9	34	23	77	1	22	21	2	13	16	GBR	1199	342	1057	765	89	658	16	0	1343	1632	94	1257	1050	317	661	438	789	817
435	724	633	752	290	900	158	176	814	346	134	229	NLD	780	378	2284	1187	185	812	51	1034	0	1961	111	1477	1142	493	742	652	815	850
441	838	609	1090	429	1214	184	223	936	332	157	311	USA	2033	358	1616	986	149	948	15	1244	1507	0	116	2220	1406	480	973	470	1565	1179
551	881	528	1215	430	1358	203	260	1090	600	143	245	ISR	41	24	95	83	26	51	3	64	91	96	0	105	76	26	76	41	73	82
52	79	61	83	34	93	28	28	89	41	31	44	ITA	693	299	1245	821	101	671	22	810	1023	1121	76	0	974	343	800	434	982	1007
443	648	462	988	336	1147	180	226	897	429	157	265	AUS	819	276	822	602	61	588	16	811	915	1211	53	586	0	289	545	404	659	650
407	960	491	621	236	702	135	159	664	292	115	197	CHR	305	453	524	287	37	266	25	297	465	456	14	295	247	0	212	248	199	258
147	200	182	246	129	294	42	100	273	112	62	104	HUN	547	198	751	525	80	462	8	564	603	891	60	640	395	177	0	273	540	571
329	401	295	677	252	681	126	138	596	318	101	173	BEL	302	207	518	338	45	425	27	361	675	345	24	329	300	222	209	0	259	338
201	278	252	298	143	360	67	95	367	130	82	133	JPN	393	150	401	347	45	293	4	337	366	580	33	368	312	142	308	134	0	691
350	437	289	607	241	675	119	147	582	375	102	137	ESP	474	270	734	541	63	589	8	635	726	690	56	696	443	214	458	302	292	0
376	428	343	624	242	726	140	164	701	317	116	199	ZAF	329	159	381	313	39	268	7	372	369	516	38	326	340	122	270	156	235	332
0	317	244	301	149	328	69	94	385	207	71	112	NZL	537	203	576	428	52	344	7	589	743	798	67	440	929	167	316	206	205	313
253	0	489	457	200	485	109	111	495	217	84	147	IRL	256	197	442	357	39	334	7	561	486	397	44	327	371	164	239	217	143	304
198	369	0	313	142	372	82	93	363	125	68	116	CZE	431	161	967	505	106	475	26	428	859	803	59	577	334	169	577	191	226	386
188	284	177	0	340	917	142	182	616	330	127	235	SVK	205	52	445	165	41	159	12	155	276	268	13	176	110	68	179	76	80	119
84	122	72	248	0	320	57	95	261	142	49	91	POL	534	220	1216	768	138	558	70	627	972	1061	72	789	446	238	574	275	308	487
235	328	246	665	196	0	188	239	782	371	143	303	LTU	54	17	301	99	16	32	0	64	90	114	13	92	44	14	68	21	25	61
23	46	30	86	29	130	0	69	139	79	29	85	LVA	108	49	208	130	62	78	19	100	146	208	20	152	75	66	99	53	62	91
55	54	51	118	45	182	49	0	196	97	44	107	PRT	797	289	1024	722	97	698	19	777	980	1133	74	843	525	255	593	350	339	727
367	426	333	497	191	781	88	154	0	354	116	234	KOR	380	84	266	223	34	181	0	242	207	661	24	326	200	71	257	67	207	212
157	149	74	230	85	285	38	59	298	0	61	80	SVN	81	42	162	131	35	82	12	97	133	113	24	132	82	44	83	68	56	88
53	61	48	97	32	127	14	27	98	31	0	65	HRV	89	72	446	203	59	103	16	168	280	183	34	209	125	74	131	112	68	157
81	87	78	174	46	259	60	89	200	37	55	0																			

HOL

common bulls below diagonal

common three quarter sib group above diagonal

ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	USA	ISR	ITA	AUS	CHR	HUN	BEL	JPN	ESP
CAN	0	272	982	442	72	469	0	565	466	1175	40	754	441	219	399	219	517	560		
177	246	163	452	155	546	78	109	397	270	74	116									
CHE	192	0	530	348	57	301	8	377	380	456	35	372	322	410	247	230	251	323		
183	233	211	263	98	300	56	88	308	140	60	106									
DEU	571	427	0	2190	294	1499	66	1665	2652	2934	115	2255	1319	600	981	621	1207	1205		
504	801	614	1448	596	1635	319	305	1047	430	185	437									
DFS	348	284	1047	0	181	981	24	1131	1409	1505	101	1274	932	302	661	414	718	745		
413	638	507	871	306	1018	191	199	754	317	149	255									
EST	42	25	197	99	0	127	14	162	250	239	38	189	147	71	132	79	134	126		
76	96	86	175	84	206	45	87	140	68	55	77									
FRA	283	262	568	409	55	0	10	927	1116	1392	80	1192	736	241	598	402	714	698		
318	493	413	788	241	944	120	144	633	285	104	158									
FRR	0	8	49	21	13	8	0	14	52	19	3	17	16	22	5	21	1	9		
8	5	5	26	17	64	0	17	15	1	11	15									
GBR	481	342	1057	691	89	498	11	0	1278	1630	94	1257	1050	317	661	438	789	812		
432	722	633	752	282	900	157	174	788	343	134	229									
NLD	383	357	2060	929	176	531	35	948	0	1843	109	1379	1094	463	705	633	777	794		
422	816	595	1038	405	1149	176	209	856	319	154	294									
USA	1024	358	1615	831	149	526	11	1244	1335	0	116	2219	1403	480	972	470	1563	1166		
547	876	528	1215	422	1357	202	259	1033	594	143	245									
ISR	29	24	95	75	26	45	3	64	89	96	0	105	76	26	76	41	73	81		
52	79	61	83	32	93	28	28	89	41	31	44									
ITA	445	299	1245	732	101	484	16	810	887	1121	76	0	973	342	800	433	982	992		
441	648	462	988	329	1145	180	225	860	427	157	264									
AUS	409	276	822	528	61	446	11	811	848	1211	53	586	0	289	544	404	659	644		
406	958	491	621	227	702	134	158	643	288	115	197									
CHR	192	453	523	258	37	222	20	297	425	456	14	295	247	0	212	248	199	256		
147	200	182	246	126	294	42	99	267	112	62	104									
HUN	358	198	751	484	80	383	5	564	545	891	60	640	395	177	0	273	540	568		
328	400	295	677	249	681	126	137	582	317	101	173									
BEL	194	207	518	314	45	338	19	361	639	345	24	329	300	222	209	0	259	336		
201	278	252	298	138	360	67	94	361	130	82	133									
JPN	284	150	401	316	45	249	1	337	336	580	33	368	312	142	308	134	0	687		
349	434	289	607	234	675	119	145	555	372	102	137									
ESP	275	267	718	495	61	493	7	628	649	674	55	685	434	211	451	300	286	0		
376	425	341	614	236	712	138	163	681	314	115	198									
ZAF	161	159	381	299	39	228	6	372	341	516	38	326	340	122	270	156	235	332		
0	317	244	301	146	326	69	93	381	205	71	111									
NZL	218	203	575	392	51	271	4	589	706	798	67	440	929	167	316	206	205	312		
253	0	488	456	196	485	109	110	483	215	84	147									
IRL	155	197	442	340	39	292	5	561	462	397	44	327	371	164	239	217	143	303		
198	369	0	313	139	371	82	92	363	125	68	116									
CZE	288	161	967	452	106	364	20	428	787	803	59	577	334	169	577	191	226	378		
188	284	177	0	338	917	142	182	596	327	127	235									
SVK	103	52	444	147	41	116	10	155	258	268	13	175	109	68	179	76	80	118		
84	122	72	248	0	317	56	93	255	141	49	90									
POL	408	220	1216	682	138	473	61	627	896	1061	72	789	446	238	574	275	308	474		
235	328	246	665	196	0	188	239	755	371	143	303									
LTU	36	17	301	89	16	26	0	64	80	114	13	92	44	14	68	21	25	61		
23	46	30	86	29	130	0	68	137	78	29	85									
LVA	66	49	208	120	62	68	15	100	127	208	20	152	75	66	99	53	62	91		
55	54	51	118	45	182	49	0	192	97	44	107									
PRT	377	283	998	652	96	577	15	764	896	1086	74	824	509	250	583	345	325	710		
365	420	331	489	190	760	87	153	0	344	112	233									
KOR	241	84	266	198	34	150	0	242	187	661	24	326	200	71	257	67	207	208		
157	149	74	230	85	285	38	59	293	0	61	80									
SVN	58	42	162	122	35	74	10	97	130	113	24	132	82	44	83	68	56	87		
53	61	48	97	32	127	14	27	94	31	0	65									
HRV	70	72	446	185	59	89	15	168	259	183	34	209	125	74	131	112	68	156		
81	87	78	174	46	259	60	89	200	37	55	0									

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	64	115	28	280	175	106	134
DFS	48	0	120	61	136	104	109	107
GBR	118	107	0	59	174	158	129	163
NLD	22	59	54	0	64	53	56	57
USA	291	108	193	68	0	371	220	293
AUS	180	68	164	46	402	0	175	335
ZAF	103	85	129	51	233	168	0	160
NZL	146	78	164	49	363	376	165	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	22	44	7	91	55	37	42
DFS	17	0	115	43	127	95	101	99
GBR	43	102	0	43	173	158	128	162
NLD	2	36	39	0	50	45	47	46
USA	81	89	193	54	0	371	220	293
AUS	49	57	164	41	402	0	175	334
ZAF	31	75	129	43	233	168	0	160
NZL	39	67	164	38	363	375	165	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	105	57	4	155	11	80	1	65	67	13	7	4
DFS	101	0	46	87	122	55	133	70	46	132	100	89	30
GBR	58	45	0	11	64	5	43	1	31	43	11	5	12
NOR	4	67	12	0	42	16	42	10	0	29	21	16	24
USA	142	122	60	42	0	17	83	8	53	76	24	9	22
DEU	10	45	5	15	17	0	31	20	1	13	29	28	13
AUS	80	109	41	35	84	29	0	15	28	105	39	26	17
EST	1	59	1	9	6	18	15	0	0	3	21	34	8
ZAF	67	43	27	0	48	1	28	0	0	29	5	1	3
NZL	65	130	40	28	76	13	107	2	25	0	22	12	7
LTU	12	83	10	16	17	28	35	20	5	18	0	36	11
LVA	7	59	5	14	8	23	25	27	1	10	32	0	9
NLD	4	30	12	23	20	12	15	7	3	7	10	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	57	26	3	58	5	23	0	13	24	9	4	3
DFS	52	0	43	89	116	55	151	70	15	130	99	90	29
GBR	26	42	0	11	62	5	41	1	16	41	11	5	10
NOR	3	68	12	0	42	16	42	10	0	29	21	16	22
USA	59	116	60	42	0	17	81	8	23	74	24	9	20
DEU	5	45	5	15	17	0	31	20	1	13	29	28	13
AUS	23	130	40	35	83	29	0	15	12	104	39	26	16
EST	0	59	1	9	6	18	15	0	0	3	21	34	8
ZAF	12	13	14	0	18	1	12	0	0	12	2	1	0
NZL	23	126	40	28	76	13	106	2	11	0	22	12	6
LTU	8	82	10	16	17	28	35	20	2	18	0	36	10
LVA	4	59	5	14	8	23	25	27	1	10	32	0	7
NLD	3	29	10	21	18	12	14	7	0	6	9	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
FRM	0	2	136	100	151	177	2	52	17	59	2
FRA	1	0	88	32	11	163	3	39	34	0	60
ITA	158	77	0	122	70	609	9	112	69	38	174
NLD	123	30	117	0	69	169	2	45	28	45	65
CHE	195	6	71	73	0	276	1	27	7	47	1
DEA	138	123	510	166	223	0	25	312	125	43	409
HUN	0	2	7	2	0	14	0	6	5	0	8
SVK	52	31	95	38	19	318	5	0	36	8	71
SVN	17	30	66	28	7	112	4	36	0	0	54
GBR	74	0	39	44	52	29	0	3	0	0	0
HRV	1	53	167	64	1	423	7	55	44	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
FRM	0	2	136	88	151	177	2	52	17	59	2
FRA	1	0	85	29	11	158	3	38	33	0	58
ITA	158	75	0	104	70	609	9	112	69	38	174
NLD	107	27	99	0	63	140	2	40	24	40	59
CHE	195	6	71	66	0	276	1	27	7	47	1
DEA	138	121	510	136	223	0	25	312	125	43	409
HUN	0	2	7	2	0	14	0	6	5	0	8
SVK	52	30	95	34	19	318	5	0	36	8	71
SVN	17	29	66	24	7	112	4	36	0	0	54
GBR	74	0	39	39	52	29	0	3	0	0	0
HRV	1	51	167	58	1	423	7	55	44	0	0