

Introduction

The latest international evaluation for dairy production traits took place as scheduled at the Interbull Centre. Data from thirty-three (33) countries were included in this evaluation.

International genetic evaluations for milk, fat and protein yields of bulls from Australia, Austria-Germany, Belgium, Canada, Croatia, Czech Republic, Denmark-Finland-Sweden, Estonia, France, Hungary, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Netherlands, New Zealand, Norway, Poland, Republic of South Africa, Slovak Republic, Slovenia, Spain, Switzerland, the United Kingdom, the United States of America, Portugal, Korea, and Uruguay were computed. Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental breed data were included in this evaluation.

Changes in national procedures

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

ITA (HOL)	Corrected a bug in the procedure that was not highlighted by the alert system.
ITA (SIM)	Reduction in information due to pedigree verification.
NLD (HOL, JER)	Reduction in information due to pedigree verification.
KOR (HOL)	Reduction in reliability is due to exclusion of recent data in this evaluation.
CHE (BSW, HOL, SIM)	Reduction in information is due to data edits.Reduction in information is due to data edits.
BEL(HOL)	The observed decreases in information is attributed to the existence of breeds alias or errors/corrections in the pedigree.
AUS (HOL, JER)	Reduction in information is a result of data clean-up and pedigree verification.
DEA (BSW, SIM)	Base change.
JPN (HOL)	Reduction in information due to pedigree verification.
USA (ALL)	Drops in information due to pedigree varification and data edits.
GBR (ALL)	Drops in information due to data changes and edits.
NZL (ALL)	Pedigree verification due to genomic information, causing change in information for many animals. New heritabilities.
ITA (BSW)	Correction of a bug in the attribution of fixed effects for first-parity cows: animals that calved for the first time in recent years were incorrectly assigned to wrong parity classes, not to the first-parity category as they should have been.
URY (HOL)	Reduction in information due to pedigree verification.
HUN (HOL)	First data submission since 2021. Revision of scope of data used in breeding value estimation, data editing cut-off changed cows having their first lactation from 2000 onwards. New age pre-correction factor were calculated. New heritability values.
EST (HOL)	Reduction in information due to pedigree correction.
ESP (HOL)	Reduction in daughters due to pedigree verification.
POL (HOL)	Reduction in information due to data edits.

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

In 2020 new post-processing windows\200\231 correlations for all breeds and traits have been applied: the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while the lower values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the real estimated ones. The previously lower value adopted (based on the 25th percentile) had been found too high causing estimated and post-processed correlations to differ significantly from each other. It is a recommendation from the Interbull Technical Committee to review such windows every 5 years. The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more in consideration the value of the new estimated ones even when no changes are applied by the countries. More information can be read on https://interbull.org/ib/rg_procedure

Since 2021 a new trait group has been added to the MACE evaluation, called stcm (SNP Training for clinical mastitis) evaluating the trait cma (pure clinical mastitis). New trait group codes have been issued as follows: 041 for international ebv files (.itb), 071 for parent average (ipr).

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 ROUTINE RUN

Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honor the agreed code of practice, decided by the Interbull Steering Committee,

and only publish international evaluations on their own country scale.
 Evaluations expressed on another country scale are confidential and may only
 be used internally for research and review purposes.

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 dairy production traits (December Routine Evaluation 2024).
 Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	235	153	9080	1930	874	
BEL			2396			
CAN	291	112	14286	934	898	
CHE	3291		3493	107		3747
CZE			5341			
DEA	6536					27139
DEU			24865	303	314	
DFS			14649	2404	8129	
ESP			4789			
EST			1475		506	
FRA	509		18849			508
FRM						5265
GBR	207	385	8420	1042	754	122
HUN			3296			
IRL			3457	163	62	105
ISR			1816			
ITA	2438		9273	173		2101
JPN			7144			
KOR			1909			
LTU			897		374	
LVA			1568		727	
NLD	254		17347	287	107	540
NOR					4409	
NZL	93	64	9529	5800	1590	
POL			13207			
PRT			3183			
SVK			1219			
SVN	353		729			722
URY			1217			
USA	1252	837	43379	5607	834	118
ZAF			1317	755	144	
HRV			987			1072
CAM					50	
No.Records	15459	1551	229117	19505	19772	41439
Pub. Proofs	12205	1222	162460	15348	17349	37138

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

BSW	mil										
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	653.53										
FRA	0.90	648.49									
USA	0.91	0.89	651.63								
CHE	0.89	0.90	0.85	493.29							
ITA	0.87	0.83	0.86	0.87	618.32						
DEA	0.82	0.85	0.82	0.94	0.89	466.77					

NLD	0.88	0.86	0.85	0.85	0.85	0.87	673.25					
SVN	0.69	0.74	0.70	0.70	0.63	0.71	0.67	10.52				
NZL	0.67	0.76	0.71	0.73	0.68	0.72	0.70	0.65	468.34			
GBR	0.84	0.86	0.82	0.84	0.77	0.76	0.83	0.68	0.72	282.93		
AUS	0.73	0.76	0.71	0.69	0.64	0.63	0.70	0.65	0.83	0.69	370.44	

BSW	fat											
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS	
CAN	27.12											
FRA	0.88	27.26										
USA	0.89	0.90	23.95									
CHE	0.85	0.89	0.82	19.42								
ITA	0.87	0.86	0.85	0.87	23.40							
DEA	0.80	0.87	0.82	0.94	0.87	17.35						
NLD	0.86	0.84	0.82	0.82	0.83	0.85	25.46					
SVN	0.77	0.79	0.73	0.72	0.70	0.77	0.67	10.72				
NZL	0.71	0.78	0.74	0.78	0.69	0.77	0.67	0.67	23.16			
GBR	0.83	0.86	0.82	0.83	0.77	0.76	0.83	0.68	0.72	9.78		
AUS	0.73	0.71	0.75	0.63	0.65	0.65	0.67	0.62	0.79	0.66	15.50	

BSW	pro											
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS	
CAN	23.34											
FRA	0.85	21.26										
USA	0.88	0.86	19.95									
CHE	0.83	0.86	0.81	15.72								
ITA	0.82	0.81	0.82	0.84	21.65							
DEA	0.77	0.81	0.79	0.93	0.86	14.57						
NLD	0.84	0.82	0.81	0.81	0.80	0.84	21.89					
SVN	0.67	0.72	0.68	0.64	0.64	0.68	0.64	10.15				
NZL	0.61	0.70	0.65	0.68	0.64	0.66	0.61	0.63	16.37			
GBR	0.83	0.82	0.79	0.80	0.74	0.70	0.81	0.65	0.65	8.12		
AUS	0.68	0.67	0.67	0.59	0.57	0.56	0.61	0.57	0.78	0.63	11.89	

GUE	mil					
	CAN	USA	AUS	GBR	NZL	
CAN	805.47					
USA	0.92	799.31				
AUS	0.76	0.72	475.57			
GBR	0.86	0.81	0.71	266.70		
NZL	0.71	0.68	0.83	0.71	377.73	

GUE	fat					
	CAN	USA	AUS	GBR	NZL	
CAN	30.71					
USA	0.92	27.31				
AUS	0.76	0.74	17.36			
GBR	0.86	0.81	0.71	10.28		
NZL	0.71	0.73	0.81	0.72	18.41	

GUE	pro					
	CAN	USA	AUS	GBR	NZL	
CAN	24.00					
USA	0.90	21.65				
AUS	0.66	0.62	13.69			
GBR	0.84	0.78	0.65	7.69		
NZL	0.62	0.59	0.79	0.63	12.56	

HOL	mil																													
	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	
CAN	799.60																													
DEU	0.94	645.59																												
DFS	0.92	0.93	11.14																											
FRA	0.91	0.92	0.90	620.34																										
ITA	0.89	0.88	0.87	0.88	601.12																									
NLD	0.92	0.94	0.91	0.89	0.87	665.08																								
USA	0.92	0.91	0.89	0.90	0.89	0.89	712.35																							
CHE	0.90	0.92	0.88	0.93	0.87	0.90	0.88	572.41																						
GBR	0.85	0.84	0.82	0.85	0.81	0.85	0.83	0.88	275.73																					
NZL	0.70	0.69	0.69	0.76	0.67	0.71	0.70	0.75	0.71	393.51																				
AUS	0.77	0.74	0.71	0.78	0.70	0.74	0.74	0.77	0.73	0.82	422.99																			
BEL	0.87	0.87	0.81	0.82	0.78	0.84	0.81	0.82	0.76	0.67	0.77	503.09																		
IRL	0.83	0.84	0.82	0.89	0.79	0.85	0.81	0.87	0.81	0.82	0.81	0.78	181.91																	
ESP	0.93	0.92	0.89	0.92	0.90	0.90	0.91	0.89	0.82	0.67	0.76	0.86	0.82	530.82																
CZE	0.87	0.88	0.83	0.80	0.81	0.82	0.84	0.77	0.73	0.64	0.71	0.84	0.72	0.84	712.14															
SVN	0.81	0.83	0.82	0.83	0.74	0.79	0.79	0.75	0.69	0.60	0.67	0.75	0.66	0.81	0.76	11.95														
EST	0.87	0.87	0.89	0.84	0.83	0.84	0.87	0.85	0.78	0.67	0.72	0.79	0.74	0.83	0.82	0.72	578.85													
ISR	0.81	0.82	0.83	0.81	0.83	0.80	0.85	0.81	0.79	0.64	0.65	0.79	0.69	0.82	0.79	0.78	0.79	403.03												
HUN	0.86	0.87	0.85	0.87	0.87	0.83	0.89	0.82	0.78	0.65	0.68	0.77	0.74	0.86	0.88	0.78	0.84	0.81	656.23											
POL	0.89	0.90	0.87	0.90	0.86	0.88	0.88	0.86	0.81	0.67	0.76	0.83	0.81	0.90	0.87	0.80	0.85	0.80	0.87	414.92										
ZAF	0.83	0.78	0.77	0.82	0.80	0.75	0.82	0.78	0.74	0.66	0.76	0.74	0.75	0.81	0.78	0.67	0.72	0.79	0.81	538.98										
JPN	0.93	0.91	0.91	0.91	0.90	0.90	0.91	0.89	0.82	0.68	0.76	0.84	0.82	0.91	0.84	0.86	0.84	0.84	0.86	0.89	0.83	622.78								
LVA	0.74	0.75	0.71	0.76	0.69	0.70	0.75	0.74	0.69	0.63	0.64	0.68	0.72	0.72	0.66	0.65	0.75	0.78	0.75	0.74	0.71	0.72	511.57							
SVK	0.77	0.79	0.79	0.79	0.75	0.71	0.78	0.75	0.72	0.62	0.64	0.76	0.69	0.79	0.80	0.74	0.78	0.78	0.84	0.80	0.70	0.79	0.67	383.75						
LTU	0.74	0.73	0.71	0.75	0.66	0.67	0.70	0.71	0.66	0.60	0.63	0.70	0.65	0.72	0.69	0.77	0.64	0.78	0.70	0.70	0.63	0.73	0.69	0.72	398.22					
PRT	0.76	0.76	0.77	0.78	0.74	0.75	0.77	0.76	0.69	0.60	0.60	0.66	0.71	0.77	0.65	0.73	0.67	0.79	0.74	0.74	0.61	0.75	0.66	0.68	0.61	592.49				
KOR	0.85	0.80	0.80	0.80	0.79	0.77	0.85	0.78	0.71	0.70	0.74	0.82	0.73	0.84	0.80	0.76	0.77	0.79	0.78	0.78	0.78	0.86	0.73	0.76	0.68	0.61	484.51			
URY	0.71	0.69	0.67	0.75	0.68	0.69	0.70	0.71	0.64	0.76	0.73	0.70	0.71	0.70	0.67	0.64	0.67	0.78	0.69	0.72	0.73	0.67	0.70	0.62	0.67	0.61	0.70	166.63		
HRV	0.63	0.65	0.66	0.65	0.62	0.67	0.62	0.62	0.62	0.59	0.59	0.66	0.59	0.65	0.61	0.62	0.64	0.78	0.65	0.64	0.70	0.66	0.62	0.64	0.61	0.61	0.63	0.62	11.18	

HOL	fat																														
	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV		
CAN	32.02																														
DEU	0.93	24.13																													
DFS	0.91	0.91	10.89																												
FRA	0.91	0.92	0.90	25.18																											
ITA	0.87	0.88	0.85	0.90	25.75																										
NLD	0.90	0.93	0.90	0.88	0.84	25.35																									
USA	0.92	0.92	0.87	0.91	0.90	0.87	26.56																								
CHE	0.87	0.90	0.86	0.91	0.84	0.88	0.85	22.72																							
GBR	0.85	0.87	0.83	0.87	0.83	0.86	0.85	0.87	9.48																						
NZL	0.67	0.68	0.68	0.75	0.66	0.67	0.72	0.74	0.71	15.56																					
AUS	0.73	0.72	0.67	0.75	0.70	0.69	0.74	0.70	0.71	0.79	14.85																				
BEL	0.86	0.86	0.81	0.84	0.79	0.83	0.81	0.80	0.79	0.68	0.75	20.29																			
IRL	0.81	0.80	0.82	0.84	0.73	0.82	0.79	0.83	0.77	0.79	0.78	0.81	6.78																		
ESP	0.90	0.90	0.85	0.91	0.89	0.87	0.91	0.85	0.82	0.64	0.73	0.82	0.78	21.07																	
CZE	0.83	0.85	0.81	0.79	0.80	0.77	0.83	0.71	0.73	0.56	0.66	0.80	0.66	0.82	22.42																
SVN	0.79	0.79	0.79	0.77	0.74	0.77	0.74	0.73	0.69	0.62	0.60	0.79	0.65	0.72	0.72	12.37															
EST	0.88	0.89	0.88	0.86	0.85	0.86	0.87	0.86	0.78	0.71	0.75	0.85	0.79	0.83	0.82	0.79	23.50														
ISR	0.76	0.80	0.72	0.76	0.79	0.75	0.83	0.75	0.70	0.63	0.60	0.63	0.60	0.76	0.71	0.62	0.77	15.03													
HUN	0.85	0.86	0.80	0.86	0.88	0.79	0.90	0.76	0.77	0.63	0.69	0.78	0.67	0.87	0.86	0.73	0.82	0.75	24.69												
POL	0.87	0.89	0.83	0.87	0.86	0.83	0.88	0.80	0.79	0.66	0.70	0.83	0.73	0.88	0.83	0.76	0.88	0.77	0.87	17.45											
ZAF	0.71	0.69	0.60	0.73	0.71	0.66	0.74	0.69	0.67	0.57	0.64	0.64	0.64	0.74	0.69	0.62	0.72	0.70	0.73	0.73	19.25										
JPN	0.92	0.91	0.91	0.90	0.87	0.89	0.89	0.87	0.83	0.68	0.69	0.84	0.80	0.87	0.79	0.85	0.85	0.74	0.81	0.84	0.66	23.99									
LVA	0.78	0.79	0.73	0.80	0.77	0.73	0.79	0.75	0.70	0.67	0.69	0.79	0.64	0.79	0.73	0.68	0.83	0.75	0.80	0.80	0.66	0.73	0.75	20.22							
SVK	0.73	0.74	0.71	0.74	0.78	0.66	0.77	0.68	0.68	0.57	0.61	0.73	0.59	0.75	0.78	0.72	0.80	0.67	0.82	0.80	0.63	0.72	0.72	15.40							
LTU	0.69	0.71	0.66	0.71	0.66	0.62	0.70	0.68	0.64	0.57	0.57	0.70	0.57	0.67	0.64	0.75	0.66	0.65	0.67	0.69	0.63	0.67	0.78	0.69	17.82						
PRT	0.73	0.75	0.71	0.77	0.75	0.71	0.77	0.73	0.72	0.60	0.59	0.63	0.63	0.76	0.62	0.66	0.68	0.61	0.73	0.74	0.60	0.73	0.69	0.60	0.60	23.94					
KOR	0.84	0.81	0.78	0.82	0.80	0.77	0.86	0.79	0.76	0.72	0.74	0.84	0.71	0.83	0.77	0.75	0.80	0.74	0.81	0.82	0.69	0.85	0.77	0.72	0.68	0.65	19.96				
URY	0.74	0.72	0.69	0.78	0.70	0.68	0.74	0.70	0.69	0.73	0.70	0.70	0.70	0.71	0.																

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV
CAN	22.47																												
DEU	0.91	17.84																											
DFS	0.90	0.92	10.49																										
FRA	0.87	0.89	0.89	16.97																									
ITA	0.85	0.85	0.85	0.84	18.55																								
NLD	0.88	0.92	0.88	0.84	0.82	19.00																							
USA	0.90	0.90	0.87	0.88	0.86	0.85	18.52																						
CHE	0.85	0.89	0.84	0.91	0.83	0.85	0.84	16.38																					
GBR	0.84	0.84	0.81	0.83	0.80	0.84	0.82	0.86	7.36																				
NZL	0.60	0.59	0.61	0.68	0.57	0.62	0.62	0.65	0.63	11.65																			
AUS	0.66	0.63	0.63	0.68	0.59	0.64	0.65	0.65	0.65	0.78	10.91																		
BEL	0.81	0.82	0.76	0.75	0.72	0.78	0.76	0.74	0.75	0.58	0.68	14.73																	
IRL	0.75	0.75	0.76	0.81	0.71	0.77	0.75	0.80	0.75	0.76	0.75	0.71	5.44																
ESP	0.90	0.89	0.87	0.88	0.86	0.85	0.89	0.84	0.81	0.57	0.67	0.79	0.76	15.20															
CZE	0.78	0.80	0.76	0.69	0.71	0.72	0.76	0.64	0.66	0.47	0.54	0.76	0.56	0.75	17.18														
SVN	0.76	0.79	0.77	0.79	0.71	0.74	0.74	0.69	0.64	0.51	0.57	0.70	0.60	0.78	0.67	11.39													
EST	0.81	0.84	0.82	0.79	0.77	0.80	0.82	0.83	0.74	0.58	0.61	0.75	0.62	0.75	0.73	0.64	17.59												
ISR	0.77	0.78	0.78	0.79	0.79	0.76	0.82	0.80	0.73	0.51	0.51	0.59	0.59	0.78	0.63	0.68	0.72	10.42											
HUN	0.82	0.85	0.81	0.84	0.83	0.78	0.87	0.77	0.74	0.56	0.54	0.70	0.63	0.82	0.79	0.70	0.78	0.77	18.93										
POL	0.85	0.86	0.84	0.84	0.80	0.81	0.84	0.80	0.76	0.56	0.62	0.77	0.72	0.85	0.78	0.75	0.81	0.73	0.83	11.39									
ZAF	0.77	0.71	0.69	0.75	0.69	0.68	0.75	0.71	0.71	0.61	0.70	0.66	0.67	0.73	0.66	0.60	0.66	0.76	0.73	0.75	14.78								
JPN	0.90	0.88	0.90	0.87	0.88	0.86	0.89	0.85	0.81	0.59	0.65	0.77	0.74	0.89	0.74	0.83	0.79	0.79	0.82	0.83	0.74	16.97							
LVA	0.73	0.73	0.68	0.73	0.67	0.67	0.73	0.71	0.67	0.59	0.57	0.69	0.62	0.71	0.61	0.61	0.74	0.69	0.72	0.73	0.68	0.70	14.66						
SVK	0.74	0.74	0.74	0.75	0.73	0.65	0.73	0.70	0.67	0.52	0.55	0.71	0.58	0.74	0.75	0.68	0.71	0.73	0.81	0.74	0.66	0.75	0.67	10.63					
LTU	0.66	0.66	0.63	0.71	0.61	0.59	0.62	0.65	0.59	0.50	0.49	0.65	0.50	0.65	0.59	0.74	0.60	0.67	0.64	0.62	0.61	0.65	0.70	0.67	11.87				
PRT	0.71	0.72	0.73	0.74	0.70	0.69	0.72	0.70	0.66	0.52	0.51	0.58	0.65	0.73	0.57	0.70	0.61	0.68	0.71	0.69	0.58	0.71	0.66	0.61	0.58	17.95			
KOR	0.82	0.75	0.76	0.75	0.76	0.73	0.82	0.75	0.67	0.60	0.63	0.80	0.63	0.81	0.72	0.71	0.72	0.73	0.75	0.75	0.68	0.81	0.67	0.71	0.62	0.63	13.49		
URY	0.63	0.63	0.62	0.73	0.60	0.60	0.63	0.64	0.58	0.71	0.66	0.59	0.64	0.64	0.58	0.61	0.60	0.61	0.61	0.63	0.67	0.58	0.70	0.59	0.62	0.58	0.60	5.16	
HRV	0.61	0.65	0.60	0.65	0.59	0.63	0.61	0.59	0.59	0.49	0.48	0.67	0.48	0.63	0.59	0.59	0.60	0.61	0.66	0.62	0.63	0.64	0.59	0.60	0.59	0.58	0.61	0.60	11.07

JER mil

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	603.04											
DFS	0.91	9.09										
USA	0.91	0.89	685.96									
NZL	0.74	0.75	0.74	307.56								
AUS	0.79	0.71	0.74	0.81	386.72							
GBR	0.83	0.80	0.77	0.67	0.71	220.98						
NLD	0.91	0.90	0.88	0.71	0.74	0.79	590.32					
ZAF	0.87	0.83	0.84	0.76	0.80	0.73	0.76	366.95				
ITA	0.89	0.87	0.89	0.75	0.79	0.80	0.85	0.88	544.46			
DEU	0.91	0.93	0.90	0.68	0.69	0.82	0.93	0.79	0.86	609.69		
IRL	0.80	0.80	0.78	0.90	0.82	0.71	0.81	0.76	0.78	0.80	173.72	
CHE	0.87	0.88	0.82	0.73	0.75	0.84	0.88	0.78	0.83	0.91	0.82	385.90

JER fat

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	27.26											
DFS	0.87	11.00										
USA	0.90	0.87	25.36									
NZL	0.68	0.69	0.71	14.38								
AUS	0.77	0.69	0.75	0.79	13.92							
GBR	0.81	0.77	0.79	0.67	0.71	9.14						
NLD	0.85	0.85	0.83	0.67	0.67	0.77	24.82					
ZAF	0.75	0.74	0.74	0.63	0.69	0.64	0.66	14.43				
ITA	0.87	0.83	0.86	0.68	0.72	0.75	0.79	0.76	25.87			
DEU	0.92	0.91	0.89	0.67	0.72	0.84	0.90	0.74	0.87	23.95		
IRL	0.77	0.76	0.74	0.82	0.79	0.73	0.78	0.61	0.69	0.76	6.06	
CHE	0.85	0.82	0.80	0.74	0.70	0.79	0.79	0.69	0.81	0.89	0.77	18.71

JER pro

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	19.52											
DFS	0.87	10.38										
USA	0.89	0.88	19.37									
NZL	0.63	0.67	0.67	10.21								
AUS	0.69	0.64	0.66	0.76	10.57							
GBR	0.82	0.80	0.76	0.66	0.67	7.04						
NLD	0.86	0.86	0.84	0.64	0.65	0.77	19.36					
ZAF	0.80	0.77	0.77	0.67	0.69	0.69	0.69	11.38				
ITA	0.85	0.83	0.86	0.62	0.67	0.77	0.81	0.84	19.52			
DEU	0.89	0.93	0.88	0.62	0.62	0.82	0.91	0.72	0.83	19.30		
IRL	0.73	0.76	0.72	0.84	0.77	0.72	0.76	0.67	0.70	0.74	5.50	
CHE	0.79	0.82	0.74	0.65	0.59	0.77	0.81	0.64	0.73	0.88	0.76	13.09

RDC mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	614.43														
NOR	0.85	12.65													
USA	0.91	0.89	733.05												
NZL	0.67	0.70	0.68	370.81											
AUS	0.73	0.69	0.71	0.82	418.52										
GBR	0.82	0.79	0.80	0.68	0.75	260.69									
DFS	0.89	0.91	0.87	0.69	0.70	0.79	10.06								
DEU	0.93	0.84	0.90	0.69	0.70	0.84	0.92	660.83							
ZAF	0.82	0.78	0.82	0.72	0.77	0.70	0.78	0.78	619.02						
EST	0.85	0.82	0.84	0.68	0.70	0.77	0.84	0.80	0.72	528.42					
LVA	0.74	0.75	0.75	0.64	0.66	0.71	0.73	0.74	0.71	0.78	332.25				
LTU	0.74	0.74	0.71	0.64	0.62	0.72	0.63	0.74	0.68	0.65	0.75	368.25			
IRL	0.82	0.76	0.80	0.84	0.82	0.78	0.80	0.83	0.75	0.74	0.72	0.72	179.12		
NLD	0.91	0.91	0.87	0.69	0.72	0.83	0.91	0.93	0.75	0.82	0.72	0.69	0.83	772.42	
CAM	0.80	0.81	0.92	0.68	0.73	0.78	0.77	0.79	0.79	0.78	0.78	0.76	0.77	0.77	426.65

RDC fat

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.55														
NOR	0.84	12.14													
USA	0.90	0.81	25.93												
NZL	0.65	0.72	0.69	15.78											
AUS	0.69	0.61	0.74	0.81	15.59										
GBR	0.82	0.72	0.82	0.68	0.72	8.66									
DFS	0.89	0.89	0.86	0.70	0.68	0.79	10.68								
DEU	0.92	0.84	0.91	0.68	0.69	0.87	0.91	26.88							
ZAF	0.75	0.78	0.80	0.62	0.65	0.65	0.71	0.69	20.72						
EST	0.86	0.67	0.87	0.64	0.71	0.78	0.81	0.85	0.73	20.94					
LVA	0.75	0.66	0.77	0.65	0.63	0.70	0.68	0.78	0.73	0.81	14.77				
LTU	0.70	0.73	0.73	0.63	0.66	0.69	0.65	0.73	0.69	0.72	0.80	16.96			
IRL	0.80	0.72	0.79	0.82	0.80	0.76	0.80	0.79	0.65	0.78	0.66	0.67	7.33		
NLD	0.89	0.86	0.86	0.66	0.69	0.84	0.90	0.93	0.67	0.81	0.73	0.67	0.81	29.29	
CAM	0.80	0.79	0.93	0.65	0.69	0.79	0.80	0.79	0.80	0.80	0.78	0.78	0.76	0.79	21.93

RDC pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.60														
NOR	0.83	12.12													
USA	0.89	0.87	20.63												
NZL	0.58	0.66	0.63	11.41											
AUS	0.62	0.65	0.65	0.65	0.77										
GBR	0.79	0.77	0.79	0.59	0.66	7.03									
DFS	0.88	0.88	0.85	0.64	0.61	0.75	10.57								
DEU	0.90	0.82	0.88	0.60	0.61	0.83	0.92	20.27							
ZAF	0.76	0.77	0.77	0.66	0.73	0.65	0.70	0.71	17.57						
EST	0.80	0.71	0.79	0.56	0.58	0.73	0.77	0.80	0.67	16.55					
LVA	0.71	0.67	0.73	0.57	0.55	0.68	0.64	0.72	0.70	0.69	9.89				

LTU	0.66	0.64	0.64	0.55	0.51	0.67	0.59	0.66	0.67	0.63	0.71	10.80					
IRL	0.74	0.74	0.75	0.79	0.77	0.74	0.74	0.74	0.68	0.63	0.64	0.61	5.37				
NLD	0.87	0.90	0.84	0.60	0.62	0.81	0.88	0.92	0.68	0.75	0.68	0.62	0.75	25.92			
CAM	0.79	0.78	0.89	0.68	0.69	0.77	0.78	0.78	0.79	0.77	0.76	0.75	0.73	0.77	10.21		

SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	565.68										
DEA	0.87	505.68									
FRM	0.95	0.86	620.87								
ITA	0.77	0.68	0.66	512.36							
SVN	0.75	0.76	0.76	0.71	9.18						
FRA	0.90	0.93	0.83	0.80	0.78	738.44					
NLD	0.88	0.92	0.89	0.75	0.77	0.88	761.49				
IRL	0.84	0.74	0.84	0.67	0.71	0.87	0.79	182.28			
GBR	0.86	0.85	0.85	0.76	0.69	0.85	0.84	0.77	229.57		
HRV	0.64	0.62	0.76	0.61	0.61	0.62	0.62	0.64	0.61	10.52	
USA	0.87	0.82	0.83	0.87	0.78	0.90	0.88	0.80	0.82	0.64	627.04

SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	22.55										
DEA	0.87	19.00									
FRM	0.94	0.89	24.17								
ITA	0.77	0.75	0.68	19.80							
SVN	0.73	0.81	0.76	0.73	9.20						
FRA	0.89	0.94	0.84	0.81	0.77	29.88					
NLD	0.86	0.91	0.89	0.72	0.78	0.88	28.76				
IRL	0.80	0.72	0.79	0.63	0.70	0.83	0.77	7.54			
GBR	0.89	0.84	0.85	0.79	0.69	0.87	0.85	0.75	7.94		
HRV	0.64	0.59	0.75	0.60	0.60	0.61	0.61	0.65	0.63	10.54	
USA	0.85	0.84	0.83	0.87	0.74	0.91	0.87	0.77	0.84	0.68	20.97

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	16.93										
DEA	0.85	15.46									
FRM	0.94	0.85	19.97								
ITA	0.69	0.64	0.64	16.03							
SVN	0.71	0.71	0.74	0.66	9.16						
FRA	0.88	0.91	0.78	0.76	0.71	24.38					
NLD	0.83	0.90	0.86	0.69	0.73	0.83	24.02				
IRL	0.77	0.74	0.78	0.57	0.67	0.80	0.73	6.35			
GBR	0.83	0.83	0.81	0.74	0.65	0.83	0.83	0.71	7.23		
HRV	0.62	0.57	0.75	0.58	0.59	0.59	0.59	0.57	0.60	10.69	
USA	0.82	0.76	0.75	0.83	0.74	0.87	0.84	0.72	0.80	0.62	17.93

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	100	202	158	155	172	62	37	39	78	107
FRA	91	0	138	197	238	263	102	53	38	77	81
USA	198	103	0	338	266	365	101	44	50	111	137
CHE	135	159	316	0	542	679	125	85	45	90	130
ITA	137	202	193	484	0	850	157	107	54	99	137
DEA	151	217	333	570	749	0	183	114	64	98	145
NLD	57	87	93	115	133	173	0	52	40	50	72

SVN	33	51	34	80	101	104	52	0	15	23	29
NZL	38	28	43	34	44	59	33	13	0	31	43
GBR	74	62	104	68	72	65	40	17	26	0	70
AUS	110	65	129	90	102	107	55	21	35	61	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	100	202	158	155	172	62	37	39	78	107
FRA	91	0	138	197	238	263	102	53	38	77	81
USA	198	103	0	338	266	365	101	44	50	111	137
CHE	135	159	316	0	542	680	125	85	45	90	130
ITA	137	202	193	484	0	851	157	107	54	99	137
DEA	151	217	333	570	750	0	183	114	64	98	145
NLD	57	87	93	115	133	173	0	52	40	50	72
SVN	33	51	34	80	101	104	52	0	15	23	29
NZL	38	28	43	34	44	59	33	13	0	31	43
GBR	74	62	104	68	72	65	40	17	26	0	70
AUS	110	65	129	90	102	107	55	21	35	61	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	100	202	158	155	172	62	37	39	78	107
FRA	91	0	138	197	238	263	102	53	38	77	81
USA	198	103	0	338	266	365	101	44	50	111	137
CHE	135	159	316	0	542	680	125	85	45	90	130
ITA	137	202	193	484	0	851	157	107	54	99	137
DEA	151	217	333	570	750	0	183	114	64	98	145
NLD	57	87	93	115	133	173	0	52	40	50	72
SVN	33	51	34	80	101	104	52	0	15	23	29
NZL	38	28	43	34	44	59	33	13	0	31	43
GBR	74	62	104	68	72	65	40	17	26	0	70
AUS	110	65	129	90	102	107	55	21	35	61	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	80	58	41	14
USA	72	0	75	104	32
AUS	55	72	0	49	27
GBR	35	105	42	0	16
NZL	11	29	27	14	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	80	58	41	14
USA	72	0	75	104	32
AUS	55	72	0	49	27
GBR	35	105	42	0	16
NZL	11	29	27	14	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	80	58	41	14
USA	72	0	75	104	32
AUS	55	72	0	49	27
GBR	35	105	42	0	16
NZL	11	29	27	14	0

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV
CAN	0	2788	1845	1759	2008	1938	4266	995	2031	921	1710	957	656	1535	1403	243	363	183	1217	1920	516	1523	605	480	301	1362	894	547	355
DEU	2269	0	3126	2819	2776	3881	4006	1266	2401	1150	1876	1419	960	1778	2199	394	566	205	1446	3255	561	1555	958	737	552	1553	776	522	730
DFS	1671	2446	0	1974	1739	2586	2578	828	1839	1000	1507	1040	822	1267	1561	291	434	186	1084	2119	516	1120	588	451	360	1213	636	460	493
FRA	1328	1784	1273	0	1701	2362	2791	813	1778	937	1466	1139	806	1433	1523	239	331	154	1068	2182	515	1327	534	484	289	1195	660	458	391
ITA	1795	2083	1478	1125	0	1910	2899	771	1660	687	1204	853	576	1385	1387	289	363	172	1176	2182	366	1175	604	401	332	1188	694	410	418
NLD	1910	3724	2339	1706	1701	0	3007	1028	2101	1281	1676	1488	992	1364	1860	305	494	199	1139	2457	525	1220	661	590	367	1353	638	477	524
USA	4893	3130	2137	1674	2429	2738	0	1123	2687	1310	2273	1129	912	1814	2061	278	475	293	1565	2897	648	2170	811	601	403	1713	1089	757	454
CHE	921	1201	781	758	704	1027	1054	0	817	479	709	682	446	633	594	150	210	73	473	803	259	517	333	252	146	605	331	229	224
GBR	2299	1895	1463	1244	1369	1902	2521	780	0	1111	1650	1008	1092	1237	1302	233	353	185	998	1773	520	1166	521	412	329	1174	626	501	390
NZL	909	903	735	621	541	1172	1266	405	972	0	1379	605	830	632	763	143	185	138	553	842	378	641	302	281	196	694	384	420	259
AUS	1753	1459	1144	1057	964	1489	2349	630	1458	1385	0	856	799	1026	1013	189	278	142	828	1318	488	1006	463	339	266	991	569	489	339
BEL	960	1473	985	1178	858	1709	1019	700	1002	496	760	0	567	783	811	186	245	100	613	999	343	618	357	324	189	811	378	275	312
IRL	611	836	677	680	495	933	830	451	1118	722	691	555	0	554	611	120	161	125	468	711	332	474	245	222	156	558	282	301	207
ESP	1079	1199	1007	1202	1021	1235	1271	527	979	484	749	771	518	0	1049	216	262	130	894	1405	455	1007	437	352	243	1039	602	391	332
CZE	1103	1803	1102	1072	1074	1717	1733	456	963	572	699	665	481	792	0	245	365	166	1094	1742	440	988	531	563	306	1025	598	440	437
SVN	188	386	236	181	252	266	226	106	172	98	130	146	89	153	178	0	107	53	186	329	74	178	139	83	73	197	126	68	129
EST	246	428	300	184	229	366	353	126	218	95	150	158	84	128	233	65	0	67	260	477	114	245	235	140	105	260	159	129	153
ISR	130	156	137	94	118	155	288	43	139	111	92	63	98	77	132	36	38	0	133	204	68	137	91	59	56	132	84	82	78
HUN	1165	1189	910	796	1056	978	1565	391	857	412	623	531	393	723	1013	141	160	92	0	1244	380	792	411	348	252	894	550	386	303
POL	1780	3097	1833	1653	1923	2370	2982	704	1598	656	1047	939	591	1074	1520	294	357	159	1161	0	427	1177	792	513	418	1356	739	478	569
ZAF	479	438	396	409	285	447	635	221	456	312	430	294	298	408	313	53	57	43	303	324	0	432	176	184	108	456	279	281	162
JPN	832	741	642	537	626	686	1040	349	619	345	572	412	303	502	477	96	95	63	445	670	283	0	413	330	231	840	668	420	264
LVA	378	803	380	293	385	455	698	186	307	171	239	216	143	237	362	84	141	58	303	652	101	181	0	207	207	502	285	212	298
SVK	336	552	243	271	244	422	408	129	239	168	169	196	108	180	486	39	59	25	241	371	101	120	105	0	106	364	230	194	159
LTU	172	514	214	122	176	225	283	59	180	92	121	93	74	98	199	32	48	25	158	325	41	75	134	48	0	251	164	135	166
PRT	1426	1470	1130	1091	1141	1369	1843	550	1077	570	836	826	499	1013	873	155	173	85	893	1379	410	513	391	247	158	0	596	434	372
KOR	867	552	476	420	571	474	1241	236	464	280	419	283	198	441	436	77	79	44	437	623	209	412	175	138	72	510	0	331	173
URY	545	398	338	316	317	384	944	182	429	345	389	214	249	318	345	41	76	45	328	415	242	263	125	123	79	394	267	0	155
HRV	219	755	396	288	313	476	352	149	279	156	216	251	143	247	339	104	110	55	225	523	109	123	233	79	114	310	83	102	0

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV
CAN	0	2788	1844	1759	2016	1938	4263	995	2031	921	1710	957	656	1534	1403	244	363	183	1217	1920	515	1519	605	480	301	1362	894	547	354
DEU	2269	0	3126	2819	2786	3881	4002	1266	2400	1150	1876	1419	960	1778	2199	395	566	205	1446	3255	560	1551	958	737	552	1553	776	522	729
DFS	1671	2446	0	1974	1744	2586	2575	828	1839	1000	1507	1040	822	1267	1560	292	434	186	1083	2118	515	1118	588	451	360	1213	636	460	492
FRA	1328	1784	1273	0	1707	2362	2790	813	1778	937	1466	1139	807	1433	1523	240	331	154	1068	2182	514	1324	534	484	289	1195	660	458	390
ITA	1803	2093	1484	1130	0	1919	2908	775	1668	690	1211	857	580	1390	1395	291	364	173	1181	2189	368	1176	607	403	332	1194	697	411	419
NLD	1910	3724	2339	1706	1711	0	3004	1028	2101	1281	1676	1488	994	1364	1860	306	494	199	1139	2457	524	1216	661	590	367	1353	638	477	523
USA	4891	3126	2132	1673	2440	2736	0	1123	2685	1309	2272	1128	911	1812	2060	279	474	293	1564	2896	647	2166	810	601	403	1711	1089	757	452
CHE	921	1201	781	758	708	1027	1054	0	817	479	709	682	446	633	594	151	210	73	473	803	258	514	333	252	146	605	331	229	223
GBR	2299	1895	1463	1244	1378	1902	2519	780	0	1111	1650	1008	1093	1237	1302	234	353	185	998	1773	519	1162	521	412	329	1174	626	501	390
NZL	909	903	735	621	543	1172	1265	405	972	0	1379	605	830	632	763	144	185	138	553	842	377	641	302	281	196	694	384	420	258
AUS	1753	1459	1144	1057	969	1489	2348	630	1458	1385	0	856	799	1026	1013	190	278	142	828	1318	487	1003	463	339	266	991	569	489	339
BEL	960	1473	985	1178	861	1709	1018	700	1002	496	760	0	567	783	811	187	245	100	613	999	342	617	357	324	189	811	378	275	311
IRL	611	836	677	680	498	935	830	451	1119	722	691	555	0	553	611	121	161	125	468	712	332	472	245	222	156	558	282	301	206
ESP	1079	1199	1006	1202	1026	1235	1268	527	979	484	749	771	518	0	1048	217	262	130	893	1404	454	1005	437	352	243	1039	602	391	332
CZE	1103	1803	1102	1072	1083	1717	1732	456	963	572	699	665	481	792	0	246	365	166	1094	1742	439	986	531	563	306	1025	598	440	436
SVN	188	386	236	181	253	266	226	106	172	98	130	146	89	153	178	0	107	53	186	330	74	178	140	84	74	198	126	69	130
EST	246	428	300	184	229	366	352	1																					

POL	1780	3097	1833	1653	1932	2370	2979	704	1598	656	1047	939	591	1074	1520	294	357	159	1161	0	426	1172	792	513	418	1356	739	478	568
ZAF	478	437	395	408	287	446	634	220	455	312	429	294	298	407	312	52	57	43	302	323	0	430	175	183	107	455	278	280	161
JPN	827	737	640	533	625	682	1033	346	614	344	567	410	301	499	475	96	92	62	443	664	282	0	412	329	231	836	667	419	264
LVA	378	803	380	293	388	455	697	186	307	171	239	216	143	237	362	84	141	58	303	652	101	180	0	207	207	502	285	212	298
SVK	336	552	243	271	245	422	408	129	239	168	169	196	108	180	486	39	59	25	241	371	101	119	105	0	106	364	230	194	159
LTU	172	514	214	122	176	225	283	59	180	92	121	93	74	98	199	32	48	25	158	325	40	75	134	48	0	251	164	135	166
PRT	1426	1470	1130	1090	1149	1369	1842	550	1077	570	836	826	499	1013	873	155	173	85	893	1379	409	509	391	247	158	0	596	434	371
KOR	867	552	476	420	573	474	1239	236	464	280	419	283	198	441	436	77	79	44	437	623	209	410	175	138	72	510	0	331	173
URY	545	398	338	316	317	384	944	182	429	345	389	214	249	318	345	41	76	45	328	415	242	260	125	123	79	394	267	0	155
HRV	217	753	394	286	312	474	349	147	278	155	215	250	141	247	337	103	110	54	224	521	109	123	233	79	113	308	82	102	0

HOL

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV
CAN	0	2788	1844	1759	2009	1938	4257	995	2031	921	1710	957	656	1534	1403	243	363	183	1217	1920	515	1516	605	480	301	1362	894	547	355
DEU	2269	0	3126	2819	2777	3881	4000	1266	2401	1150	1876	1419	960	1778	2199	394	566	205	1446	3255	560	1549	958	737	552	1553	776	522	730
DFS	1671	2446	0	1974	1738	2586	2573	828	1840	1000	1507	1040	821	1266	1560	291	434	186	1083	2118	515	1116	588	451	360	1213	636	460	493
FRA	1328	1784	1273	0	1701	2362	2789	813	1779	937	1466	1139	807	1433	1523	239	331	154	1068	2182	514	1324	534	484	289	1195	660	458	391
ITA	1796	2084	1478	1125	0	1911	2899	772	1661	687	1204	853	576	1384	1387	289	363	172	1176	2182	365	1171	604	401	332	1188	694	410	418
NLD	1910	3723	2339	1706	1701	0	3003	1028	2102	1281	1676	1488	994	1364	1860	305	494	199	1139	2457	524	1214	661	590	367	1353	638	477	524
USA	4888	3126	2132	1673	2428	2736	0	1123	2684	1309	2269	1127	911	1811	2060	278	474	293	1564	2896	647	2161	810	600	403	1711	1090	757	453
CHE	921	1201	781	758	705	1027	1053	0	817	479	709	682	446	633	594	150	210	73	473	803	258	512	333	252	146	605	331	229	224
GBR	2299	1897	1465	1246	1370	1903	2519	780	0	1112	1650	1009	1094	1238	1302	233	353	185	998	1774	519	1161	521	412	329	1175	626	501	391
NZL	909	903	735	621	541	1172	1265	405	972	0	1379	605	830	632	763	143	185	138	553	842	377	640	302	281	196	694	384	420	259
AUS	1753	1459	1144	1057	964	1488	2347	630	1458	1385	0	856	799	1026	1013	189	278	142	828	1318	487	1002	463	339	266	991	569	489	339
BEL	960	1473	985	1178	858	1709	1017	700	1003	496	760	0	567	783	811	186	245	100	613	999	342	617	357	324	189	811	378	275	312
IRL	611	836	677	680	495	935	830	451	1121	722	691	555	0	553	611	120	161	125	468	712	332	472	245	222	156	558	282	301	207
ESP	1079	1199	1006	1202	1021	1235	1268	527	980	484	749	771	518	0	1048	216	262	130	893	1404	454	1004	437	352	243	1039	602	391	332
CZE	1103	1803	1102	1072	1074	1717	1732	456	964	572	699	665	481	792	0	245	365	166	1094	1742	439	986	531	563	306	1025	598	440	437
SVN	188	386	236	181	252	266	226	106	172	98	130	146	89	153	178	0	107	53	186	329	73	178	139	83	73	197	126	68	129
EST	246	428	300	184	229	366	352	126	218	95	150	158	84	128	233	65	0	67	260	477	114	241	235	140	105	260	159	129	153
ISR	130	156	137	94	118	155	288	43	139	111	92	63	98	77	132	36	38	0	133	204	67	136	91	59	56	132	84	82	78
HUN	1165	1189	909	796	1056	978	1563	391	857	412	623	531	393	722	1013	141	160	92	0	1244	379	790	411	348	252	894	550	386	303
POL	1780	3097	1833	1653	1923	2369	2979	704	1600	656	1047	939	591	1074	1520	294	357	159	1161	0	426	1172	792	513	418	1356	739	478	568
ZAF	478	437	395	408	284	446	634	220	455	312	429	294	298	407	312	52	57	43	302	323	0	430	175	183	107	455	278	280	161
JPN	824	736	640	533	623	681	1030	346	615	343	566	410	301	499	475	96	91	62	443	664	282	0	411	329	231	836	667	419	264
LVA	378	803	380	293	385	455	697	186	308	171	239	216	143	237	362	84	141	58	303	652	101	179	0	207	207	502	285	212	298
SVK	336	552	243	271	244	422	407	129	239	168	169	196	108	180	486	39	59	25	241	371	101	119	105	0	106	364	230	194	159
LTU	172	514	214	122	176	225	283	59	181	92	121	93	74	98	199	32	48	25	158	325	40	75	134	48	0	251	164	135	166
PRT	1426	1470	1130	1090	1141	1369	1841	550	1079	570	835	826	499	1013	873	155	173	85	893	1379	409	509	390	247	158	0	596	434	372
KOR	867	552	476	420	571	474	1241	236	464	280	419	283	198	441	436	77	79	44	437	623	209	410	175	138	72	510	0	331	173
URY	545	398	338	316	317	384	944	182	429	345	389	214	249	318	345	41	76	45	328	415	242	260	125	123	79	394	267	0	155
HRV	218	754	395	287	312	475	350	148	280	156	215	251	142	247	338	103	110	54	224	522	109	123	233	79	113	309	82	102	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	157	543	231	306	203	58	170	71	107	9	47
DFS	153	0	254	203	187	216	186	167	110	194	37	63
USA	575	239	0	454	554	290	126	326	101	183	39	79
NZL	239	181	531	0	521	273	112	226	87	120	106	60
AUS	312	160	600	577	0	264	90	260	85	111	53	63
GBR	200	206	313	274	261	0	115	185	105	134	68	78
NLD	52	190	130	107	80	106	0	84	56	134	27	44
ZAF	166	149	340	233	244	186	80	0	91	97	34	59
ITA	67	110	108	86	80	106	56	84	0	61	20	45
DEU	103	193	182	112	102	130	130	94	61	0	21	55
IRL	6	33	40	118	50	71	25	34	19	21	0	18
CHE	41	63	80	51	53	75	37	52	43	51	13	0

JER

common bulls below diagonal

common three quarter sib group above diagonal												
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	157	543	231	306	203	58	170	71	107	9	47
DFS	153	0	254	203	187	216	186	167	110	194	37	63
USA	574	239	0	454	554	289	126	324	101	183	39	79
NZL	239	181	531	0	521	273	112	226	87	120	106	61
AUS	312	160	600	577	0	264	90	260	85	111	53	63
GBR	200	206	312	274	261	0	115	185	105	134	68	78
NLD	52	190	130	107	80	106	0	84	56	134	27	44
ZAF	166	149	338	233	244	186	80	0	91	97	34	59
ITA	67	110	108	86	80	106	56	84	0	61	20	45
DEU	103	193	182	112	102	130	130	94	61	0	21	55
IRL	6	33	40	118	50	71	25	34	19	21	0	18
CHE	41	63	80	51	53	75	37	52	43	51	13	0

JER

common bulls below diagonal												
common three quarter sib group above diagonal												
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	157	543	231	306	203	58	170	71	107	9	47
DFS	153	0	254	203	187	216	186	167	110	194	37	63
USA	574	239	0	454	554	291	126	324	101	183	39	79
NZL	239	181	531	0	521	274	112	226	87	120	106	60
AUS	312	160	600	577	0	265	90	260	85	111	53	63
GBR	201	207	315	276	262	0	115	185	105	134	68	78
NLD	52	190	130	107	80	106	0	84	56	134	27	44
ZAF	166	149	338	233	244	186	80	0	91	97	34	59
ITA	67	110	108	86	80	106	56	84	0	61	20	45
DEU	103	193	182	112	102	130	130	94	61	0	21	55
IRL	6	33	40	118	50	71	25	34	19	21	0	18
CHE	41	63	80	51	53	75	37	52	43	51	13	0

RDC

common bulls below diagonal															
common three quarter sib group above diagonal															
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	8	236	100	110	102	205	14	75	3	10	22	3	7	0
NOR	7	0	89	58	82	85	150	18	0	35	22	25	49	55	0
USA	222	90	0	145	157	142	235	29	64	29	27	41	25	52	32
NZL	101	58	145	0	178	101	218	26	39	26	21	26	11	31	13
AUS	111	71	159	178	0	107	225	49	38	52	41	46	15	49	14
GBR	100	89	134	97	106	0	136	16	43	15	17	29	19	49	0
DFS	212	125	232	213	199	130	0	72	53	154	134	108	15	63	0
DEU	13	17	27	25	48	16	63	0	1	35	37	28	5	21	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	35	28	24	46	13	141	34	0	0	58	22	0	27	0
LVA	10	20	24	18	37	16	93	31	2	50	0	48	3	18	0
LTU	21	22	36	25	43	27	93	27	5	22	43	0	6	16	0
IRL	3	48	25	11	14	18	12	5	2	0	3	6	0	10	0
NLD	7	54	51	30	47	48	60	20	2	26	17	15	10	0	0
CAM	0	0	32	13	14	0	0	0	0	0	0	0	0	0	0

RDC

common bulls below diagonal															
common three quarter sib group above diagonal															
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	8	236	100	110	102	205	14	75	3	10	22	3	7	0
NOR	7	0	88	58	82	85	150	18	0	35	22	25	49	55	0
USA	222	89	0	145	157	141	233	29	64	29	27	41	25	52	32
NZL	101	58	145	0	178	101	218	26	39	26	21	26	11	31	13
AUS	111	71	159	178	0	107	225	49	38	52	41	46	15	49	14
GBR	100	89	133	97	106	0	136	16	43	15	17	29	19	49	0

DFS	212	125	230	213	199	130	0	72	53	154	134	108	15	63	0
DEU	13	17	27	25	48	16	63	0	1	35	37	28	5	21	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	35	28	24	46	13	141	34	0	0	58	22	0	27	0
LVA	10	20	24	18	37	16	93	31	2	50	0	48	3	18	0
LTU	21	22	36	25	43	27	93	27	5	22	43	0	6	16	0
IRL	3	48	25	11	14	18	12	5	2	0	3	6	0	10	0
NLD	7	54	51	30	47	48	60	20	2	26	17	15	10	0	0
CAM	0	0	32	13	14	0	0	0	0	0	0	0	0	0	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	8	236	100	110	102	205	14	75	3	10	22	3	7	0
NOR	7	0	88	58	82	85	150	18	0	35	22	25	49	55	0
USA	222	89	0	145	157	142	233	29	64	29	27	41	25	52	32
NZL	101	58	145	0	178	101	218	26	39	26	21	26	11	31	13
AUS	111	71	159	178	0	107	225	49	38	52	41	46	15	49	14
GBR	100	89	134	97	106	0	136	16	43	15	17	29	19	49	0
DFS	212	125	230	213	199	130	0	72	53	154	134	108	15	63	0
DEU	13	17	27	25	48	16	63	0	1	35	37	28	5	21	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	35	28	24	46	13	141	34	0	0	58	22	0	27	0
LVA	10	20	24	18	37	16	93	31	2	50	0	48	3	18	0
LTU	21	22	36	25	43	27	93	27	5	22	43	0	6	16	0
IRL	3	48	25	11	14	18	12	5	2	0	3	6	0	10	0
NLD	7	54	51	30	47	48	60	20	2	26	17	15	10	0	0
CAM	0	0	32	13	14	0	0	0	0	0	0	0	0	0	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	0	397	256	107	2	15	94	57	56	3	34
DEA	365	0	292	1153	288	270	424	68	55	741	41
FRM	308	335	0	196	11	2	137	72	73	2	96
ITA	109	1061	221	0	170	158	278	66	48	351	39
SVN	2	270	10	157	0	59	90	6	0	135	2
FRA	12	228	1	143	55	0	86	6	0	110	3
NLD	96	442	160	273	83	82	0	59	53	174	32
IRL	54	61	77	62	6	6	53	0	40	10	18
GBR	64	58	94	52	0	0	54	34	0	0	20
HRV	3	775	1	333	125	99	167	9	0	0	5
USA	33	43	111	46	2	3	33	17	28	5	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	0	396	256	107	2	15	94	57	56	3	34
DEA	365	0	292	1154	288	270	424	68	55	739	41
FRM	308	335	0	196	11	2	137	72	73	2	96
ITA	109	1062	221	0	170	158	278	66	48	350	39
SVN	2	270	10	157	0	59	90	6	0	136	2
FRA	12	228	1	143	55	0	86	6	0	110	3
NLD	96	442	160	273	83	82	0	59	53	174	32
IRL	54	61	77	62	6	6	53	0	40	10	18
GBR	64	58	94	52	0	0	54	34	0	0	20
HRV	3	773	1	332	126	99	167	9	0	0	5
USA	33	43	111	46	2	3	33	17	28	5	0

SIM

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common bulls below diagonal
common three quarter sib group above diagonal

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	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	0	396	256	107	2	15	94	57	56	3	34
DEA	365	0	292	1153	288	270	424	68	55	740	41
FRM	308	335	0	196	11	2	137	72	73	2	96
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IRL	54	61	77	62	6	6	53	0	40	10	18
GBR	64	58	94	52	0	0	54	34	0	0	20
HRV	3	774	1	332	125	99	167	9	0	0	5
USA	33	43	111	46	2	3	33	17	28	5	0

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