

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) Standard deviation of RBV changed from 10 to 12 to mimic the expected effect of a future change to a cow-base
FRA (ALL) Base change, correction of IDs for some bulls
ISR (HOL) Base change
ITA (HOL) Base change, one year cut off of data
DEU (HOL,RDC,JER) Base change: all cows born 2010 - 2012 (16CB11), having at least 3 test day records in BV production
LTU (HOL,RDC) Base change
SVN (HOL,BSW) Phenotypic data improvements and pedigree corrections
NLD (ALL) Adding clinical mastitis to the ebv
NZL (ALL) Data provided by a new organization Dairy NewZealand (DNZ): daughter counts, herd counts and EDC have changed due to parentage verification.
Herd count is now calculated on the daughters that are used to estimate breeding values.

CAN (ALL) Base change. Evaluations for SCS is performed in a separate model from the evaluations for the three yield traits. This resulted in the elimination of correlations between SCS and the yield traits, genetic parameters have also been re-estimated.

CHE (BSW) New software for type of proofs, implemented new rules for publication of proofs, new genetic parameters

ITA (BSW) Base change, changed procedure to estimate reliabilities and EDC, parentage correction. Changed formula to standardized the ebv

ZAF (HOL,JER) Data since 2012 on 18 ARC herds were added which influenced the breeding values of especially the 2004/2005 born bulls. Furthermore, quite a lot of French bulls entered the evaluation

POL (HOL) New Test Day Model: herd-test-date of all three parities are combined and treated as fixed effect in the new TDM. The fixed lactation curves, modelled with Wilmlink function, are defined in the new TDM for parity x calving-season x calving age x calving year class x breed

PRT (HOL) Change base to 2010

CZE (HOL) Base change

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

Subsetting:

As decided by the ITC in Orlando, new subsetting was introduced in the september test run. Sub-setting is necessary for operational purposes and restrictions of time scales. To minimize the effect of subsetting, 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.

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

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		123	7077	1424	627	
BEL			1024			
CAN	205	92	10883	601	740	
CHE	2708		2973			2935
CZE			3425			
DEA	5230					20628
DEU			25656		397	
DFS			12257	1961	7331	
ESP			3130			
EST			952		382	
FRA	341		15912			370
FRM						3914
FRR			229			
GBR	100	258	5964	631	422	80
HUN			2436			152
IRL			2096			
ISR			1246			
ITA	1744		9186			1278
JPN			5335			
KOR			1007			
LTU			650		392	
LVA			528		564	
NLD	161		14301	117	62	294
NOR					3824	
NZL	37	57	6684	3981	1154	
POL			8886			
PRT			2087			
SVK			979			515
SVN	318		420			525
URY						
USA	977	665	34080	3835	602	37
ZAF		16	1117	520	121	
HRV			599			703
No. Records	11821	1211	181119	13070	16618	31431
Pub. Proofs	9682	950	142742	10874	16042	28501

^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	0.91	0.93	4.16							
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	11.93				
NZL	0.87	0.86	0.87	0.84	0.87	0.86	0.37			
ITA	0.91	0.90	0.88	0.88	0.95	0.91	0.87	18.10		
GBR	0.93	0.96	0.96	0.91	0.94	0.95	0.87	0.89	13.09	
SVN	0.90	0.87	0.88	0.89	0.89	0.87	0.85	0.89	0.88	10.47

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	3.58							
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	11.93				
NZL	0.81	0.76	0.79	0.82	0.83	0.77	0.37			
ITA	0.89	0.87	0.89	0.88	0.96	0.91	0.84	18.10		
GBR	0.85	0.72	0.88	0.88	0.90	0.91	0.84	0.88	13.09	
SVN	0.77	0.68	0.79	0.78	0.85	0.85	0.69	0.87	0.77	10.47

GUE scs

	CAN	GBR	USA	AUS	NZL	ZAF
CAN	0.24					
GBR	0.93	13.37				
USA	0.94	0.90	0.25			
AUS	0.88	0.92	0.87	29.04		
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	9.30											
CHE	0.81	10.86										
DEU	0.83	0.92	12.71									
DFS	0.92	0.80	0.85	12.23								
EST	0.78	0.82	0.90	0.80	13.09							
FRA	0.95	0.81	0.84	0.93	0.78	1.22						
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	12.82				
NLD	0.86	0.87	0.93	0.87	0.88	0.87	0.72	0.90	4.88			
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	5.83
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
30.19												
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	1.43											
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	0.50										
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	11.62								
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	25.90							
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	0.79	0.91	0.91	0.81	0.82	0.80	0.56	0.96	0.88	0.85	0.74	0.87
0.94	0.85	0.93	0.84	0.90	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	0.83	16.45				
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	9.96		
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	0.76	0.81	0.78	0.85	0.36	
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	0.83
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	0.81	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	0.78	0.81	0.75	0.85	0.69	0.73
0.81	0.75	10.72										
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	0.77	0.83	0.78	0.88	0.81	0.82
0.84	0.76	0.79	11.98									

JER scs

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0.22							
DFS	0.92	12.44						
GBR	0.92	0.91	11.27					
NLD	0.92	0.94	0.96	4.39				
USA	0.91	0.88	0.89	0.88	0.19			
AUS	0.86	0.87	0.88	0.92	0.86	28.94		
ZAF	0.90	0.87	0.88	0.91	0.88	0.90	20.74	
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	8.50							
DFS	0.89	12.43						
GBR	0.72	0.77	11.27					
NLD	0.85	0.86	0.90	4.06				
USA	0.86	0.86	0.88	0.88	0.19			
AUS	0.69	0.72	0.88	0.86	0.85	28.96		
ZAF	0.74	0.79	0.87	0.89	0.88	0.88	20.74	
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	11.45									
NOR	0.92	0.94	0.90	14.28								
USA	0.93	0.88	0.89	0.89	0.24							
DEU	0.93	0.94	0.94	0.90	0.89	13.56						
AUS	0.89	0.92	0.91	0.92	0.86	0.90	31.28					
EST	0.89	0.94	0.91	0.90	0.91	0.94	0.90	11.79				
ZAF	0.89	0.90	0.90	0.93	0.89	0.91	0.88	0.90	25.27			
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

RDC mas

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA
NLD												
CAN	8.63											
DFS	0.87	13.24										
GBR	0.78	0.79	11.48									
NOR	0.89	0.88	0.89	14.28								
USA	0.87	0.87	0.89	0.89	0.24							
DEU	0.81	0.81	0.93	0.90	0.88	13.56						
AUS	0.72	0.73	0.89	0.90	0.85	0.87	31.33					
EST	0.75	0.77	0.82	0.89	0.86	0.91	0.84	11.79				
ZAF	0.86	0.86	0.89	0.91	0.89	0.89	0.85	0.82	25.36			
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

SIM scs

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	1.09											
FRA	0.92	0.99										
ITA	0.96	0.90	13.98									
NLD	0.92	0.94	0.88	4.35								
CHE	0.93	0.92	0.90	0.91	10.32							
DEA	0.93	0.92	0.88	0.90	0.90	12.15						
HUN	0.93	0.91	0.93	0.88	0.89	0.93	15.65					
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	8.87			
GBR	0.92	0.96	0.89	0.95	0.90	0.92	0.89	0.87	0.87	11.01		
HRV	0.92	0.87	0.88	0.87	0.87	0.86	0.89	0.87	0.87	0.86	10.17	
USA	0.89	0.90	0.89	0.88	0.89	0.90	0.92	0.89	0.89	0.90	0.88	0.21

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	13.98									
NLD	0.88	0.88	0.88	3.73								
CHE	0.92	0.84	0.90	0.87	10.32							
DEA	0.92	0.92	0.88	0.88	0.89	12.15						
HUN	0.91	0.87	0.93	0.90	0.88	0.92	15.65					
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	8.87			
GBR	0.92	0.82	0.89	0.90	0.90	0.90	0.89	0.86	0.85	11.01		
HRV	0.90	0.85	0.88	0.83	0.86	0.86	0.88	0.87	0.87	0.84	10.17	
USA	0.89	0.88	0.89	0.89	0.89	0.90	0.92	0.89	0.89	0.90	0.89	0.21

^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	76	46	145	110	110	16	103	55	22
FRA	69	0	76	117	145	186	14	163	48	45
NLD	42	62	0	71	82	125	15	110	34	34
USA	142	78	61	0	294	284	20	203	72	31
CHE	90	108	73	276	0	503	17	377	59	55
DEA	96	140	115	250	400	0	22	538	61	80
NZL	16	10	8	18	13	17	0	18	10	3
ITA	91	130	90	140	330	444	14	0	61	72
GBR	56	39	27	69	47	42	8	44	0	17
SVN	20	45	35	25	57	75	2	73	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	55	22
FRA	59	0	58	101	138	166	11	146	44	43
NLD	36	48	0	63	72	106	15	93	31	31
USA	142	68	50	0	294	284	20	203	72	31
CHE	90	104	64	276	0	503	17	377	59	55
DEA	96	126	93	250	400	0	22	538	61	80
NZL	16	8	8	18	13	17	0	18	10	3
ITA	91	119	71	140	330	444	14	0	61	72
GBR	56	39	24	69	47	42	8	44	0	17
SVN	20	43	31	25	57	75	2	73	13	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL	ZAF
CAN	0	26	61	42	13	1
GBR	21	0	76	32	13	3
USA	52	78	0	56	29	6
AUS	40	27	52	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

	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	0	427	1080	506	92	559	0	629	541	1313	46	834	528	465	252	598	621	200	267
192	501	180	658	106	109	496	321	103	139										
CHE	333	0	969	524	122	439	23	557	693	789	47	600	486	371	348	383	450	232	320
282	425	186	525	90	136	435	191	107	156										
DEU	673	804	0	2286	317	1616	70	1756	2780	3080	122	2294	1416	1050	671	1306	1289	528	816
648	1520	631	1861	384	304	1068	476	226	469										
DFS	421	435	1168	0	205	1043	26	1203	1492	1577	106	1306	987	704	452	783	803	438	659
533	930	329	1173	226	202	757	347	178	278										
EST	55	67	214	113	0	149	15	185	271	263	41	207	166	153	92	158	150	82	105
96	196	92	232	56	88	151	79	62	86										
FRA	362	367	660	473	68	0	14	996	1197	1486	87	1272	805	665	448	786	775	337	518
441	861	265	1069	148	145	674	322	133	179										
FRR	0	20	51	22	14	11	0	15	56	19	3	18	17	5	23	2	10	8	5
5	27	18	73	0	17	11	1	11	15										
GBR	564	508	1165	757	102	567	11	0	1359	1721	102	1308	1118	700	476	868	869	455	747
671	806	305	1002	185	177	804	376	165	250										
NLD	462	639	2189	1020	191	625	36	1040	0	1926	115	1415	1162	758	674	853	859	443	838
634	1107	436	1303	208	211	865	354	179	316										
USA	1215	686	1799	916	172	622	11	1362	1431	0	123	2269	1511	1053	504	1677	1251	574	893
558	1278	445	1542	244	259	1096	650	174	275										
ISR	31	33	101	80	26	48	3	69	93	105	0	110	81	83	44	79	86	52	85
64	88	35	102	32	28	88	43	33	49										
ITA	532	523	1328	797	114	557	17	887	948	1235	82	0	1028	862	467	1058	1070	455	653
488	1046	347	1258	217	224	885	468	185	287										
AUS	524	414	926	583	77	514	12	898	923	1361	55	655	0	581	439	728	698	423	988
526	668	247	785	154	162	660	323	135	213										
HUN	419	300	803	519	94	429	5	599	590	974	66	698	422	0	303	600	623	352	417
319	730	268	754	149	138	612	355	127	192										
BEL	231	312	587	358	55	392	21	405	694	384	26	369	340	230	0	304	379	216	299
274	332	156	414	79	96	383	152	100	144										
JPN	362	240	477	372	57	299	2	415	403	685	37	431	375	341	180	0	759	381	467
323	674	260	790	147	147	608	421	128	160										
ESP	328	351	776	538	71	547	7	675	699	740	56	736	477	489	335	338	0	401	443
366	670	261	812	160	164	710	351	139	214										
ZAF	185	185	400	318	42	245	6	390	358	547	38	342	358	285	168	266	350	0	330
261	320	155	357	83	95	382	223	80	117										
NZL	244	262	594	420	55	298	4	621	735	823	69	457	969	329	224	245	328	259	0
526	470	207	520	123	109	476	231	98	157										
IRL	183	259	486	369	47	322	5	608	510	434	48	364	409	256	236	182	322	208	409
0	337	150	412	96	94	356	141	78	124										
CZE	323	274	1029	494	122	415	21	474	851	861	62	622	365	619	213	264	408	198	295
197	0	366	1012	167	182	634	360	155	255										
SVK	117	95	471	158	43	131	11	168	281	287	15	190	122	192	82	94	127	86	126
74	270	0	358	71	94	271	156	57	100										
POL	509	415	1455	815	158	572	80	740	1039	1265	81	884	523	640	331	377	535	259	363
289	730	234	0	234	249	834	426	179	333										
LTU	51	31	360	105	24	34	0	77	95	148	14	103	52	82	24	36	66	30	52
37	104	32	172	0	71	155	97	36	104										
LVA	66	78	207	121	63	68	15	102	129	208	20	152	77	99	54	66	92	57	54
53	118	46	185	50	0	189	98	44	112										
PRT	467	371	953	626	101	562	11	727	836	1112	66	799	495	586	352	362	663	338	382
294	497	183	818	96	143	0	379	130	238										
KOR	287	128	302	223	41	177	0	275	214	729	27	373	228	293	84	250	234	168	162
84	248	92	337	44	59	307	0	74	96										
SVN	76	77	206	140	39	87	10	118	151	134	26	151	97	99	77	71	101	57	69
55	112	33	157	16	27	100	41	0	75										
HRV	78	102	479	198	63	104	15	175	271	203	34	221	131	144	118	74	168	81	88
81	182	49	289	70	91	190	41	59	0										

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	67	124	28	314	204	116	138
DFS	51	0	126	66	140	110	110	108
GBR	126	113	0	64	191	170	136	170
NLD	22	64	59	0	66	55	56	57
USA	321	112	209	71	0	410	232	300
AUS	205	73	173	48	440	0	184	349
ZAF	112	87	137	52	242	175	0	166
NZL	152	80	175	49	369	390	173	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL
CAN	0	28	55	10	122	79	45	50
DFS	22	0	121	51	129	101	102	100
GBR	51	108	0	51	189	170	135	169
NLD	4	44	46	0	55	48	49	48
USA	107	91	209	59	0	410	232	300
AUS	68	62	173	44	440	0	184	348
ZAF	39	77	137	44	242	175	0	166
NZL	49	69	175	40	369	389	173	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	116	62	4	167	11	87	1	68	70	14	7	5
DFS	113	0	53	100	144	58	148	77	49	138	106	90	37
GBR	62	52	0	20	72	5	49	1	33	45	12	5	16
NOR	4	73	21	0	53	17	50	12	0	33	23	16	28
USA	152	141	68	54	0	21	101	12	56	90	29	12	27
DEU	10	49	5	17	21	0	36	23	2	15	32	28	14
AUS	87	124	47	41	102	35	0	18	31	113	40	26	21
EST	1	67	1	12	11	22	18	0	0	4	22	34	9
ZAF	70	46	29	0	51	2	31	0	0	30	5	1	3
NZL	68	135	43	31	90	15	114	3	26	0	24	12	11
LTU	13	90	11	18	23	30	36	21	5	20	0	37	12
LVA	7	59	5	14	10	23	25	28	1	10	32	0	9
NLD	5	37	16	27	26	14	19	8	3	11	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	63	29	3	64	5	28	0	35	27	10	4	3
DFS	61	0	50	101	135	58	165	77	45	136	105	91	33
GBR	29	48	0	20	70	5	47	1	30	44	12	5	14
NOR	3	73	21	0	53	17	50	12	0	33	23	16	26
USA	66	133	68	54	0	21	99	12	52	88	29	12	25
DEU	5	49	5	17	21	0	36	23	2	15	32	28	14
AUS	28	143	46	41	101	35	0	18	29	112	40	26	19
EST	0	67	1	12	11	22	18	0	0	4	22	34	9
ZAF	37	44	28	0	51	2	31	0	0	28	5	1	2
NZL	27	131	43	31	90	15	113	3	26	0	24	12	9
LTU	9	89	11	18	23	30	36	21	5	20	0	37	11
LVA	4	59	5	14	10	23	25	28	1	10	32	0	7
NLD	3	33	14	25	24	14	17	8	2	9	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	2	144	104	158	204	2	54	17	63	2	23
FRA	1	0	100	41	9	179	3	43	40	0	70	0
ITA	174	88	0	146	76	663	10	122	84	42	183	18
NLD	127	40	141	0	73	198	3	50	40	46	70	14
CHE	207	6	77	76	0	258	2	30	5	50	0	17
DEA	244	137	568	206	227	0	27	329	154	45	418	15
HUN	0	2	7	3	1	15	0	6	6	0	7	0
SVK	54	37	104	42	22	335	5	0	40	9	71	3
SVN	17	37	79	38	5	140	5	39	0	0	61	0
GBR	80	0	46	45	57	47	0	4	0	0	0	17
HRV	1	64	173	67	0	439	7	54	49	0	0	0
USA	37	0	25	17	18	20	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	144	91	157	201	2	54	17	63	2	23
FRA	1	0	86	29	9	158	3	39	34	0	57	0
ITA	174	75	0	124	76	663	10	122	84	42	183	18
NLD	110	28	121	0	67	160	3	44	32	42	62	14
CHE	206	6	77	68	0	258	2	30	5	50	0	17
DEA	241	121	568	169	227	0	27	329	154	45	418	15
HUN	0	2	7	3	1	15	0	6	6	0	7	0
SVK	54	31	104	37	22	335	5	0	40	9	71	3
SVN	17	29	79	32	5	140	5	39	0	0	61	0
GBR	80	0	46	41	57	47	0	4	0	0	0	17
HRV	1	50	173	59	0	439	7	54	49	0	0	0
USA	37	0	25	17	18	20	0	3	0	24	0	0