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 Urugay 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 conformation traits are as follows:

USA (ALL)	Decrease in information due to the pedigree correction and herd-year minimum edits
AUS (ALL)	Some decrease in information due to pedigree, data updates and change in bulls' status which made bulls no longer qualifying for inclusion.
NLD (ALL)	Base change. Minor update of the EDC calculation. Too many data were provided for the January test run, the error has been corrected resulting in drops of information especially for HOL.
DEA (SIM)	HUN included in the DEA-consortium. Model as previous runs, except for new effect classes with respect to the added Hungarian data.
POL (HOL)	Drop in information due to the data edits.
DFS (RDC)	Improved handling of Finnish AMS data. Finnish HOL discarded from RDC model. Update of genetic parameters/heritability.
CHE (ALL)	Drop of information due to changes in the groups of fixed effects regions and level (geographical) and edits in database. Base change.
FRA (ALL)	Base change
DEU (ALL)	Base change
EST (HOL,JER)	Drop in information due to the pedigree update and/or new location of some daughters in different dairy farms of owners.
JPN (HOL)	Drop in information due to the pedigree modification
IRL (HOL,JER)	Drop in information because ancestry errors are being corrected on an on-going basis as the genotypes come in.
ITA (HOL)	Base change. Drop in information due to the yearly data cut-off for phenotypes
ITA (SIM)	Base change. Drop in information due to the pedigree editing.
BEL (HOL)	Drop in information due to few pedigree correction
NZL (HOL,JER,RDC)	Drop in information due to the DNA parentage testing.
ITA (BSW)	Base change
GBR (HOL,JER,RDC,BSW)	Drop in information due to the pedigree updates and clean up and data edits.
CAN (ALL)	Base change

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

In 2020 new post-processing windowsâ\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 previoulsy 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 (April Routine Evaluation 2024).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	232	151	8988	1914	864	
BEL			2345			
CAN	288	111	14093	902	892	
CHE	3257		3441	103		3695
CZE			5255			
DEA	6482					26842
DEU			24562	281	308	
DFS			14434	2374	8078	
ESP			4626			
EST			1432		498	
FRA	503		18711			497
FRM						5209
GBR	197	382	8277	1015	738	122
HUN			3614			
IRL			3279	163	62	104
ISR			1758			
ITA	2414		9073	172		2039
JPN			6958			
KOR			1781			
LTU			897		373	
LVA			1532		721	
NLD	243		17140	271	104	523
NOR					4373	
NZL	89	63	9250	5656	1566	
POL			12946			
PRT			2971			
SVK			1211			
SVN	348		720			704
URY			1191			
USA	1236	833	42885	5485	821	114
ZAF			1316	752	144	
HRV			986			1072
CAM					50	
No.Records	15289	1540	225672	19088	19592	40921
Pub. Proofs	12091	1214	161563	15077	17229	36740

^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	654.47										
FRA	0.90	651.62									
USA	0.91	0.89	638.95								
CHE	0.90	0.90	0.85	488.71							
ITA	0.87	0.83	0.86	0.87	613.73						
DEA	0.82	0.85	0.83	0.94	0.89	467.04					
NLD	0.88	0.87	0.86	0.85	0.85	0.86	658.95				
SVN	0.69	0.74	0.70	0.71	0.63	0.72	0.68	10.52			

NZL	0.68	0.76	0.70	0.73	0.68	0.72	0.71	0.65	475.68	
GBR	0.84	0.86	0.82	0.85	0.77	0.76	0.83	0.68	0.72	289.21
AUS	0.72	0.76	0.70	0.69	0.64	0.63	0.71	0.65	0.83	0.69	369.21

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.15										
FRA	0.88	27.08									
USA	0.89	0.89	23.52								
CHE	0.85	0.89	0.82	19.34							
ITA	0.87	0.87	0.85	0.87	23.33						
DEA	0.80	0.87	0.82	0.94	0.87	17.35					
NLD	0.86	0.84	0.83	0.83	0.83	0.85	25.21				
SVN	0.77	0.79	0.72	0.73	0.70	0.78	0.67	10.78			
NZL	0.70	0.79	0.74	0.78	0.68	0.78	0.68	0.67	23.13		
GBR	0.83	0.86	0.83	0.83	0.78	0.76	0.83	0.68	0.72	10.18	
AUS	0.73	0.72	0.74	0.63	0.65	0.65	0.67	0.62	0.80	0.67	15.41

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.41										
FRA	0.86	21.16									
USA	0.88	0.86	18.99								
CHE	0.83	0.85	0.81	15.56							
ITA	0.82	0.81	0.82	0.85	21.46						
DEA	0.77	0.80	0.79	0.93	0.87	14.54					
NLD	0.84	0.82	0.82	0.81	0.81	0.84	21.74				
SVN	0.66	0.72	0.68	0.65	0.64	0.69	0.64	10.19			
NZL	0.61	0.71	0.64	0.68	0.63	0.68	0.63	0.62	16.58		
GBR	0.83	0.82	0.79	0.80	0.74	0.70	0.82	0.65	0.65	8.43	
AUS	0.68	0.68	0.67	0.60	0.57	0.57	0.62	0.56	0.78	0.63	11.81

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	809.36				
USA	0.93	783.11			
AUS	0.76	0.73	479.41		
GBR	0.86	0.82	0.71	267.08	
NZL	0.71	0.68	0.83	0.71	376.26

GUE fat

	CAN	USA	AUS	GBR	NZL
CAN	30.87				
USA	0.92	27.29			
AUS	0.76	0.74	17.43		
GBR	0.86	0.81	0.71	10.37	
NZL	0.71	0.73	0.82	0.72	18.45

GUE pro

	CAN	USA	AUS	GBR	NZL
CAN	24.14				
USA	0.90	20.75			
AUS	0.66	0.63	13.75		
GBR	0.84	0.79	0.65	7.77	
NZL	0.62	0.60	0.79	0.63	12.69

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	800.39																												
DEU	0.94	646.44																											
DFS	0.92	0.93	11.18																										
FRA	0.91	0.92	0.90	620.70																									
ITA	0.89	0.88	0.87	0.88	604.41																								
NLD	0.92	0.94	0.92	0.89	0.88	665.70																							
USA	0.93	0.91	0.89	0.90	0.90	0.89	713.56																						
CHE	0.90	0.93	0.88	0.93	0.88	0.91	0.88	568.10																					
GBR	0.86	0.84	0.83	0.85	0.82	0.85	0.83	0.89	275.93																				
NZL	0.70	0.69	0.69	0.76	0.68	0.72	0.70	0.75	0.70	390.62																			
AUS	0.77	0.74	0.71	0.78	0.70	0.75	0.74	0.77	0.73	0.83	422.12																		
BEL	0.86	0.87	0.81	0.82	0.78	0.84	0.81	0.81	0.76	0.67	0.77	501.65																	
IRL	0.83	0.84	0.82	0.90	0.79	0.85	0.81	0.87	0.81	0.82	0.81	0.78	180.53																
ESP	0.93	0.92	0.89	0.92	0.89	0.90	0.92	0.89	0.82	0.68	0.76	0.86	0.83	530.44															
CZE	0.87	0.88	0.84	0.81	0.81	0.82	0.84	0.77	0.73	0.64	0.71	0.84	0.73	0.84	709.48														
SVN	0.81	0.84	0.81	0.83	0.72	0.80	0.79	0.75	0.69	0.60	0.67	0.75	0.67	0.82	0.76	12.03													
EST	0.87	0.87	0.89	0.85	0.83	0.84	0.87	0.85	0.78	0.67	0.72	0.79	0.75	0.83	0.82	0.72	576.48												
ISR	0.81	0.82	0.83	0.82	0.84	0.80	0.86	0.81	0.79	0.63	0.66	0.79	0.70	0.83	0.79	0.78	0.80	397.50											
HUN	0.85	0.86	0.83	0.87	0.88	0.85	0.89	0.85	0.81	0.66	0.65	0.74	0.77	0.85	0.83	0.72	0.83	0.83	684.76										
POL	0.89	0.90	0.87	0.89	0.86	0.88	0.87	0.86	0.81	0.68	0.75	0.83	0.81	0.89	0.87	0.81	0.86	0.80	0.87	412.20									
ZAF	0.83	0.78	0.77	0.82	0.79	0.75	0.82	0.78	0.74	0.66	0.76	0.75	0.75	0.82	0.78	0.67	0.72	0.80	0.79	0.80	539.51								
JPN	0.93	0.91	0.92	0.91	0.89	0.90	0.92	0.89	0.83	0.68	0.76	0.84	0.81	0.91	0.85	0.86	0.84	0.85	0.84	0.89	0.83	623.62							
LVA	0.74	0.75	0.71	0.76	0.68	0.70	0.75	0.74	0.69	0.63	0.64	0.68	0.73	0.72	0.66	0.65	0.76	0.79	0.72	0.74	0.71	0.72	508.09						
SVK	0.77	0.79	0.79	0.79	0.75	0.72	0.78	0.76	0.73	0.62	0.64	0.76	0.69	0.79	0.80	0.74	0.79	0.79	0.81	0.80	0.70	0.80	0.68	382.97					
LTU	0.74	0.73	0.71	0.76	0.66	0.67	0.70	0.71	0.66	0.60	0.63	0.70	0.65	0.73	0.69	0.77	0.63	0.78	0.68	0.70	0.63	0.73	0.68	0.72	398.17				
PRT	0.76	0.76	0.77	0.78	0.74	0.74	0.77	0.75	0.69	0.60	0.60	0.67	0.71	0.77	0.65	0.76	0.67	0.79	0.72	0.74	0.61	0.75	0.66	0.68	0.61	589.42			
KOR	0.85	0.79	0.80	0.80	0.78	0.77	0.85	0.78	0.71	0.70	0.74	0.82	0.73	0.84	0.80	0.75	0.78	0.79	0.74	0.78	0.78	0.85	0.73	0.77	0.67	0.68	481.04		
URY	0.71	0.70	0.67	0.75	0.69	0.69	0.70	0.71	0.64	0.76	0.73	0.70	0.71	0.70	0.67	0.64	0.66	0.78	0.68	0.72	0.74	0.67	0.70	0.62	0.68	0.61	0.70	166.79	
HRV	0.64	0.65	0.66	0.65	0.64	0.68	0.63	0.62	0.62	0.59	0.59	0.66	0.60	0.65	0.62	0.62	0.65	0.79	0.66	0.66	0.70	0.67	0.62	0.65	0.61	0.61	0.63	0.63	11.19

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	32.00																												
DEU	0.93	24.12																											
DFS	0.90	0.91	10.90																										
FRA	0.91	0.92	0.90	25.19																									
ITA	0.88	0.88	0.84	0.90	25.48																								
NLD	0.90	0.94	0.90	0.88	0.85	25.34																							
USA	0.92	0.92	0.87	0.91	0.90	0.87	26.58																						
CHE	0.87	0.90	0.86	0.91	0.84	0.88	0.85	22.79																					
GBR	0.85	0.87	0.83	0.87	0.83	0.86	0.85	0.88	9.48																				
NZL	0.67	0.68	0.69	0.75	0.66	0.68	0.72	0.74	0.71	15.31																			
AUS	0.73	0.72	0.67	0.75	0.70	0.70	0.74	0.70	0.71	0.79	14.80																		
BEL	0.86	0.86	0.81	0.84	0.79	0.83	0.82	0.80	0.79	0.69	0.75	20.32																	
IRL	0.81	0.80	0.82	0.84	0.73	0.82	0.79	0.83	0.78	0.80	0.78	0.81	6.75																
ESP	0.91	0.90	0.86	0.91	0.89	0.87	0.92	0.85	0.83	0.65	0.74	0.82	0.78	21.01															
CZE	0.83	0.85	0.81	0.79	0.80	0.78	0.84	0.71	0.74	0.57	0.66	0.80	0.67	0.82	22.33														
SVN	0.78	0.79	0.78	0.77	0.73	0.78	0.74	0.73	0.68	0.61	0.59	0.79	0.65	0.76	0.72	12.66													
EST	0.87	0.89	0.88	0.86	0.85	0.86	0.87	0.86	0.78	0.73	0.75	0.85	0.79	0.83	0.82	0.79	23.36												
ISR	0.77	0.80	0.73	0.76	0.79	0.76	0.84	0.76	0.71	0.63	0.60	0.64	0.60	0.77	0.72	0.62	0.77	15.00											
HUN	0.83	0.86	0.78	0.86	0.88	0.81	0.89	0.81	0.78	0.64	0.65	0.72	0.69	0.86	0.79	0.64	0.80	0.84	27.30										
POL	0.88	0.90	0.84	0.88	0.86	0.84	0.89	0.81	0.80	0.66	0.70	0.83	0.74	0.89	0.84	0.77	0.88	0.78	0.86	17.21									
ZAF	0.71	0.69	0.61	0.73	0.70	0.67	0.75	0.69	0.67	0.57	0.65	0.64	0.64	0.75	0.69	0.62	0.72	0.71	0.71	0.74	19.24								
JPN	0.92	0.91	0.92	0.90	0.87	0.89	0.89	0.87	0.83	0.68	0.69	0.84	0.80	0.87	0.80	0.85	0.85	0.75	0.78	0.86	0.67	24.01							
LVA	0.78	0.79	0.73	0.80	0.76	0.73	0.79	0.75	0.71	0.66	0.69	0.79	0.64	0.79	0.73	0.67	0.84	0.76	0.75	0.81	0.73	0.75	20.26						
SVK	0.73	0.75	0.72	0.75	0.78	0.67	0.78	0.70	0.70	0.58	0.61	0.74	0.60	0.76	0.78	0.72	0.80	0.68	0.76	0.80	0.64	0.72	0.73	15.25					
LTU	0.69	0.70	0.65	0.71	0.67	0.61	0.70	0.68	0.64	0.57	0.57	0.70	0.57	0.68	0.64	0.74	0.66	0.65	0.63	0.70	0.62	0.67	0.78	0.69	17.83				
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	0.68	0.68	0.62	0.74	0.74	0.60	0.73	0.70	0.61	0.61	23.63			
KOR	0.84	0.81	0.78	0.82	0.80	0.78	0.86	0.79	0.76	0.72	0.74	0.84	0.71	0.84	0.77	0.74	0.80	0.75	0.76	0.83	0.70	0.85	0.76	0.73	0.69	0.66	19.66		
URY	0.75	0.73	0.70	0.79	0.71	0.68	0.75	0.70	0.70	0.73	0.70	0.70	0.70	0.71	0.68	0.67	0.78	0.66	0.69	0.76	0.69	0.70	0.77	0.63	0.61	0.60	0.70	6.71	
HRV	0.62	0.66	0.67	0.67	0.68	0.66	0.68	0.62	0.63	0.56	0.57	0.62	0.57	0.67	0.64	0.61	0.65	0.68	0.65	0.65	0.65	0.67	0.61	0.62	0.61	0.63	0.75	0.62	11.74

HOL pro

	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	17.87																															
DFS	0.90	0.92	10.53																														
FRA	0.87	0.89	0.89	16.98																													
ITA	0.85	0.85	0.84	0.84	18.66																												
NLD	0.88	0.93	0.89	0.84	0.83	18.99																											
USA	0.90	0.90	0.88	0.88	0.86	0.85	18.22																										
CHE	0.85	0.89	0.84	0.91	0.83	0.85	0.84	16.33																									
GBR	0.84	0.84	0.82	0.83	0.80	0.84	0.82	0.86	7.36																								
NZL	0.60	0.59	0.61	0.69	0.57	0.62	0.62	0.65	0.63	11.48																							
AUS	0.66	0.63	0.63	0.68	0.59	0.64	0.65	0.65	0.66	0.78	10.89																						
BEL	0.81	0.82	0.76	0.74	0.72	0.78	0.76	0.74	0.75	0.58	0.68	14.70																					
IRL	0.75	0.75	0.76	0.81	0.71	0.77	0.75	0.80	0.75	0.76	0.75	0.72	5.45																				
ESP	0.90	0.89	0.87	0.88	0.86	0.85	0.89	0.84	0.82	0.58	0.67	0.79	0.76	15.19																			
CZE	0.78	0.81	0.76	0.69	0.71	0.72	0.76	0.64	0.66	0.47	0.55	0.76	0.57	0.75	17.11																		
SVN	0.76	0.79	0.76	0.80	0.70	0.75	0.75	0.70	0.64	0.51	0.57	0.70	0.60	0.79	0.67	11.53																	
EST	0.81	0.84	0.83	0.79	0.77	0.80	0.82	0.83	0.73	0.58	0.61	0.75	0.62	0.75	0.73	0.65	17.38																
ISR	0.77	0.78	0.78	0.80	0.80	0.76	0.82	0.80	0.73	0.50	0.52	0.60	0.59	0.79	0.63	0.69	0.72	10.34															
HUN	0.80	0.83	0.79	0.84	0.84	0.80	0.86	0.82	0.77	0.54	0.52	0.66	0.66	0.80	0.71	0.65	0.77	0.80	21.97														
POL	0.84	0.87	0.84	0.84	0.80	0.82	0.84	0.80	0.77	0.56	0.62	0.78	0.73	0.85	0.79	0.75	0.82	0.73	0.82	11.25													
ZAF	0.77	0.71	0.69	0.75	0.69	0.68	0.75	0.71	0.71	0.61	0.70	0.67	0.67	0.73	0.66	0.60	0.66	0.76	0.70	0.75	14.78												
JPN	0.90	0.89	0.90	0.87	0.87	0.86	0.90	0.85	0.81	0.59	0.65	0.77	0.74	0.89	0.74	0.82	0.79	0.79	0.79	0.84	0.74	17.01											
LVA	0.73	0.73	0.68	0.73	0.67	0.67	0.73	0.71	0.68	0.58	0.57	0.70	0.63	0.71	0.61	0.60	0.74	0.71	0.68	0.73	0.68	0.70	14.63										
SVK	0.74	0.75	0.74	0.75	0.72	0.66	0.74	0.71	0.68	0.52	0.55	0.71	0.59	0.74	0.75	0.69	0.73	0.74	0.76	0.74	0.66	0.76	0.67	10.53									
LTU	0.66	0.66	0.63	0.71	0.61	0.59	0.63	0.64	0.59	0.51	0.49	0.65	0.50	0.65	0.59	0.74	0.60	0.67	0.61	0.62	0.61	0.65	0.69	0.67	11.88								
PRT	0.71	0.72	0.74	0.74	0.70	0.68	0.72	0.69	0.66	0.52	0.51	0.58	0.64	0.73	0.58	0.73	0.61	0.68	0.69	0.68	0.58	0.72	0.66	0.61	0.58	17.88							
KOR	0.82	0.76	0.76	0.75	0.77	0.73	0.82	0.75	0.68	0.60	0.63	0.80	0.64	0.82	0.72	0.71	0.72	0.74	0.69	0.76	0.69	0.81	0.67	0.72	0.61	0.63	13.36						
URY	0.64	0.64	0.63	0.73	0.61	0.60	0.64	0.65	0.58	0.72	0.66	0.59	0.64	0.64	0.59	0.62	0.60	0.61	0.59	0.63	0.67	0.59	0.70	0.60	0.63	0.58	0.60	5.19					
HRV	0.61	0.65	0.61	0.64	0.61	0.64	0.62	0.59	0.59	0.49	0.49	0.66	0.49	0.63	0.59	0.59	0.61	0.61	0.63	0.63	0.63	0.64	0.59	0.61	0.59	0.58	0.61	0.60	11.09				

JER mil

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	605.59											
DFS	0.90	9.11										
USA	0.91	0.89	707.63									
NZL	0.73	0.75	0.74	307.39								
AUS	0.79	0.71	0.74	0.81	385.88							
GBR	0.83	0.80	0.77	0.67	0.71	223.35						
NLD	0.91	0.90	0.88	0.71	0.74	0.80	607.06					
ZAF	0.87	0.83	0.84	0.77	0.80	0.73	0.76	372.06				
ITA	0.89	0.87	0.89	0.75	0.79	0.80	0.85	0.88	543.19			
DEU	0.91	0.94	0.91	0.69	0.69	0.82	0.93	0.79	0.86	611.00		
IRL	0.80	0.80	0.78	0.90	0.82	0.71	0.82	0.76	0.78	0.80	174.49	
CHE	0.87	0.87	0.82	0.73	0.75	0.84	0.88	0.78	0.83	0.91	0.82	371.16

JER fat

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	27.34											
DFS	0.88	11.06										
USA	0.89	0.87	26.19									
NZL	0.67	0.68	0.71	14.31								
AUS	0.77	0.69	0.75	0.79	13.85							
GBR	0.81	0.78	0.80	0.67	0.71	9.23						
NLD	0.86	0.85	0.83	0.67	0.66	0.77	25.90					
ZAF	0.76	0.74	0.74	0.63	0.69	0.64	0.66	14.67				
ITA	0.87	0.83	0.86	0.67	0.72	0.75	0.79	0.76	25.79			
DEU	0.92	0.92	0.89	0.68	0.72	0.84	0.90	0.75	0.87	24.13		
IRL	0.77	0.76	0.74	0.83	0.79	0.74	0.78	0.62	0.70	0.76	6.16	
CHE	0.84	0.82	0.80	0.73	0.70	0.78	0.79	0.70	0.81	0.89	0.77	17.47

JER pro

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	19.69											

DFS	0.88	10.44												
USA	0.88	0.88	20.28											
NZL	0.63	0.67	0.67	10.19										
AUS	0.69	0.64	0.66	0.76	10.58									
GBR	0.82	0.80	0.77	0.65	0.68	7.06								
NLD	0.86	0.86	0.84	0.64	0.65	0.77	19.83							
ZAF	0.80	0.77	0.77	0.67	0.68	0.69	0.70	11.61						
ITA	0.85	0.83	0.86	0.61	0.67	0.77	0.81	0.84	19.46					
DEU	0.89	0.93	0.89	0.62	0.62	0.82	0.91	0.73	0.84	19.14				
IRL	0.73	0.75	0.72	0.84	0.77	0.72	0.76	0.67	0.70	0.75	5.51			
CHE	0.79	0.82	0.74	0.65	0.59	0.76	0.81	0.65	0.74	0.87	0.76	12.54		

RDC mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	612.77														
NOR	0.85	12.63													
USA	0.91	0.89	721.19												
NZL	0.67	0.69	0.68	371.65											
AUS	0.74	0.69	0.72	0.82	420.29										
GBR	0.82	0.79	0.81	0.68	0.75	261.02									
DFS	0.89	0.91	0.87	0.69	0.70	0.79	10.05								
DEU	0.93	0.84	0.89	0.69	0.70	0.84	0.92	656.80							
ZAF	0.82	0.78	0.82	0.72	0.78	0.70	0.78	0.78	611.59						
EST	0.85	0.81	0.84	0.67	0.69	0.77	0.83	0.80	0.72	523.55					
LVA	0.74	0.74	0.75	0.65	0.66	0.71	0.73	0.74	0.72	0.77	329.94				
LTU	0.74	0.75	0.72	0.64	0.62	0.72	0.63	0.73	0.68	0.65	0.75	368.60			
IRL	0.82	0.76	0.80	0.84	0.82	0.78	0.80	0.83	0.75	0.74	0.73	0.72	176.51		
NLD	0.91	0.91	0.87	0.70	0.72	0.84	0.91	0.93	0.75	0.82	0.72	0.69	0.83	773.08	
CAM	0.80	0.81	0.91	0.67	0.73	0.78	0.78	0.79	0.79	0.78	0.78	0.76	0.77	0.78	427.50

RDC fat

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.53														
NOR	0.84	12.09													
USA	0.90	0.80	25.99												
NZL	0.66	0.73	0.70	15.90											
AUS	0.69	0.63	0.74	0.81	15.58										
GBR	0.82	0.71	0.82	0.68	0.73	8.71									
DFS	0.89	0.88	0.86	0.70	0.69	0.79	10.67								
DEU	0.92	0.84	0.91	0.68	0.69	0.87	0.91	26.40							
ZAF	0.76	0.78	0.80	0.63	0.66	0.66	0.71	0.70	20.71						
EST	0.86	0.67	0.87	0.65	0.71	0.78	0.81	0.85	0.73	20.59					
LVA	0.75	0.67	0.77	0.65	0.63	0.70	0.69	0.78	0.73	0.81	14.41				
LTU	0.70	0.73	0.73	0.62	0.65	0.68	0.66	0.73	0.69	0.72	0.80	16.98			
IRL	0.80	0.72	0.79	0.82	0.80	0.77	0.80	0.79	0.65	0.78	0.66	0.66	7.29		
NLD	0.90	0.86	0.86	0.66	0.68	0.84	0.90	0.93	0.67	0.81	0.74	0.67	0.81	28.35	
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	0.77	0.80	22.23

RDC pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.58														
NOR	0.83	12.09													
USA	0.89	0.87	20.11												
NZL	0.58	0.66	0.63	11.48											
AUS	0.62	0.65	0.66	0.78	12.07										
GBR	0.80	0.77	0.80	0.59	0.66	7.03									
DFS	0.88	0.88	0.85	0.64	0.61	0.75	10.54								
DEU	0.90	0.82	0.88	0.60	0.61	0.84	0.92	20.13							
ZAF	0.76	0.77	0.77	0.66	0.73	0.65	0.70	0.71	17.44						
EST	0.80	0.69	0.79	0.57	0.57	0.74	0.77	0.80	0.67	16.24					
LVA	0.71	0.68	0.73	0.57	0.55	0.68	0.64	0.72	0.69	0.69	9.76				
LTU	0.66	0.65	0.66	0.56	0.51	0.67	0.59	0.66	0.67	0.63	0.71	10.80			
IRL	0.74	0.74	0.76	0.79	0.77	0.74	0.74	0.75	0.68	0.63	0.64	0.62	5.32		

NLD	0.88	0.90	0.84	0.60	0.62	0.81	0.89	0.92	0.69	0.74	0.68	0.62	0.76	25.85	
CAM	0.79	0.78	0.88	0.66	0.69	0.78	0.78	0.78	0.79	0.76	0.76	0.75	0.73	0.77	10.37

SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	562.65										
DEA	0.87	506.61									
FRM	0.95	0.86	618.87								
ITA	0.77	0.68	0.66	505.69							
SVN	0.75	0.75	0.76	0.71	9.28						
FRA	0.90	0.93	0.84	0.81	0.79	741.59					
NLD	0.88	0.92	0.89	0.75	0.77	0.88	756.73				
IRL	0.84	0.74	0.84	0.67	0.71	0.87	0.79	179.22			
GBR	0.86	0.85	0.85	0.76	0.68	0.85	0.85	0.77	228.53		
HRV	0.64	0.62	0.76	0.61	0.61	0.62	0.62	0.64	0.62	10.52	
USA	0.86	0.81	0.82	0.87	0.78	0.90	0.89	0.79	0.82	0.64	610.32

SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	22.50										
DEA	0.87	19.05									
FRM	0.94	0.89	24.18								
ITA	0.77	0.75	0.69	19.66							
SVN	0.73	0.81	0.75	0.73	9.41						
FRA	0.89	0.94	0.84	0.81	0.77	29.82					
NLD	0.86	0.91	0.89	0.73	0.78	0.87	28.38				
IRL	0.79	0.72	0.79	0.63	0.70	0.83	0.78	7.61			
GBR	0.89	0.84	0.85	0.79	0.68	0.87	0.85	0.75	7.94		
HRV	0.64	0.59	0.75	0.61	0.60	0.61	0.61	0.64	0.63	10.54	
USA	0.85	0.84	0.82	0.88	0.74	0.91	0.87	0.76	0.84	0.68	20.15

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA
CHE	16.78										
DEA	0.85	15.46									
FRM	0.94	0.85	19.93								
ITA	0.70	0.64	0.64	15.84							
SVN	0.71	0.71	0.73	0.66	9.26						
FRA	0.88	0.91	0.79	0.77	0.73	24.28					
NLD	0.83	0.90	0.86	0.70	0.73	0.83	23.70				
IRL	0.77	0.74	0.78	0.58	0.67	0.80	0.73	6.22			
GBR	0.83	0.83	0.81	0.74	0.65	0.83	0.83	0.72	7.17		
HRV	0.62	0.57	0.75	0.58	0.59	0.59	0.60	0.57	0.60	10.69	
USA	0.82	0.76	0.74	0.83	0.75	0.87	0.85	0.71	0.80	0.62	17.49

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^LAPPENDIX II. Number of common bulls

BSW

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common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	99	199	156	150	169	61	35	37	78	105
FRA	90	0	136	196	233	262	100	52	36	74	80
USA	195	101	0	337	264	360	97	42	48	110	136
CHE	133	155	316	0	531	667	121	81	45	89	128
ITA	133	196	191	472	0	835	153	101	52	97	135
DEA	148	214	329	559	733	0	174	108	62	96	142
NLD	56	85	89	112	129	165	0	50	39	47	70
SVN	31	50	33	76	95	99	50	0	15	22	28
NZL	36	27	40	34	44	56	32	13	0	31	42

GBR	74	61	103	67	71	64	38	17	26	0	68
AUS	108	64	128	88	100	104	53	20	34	60	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	99	199	156	150	169	61	35	37	78	105
FRA	90	0	136	196	233	262	100	52	36	74	80
USA	195	101	0	337	264	360	97	42	48	110	136
CHE	133	155	316	0	531	668	121	81	45	89	128
ITA	133	196	191	472	0	836	153	101	52	97	135
DEA	148	214	329	559	734	0	174	108	62	96	142
NLD	56	85	89	112	129	165	0	50	39	47	70
SVN	31	50	33	76	95	99	50	0	15	22	28
NZL	36	27	40	34	44	56	32	13	0	31	42
GBR	74	61	103	67	71	64	38	17	26	0	68
AUS	108	64	128	88	100	104	53	20	34	60	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	99	199	156	150	169	61	35	37	78	105
FRA	90	0	136	196	233	262	100	52	36	74	80
USA	195	101	0	337	264	360	97	42	48	110	136
CHE	133	155	316	0	531	668	121	81	45	89	128
ITA	133	196	191	472	0	836	153	101	52	97	135
DEA	148	214	329	559	734	0	174	108	62	96	142
NLD	56	85	89	112	129	165	0	50	39	47	70
SVN	31	50	33	76	95	99	50	0	15	22	28
NZL	36	27	40	34	44	56	32	13	0	31	42
GBR	74	61	103	67	71	64	38	17	26	0	68
AUS	108	64	128	88	100	104	53	20	34	60	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	79	56	41	14
USA	71	0	73	104	32
AUS	53	70	0	47	27
GBR	35	105	40	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	79	56	41	14
USA	71	0	73	104	32
AUS	53	70	0	47	27
GBR	35	105	40	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	79	56	41	14
USA	71	0	73	104	32
AUS	53	70	0	47	27
GBR	35	105	40	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	2729	1782	1735	1929	1878	4150	973	1977	887	1668	941	642	1487	1376	240	344	171	1111	1855	515	1495	594	477	300	1265	830	541	355
DEU	2203	0	3020	2774	2682	3781	3936	1242	2349	1121	1846	1380	943	1717	2160	392	540	198	1307	3160	560	1526	935	731	553	1453	730	516	730
DFS	1602	2339	0	1932	1641	2498	2495	800	1792	969	1471	1007	803	1206	1518	282	412	179	991	2032	515	1086	578	444	359	1119	584	454	493
FRA	1300	1738	1227	0	1664	2334	2772	800	1757	920	1453	1118	800	1404	1509	235	321	148	1047	2124	514	1315	525	481	289	1142	636	454	391
ITA	1688	1938	1355	1064	0	1835	2788	753	1606	662	1181	818	561	1322	1330	278	343	158	971	2032	364	1137	584	395	328	1071	633	394	405
NLD	1840	3611	2256	1673	1583	0	2930	1004	2052	1246	1648	1455	968	1312	1824	301	472	192	1058	2378	524	1193	647	586	367	1267	594	468	523
USA	4752	3044	2052	1651	2260	2651	0	1103	2626	1265	2227	1107	895	1763	2013	275	455	267	1431	2783	647	2134	798	597	403	1595	1009	741	454
CHE	899	1174	758	747	689	1004	1039	0	799	466	697	670	437	619	584	149	201	71	453	790	259	507	328	251	145	566	310	227	223
GBR	2239	1844	1414	1213	1291	1847	2454	764	0	1062	1608	984	1059	1214	1282	230	338	176	941	1719	519	1150	517	410	329	1103	586	494	390
NZL	878	870	706	606	509	1136	1220	393	926	0	1346	588	800	615	749	138	174	135	550	812	376	626	295	279	194	667	363	410	257
AUS	1704	1427	1108	1039	921	1460	2297	620	1418	1352	0	836	789	1006	1003	185	269	138	795	1283	487	987	458	336	266	946	537	481	339
BEL	943	1431	952	1152	813	1672	998	687	978	481	742	0	557	766	794	181	236	97	598	974	341	604	350	322	187	767	357	273	308
IRL	599	818	658	674	475	907	810	442	1083	692	679	545	0	546	604	117	156	118	467	697	331	471	244	222	156	536	273	296	207
ESP	1038	1147	947	1175	955	1185	1219	516	961	471	731	752	512	0	1025	213	251	125	843	1340	455	986	433	350	243	979	569	388	330
CZE	1074	1765	1070	1058	995	1682	1679	452	943	562	691	653	475	769	0	241	345	160	1041	1680	439	974	522	556	306	974	570	436	436
SVN	186	384	227	178	239	263	224	106	168	93	127	142	87	152	177	0	104	53	162	320	74	175	138	83	72	179	117	66	129
EST	227	403	281	173	208	349	334	120	206	90	145	153	81	121	223	63	0	65	231	454	114	237	229	139	102	242	146	126	153
ISR	120	151	133	92	103	151	257	42	129	108	88	63	91	75	127	36	37	0	124	192	68	133	88	58	56	124	77	80	78
HUN	1048	1053	803	773	828	897	1409	379	819	428	601	518	405	681	972	120	138	85	0	1085	404	778	392	339	248	828	521	402	299
POL	1700	2993	1748	1595	1742	2288	2833	691	1537	631	1018	910	578	1011	1458	285	339	152	983	0	427	1147	777	505	418	1263	684	468	565
ZAF	479	438	396	409	279	447	635	221	456	312	429	293	298	408	313	53	57	43	336	323	0	431	176	184	108	450	279	281	162
JPN	801	714	613	526	584	661	1003	343	602	332	559	396	296	488	464	94	90	57	426	646	283	0	408	328	229	808	637	418	263
LVA	371	781	373	289	364	444	686	182	301	167	235	213	142	233	356	83	139	57	281	638	101	177	0	206	206	481	275	210	297
SVK	334	547	238	267	234	417	405	129	237	167	168	195	107	178	479	39	58	24	235	362	101	116	104	0	106	354	226	193	159
LTU	171	514	213	122	166	225	283	59	180	91	121	92	74	97	199	31	46	25	150	325	41	74	133	48	0	245	159	134	166
PRT	1329	1363	1032	1044	1017	1283	1708	517	1019	543	791	782	478	949	824	142	165	81	822	1295	405	493	373	237	153	0	553	430	366
KOR	813	512	433	398	523	437	1164	222	433	269	397	266	190	413	415	73	71	41	422	579	208	389	167	136	71	472	0	325	173
URY	539	391	332	311	301	376	926	180	421	333	381	210	241	315	342	38	74	44	342	405	241	259	124	123	78	384	263	0	155
HRV	219	755	396	287	297	477	352	149	279	154	216	249	143	245	338	104	110	55	219	516	109	122	232	79	114	301	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	2729	1780	1735	1937	1878	4148	973	1977	887	1668	941	642	1486	1376	241	344	171	1111	1855	514	1489	594	477	300	1265	830	541	354
DEU	2203	0	3019	2774	2692	3781	3933	1242	2348	1121	1846	1380	943	1717	2160	393	540	198	1307	3160	559	1520	935	731	553	1453	730	516	729
DFS	1602	2339	0	1932	1646	2497	2492	800	1792	969	1471	1007	802	1205	1516	283	412	179	990	2030	514	1083	578	444	359	1119	584	454	492
FRA	1300	1738	1227	0	1670	2334	2771	800	1757	920	1453	1118	801	1404	1509	236	321	148	1047	2124	513	1312	525	481	289	1142	636	454	390
ITA	1696	1948	1361	1069	0	1844	2797	757	1614	665	1188	822	565	1327	1338	280	344	159	976	2039	366	1137	587	397	328	1077	636	395	406
NLD	1840	3611	2256	1673	1593	0	2928	1004	2052	1246	1648	1455	970	1312	1824	302	472	192	1058	2378	523	1188	647	586	367	1267	594	468	522
USA	4750	3040	2048	1650	2272	2650	0	1103	2625	1264	2227	1106	894	1761	2012	276	454	267	1430	2782	646	2128	797	597	403	1593	1009	741	452
CHE	899	1174	758	747	693	1004	1039	0	799	466	697	670	437	619	584	150	201	71	453	790	258	504	328	251	145	566	310	227	222
GBR	2239	1844	1414	1213	1300	1847	2453	764	0	1062	1608	984	1060	1214	1282	231	338	176	941	1719	518	1145	517	410	329	1103	586	494	390
NZL	878	870	706	606	511	1136	1219	393	926	0	1346	588	800	615	749	139	174	135	550	812	375	626	295	279	194	667	363	410	256
AUS	1704	1427	1108	1039	926	1460	2297	620	1418	1352	0	836	789	1006	1003	186	269	138	795	1283	486	983	458	336	266	946	537	481	339
BEL	943	1431	952	1152	816	1672	997	687	978	481	742	0	557	766	794	182	236	97	598	974	340	603	350	322	187	767	357	273	307
IRL	599	818	658	674	478	909	810	442	1084	692	679	545	0	545	604	118	156	118	467	698	331	469	244	222	156	536	273	296	206
ESP	1038	1147	946	1175	960	1185	1216	516	961	471	731	752	512	0	1024	214	251	125	842	1339	454	984	433	350	243	979	569	388	330
CZE	1074	1765	1070	1058	1004	1682	1678	452	943	562	691	653	475	769	0	242	345	160	1041	1680	438	972	522	556	306	974	570	436	435
SVN	186	384	227	178	240	263	224	106	168	93	127	142	87	152	177	0	104	53	162	321	74	175	139	84	73	180	117	67	130
EST	227	403	281	173	208	349	333	120	206	90	145	153	81	121	223	63	0	65	231	454	114	234	229	139	102	242	146	126	153
ISR	120	151	133	92	103	151	257	42	129	108	88	63	91	75	127	36	37	0	124	192	67	132	88	58	56	124	77	80	78
HUN	1048	1053	803	773	835	897	1408	379	819	428	601	518	405	681	972	120	138	85	0	1085	403	776	392	339	248	828	521	402	299
POL	1700	2993	1748	1595	1751	2288	2830	691	1537	631	1018	910	578	1011	1458	285	339	152	983	0	426	1141	777	505	418	1263	684	468	564
ZAF	478	437	395	408	281	446	634	220	455	312	428	293	298	407	312	52	57	43	335	322	0	429	175	183	107	449	278	280	161

JPN	795	708	611	522	582	656	994	340	597	331	554	394	294	485	462	94	87	56	424	640	282	0	406	327	229	804	636	417	263
LVA	371	781	373	289	367	444	684	182	301	167	235	213	142	233	356	83	139	57	281	638	101	175	0	206	206	481	275	210	297
SVK	334	547	238	267	235	417	405	129	237	167	168	195	107	178	479	39	58	24	235	362	101	115	104	0	106	354	226	193	159
LTU	171	514	213	122	166	225	283	59	180	91	121	92	74	97	199	31	46	25	150	325	40	74	133	48	0	245	159	134	166
PRT	1328	1362	1031	1042	1025	1282	1706	517	1018	543	790	781	478	948	824	142	165	81	822	1295	404	488	373	237	153	0	553	430	365
KOR	813	512	433	398	525	437	1162	222	433	269	397	266	190	413	415	73	71	41	422	579	208	387	167	136	71	472	0	325	173
URY	539	391	332	311	301	376	926	180	421	333	381	210	241	315	342	38	74	44	342	405	241	256	124	123	78	384	263	0	155
HRV	217	753	394	285	296	475	349	147	278	153	215	248	141	245	336	103	110	54	218	514	109	122	232	79	113	299	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	2729	1780	1735	1930	1878	4142	973	1977	887	1668	941	642	1486	1376	240	344	171	1111	1855	514	1488	594	477	300	1265	830	541	355
DEU	2203	0	3019	2774	2683	3781	3931	1242	2349	1121	1846	1380	943	1717	2160	392	540	198	1307	3160	559	1520	935	731	553	1453	730	516	730
DFS	1602	2339	0	1932	1640	2497	2490	800	1793	969	1471	1007	802	1205	1516	282	412	179	990	2030	514	1083	578	444	359	1119	584	454	493
FRA	1300	1738	1227	0	1664	2334	2770	800	1758	920	1453	1118	801	1404	1509	235	321	148	1047	2124	513	1312	525	481	289	1142	636	454	391
ITA	1689	1939	1355	1064	0	1836	2788	754	1607	662	1181	818	561	1321	1330	278	343	158	971	2032	363	1133	584	395	328	1071	633	394	405
NLD	1840	3611	2256	1673	1584	0	2927	1004	2053	1246	1648	1455	970	1312	1824	301	472	192	1058	2378	523	1187	647	586	367	1267	594	468	523
USA	4747	3040	2048	1650	2260	2650	0	1103	2624	1264	2224	1105	894	1760	2012	275	454	267	1430	2782	646	2125	797	596	403	1593	1010	741	453
CHE	899	1174	758	747	690	1004	1038	0	799	466	697	670	437	619	584	149	201	71	453	790	258	503	328	251	145	566	310	227	223
GBR	2239	1846	1416	1215	1292	1849	2453	764	0	1063	1608	985	1061	1215	1282	230	338	176	941	1720	518	1145	517	410	329	1104	586	494	391
NZL	878	870	706	606	509	1136	1219	393	926	0	1346	588	800	615	749	138	174	135	550	812	375	626	295	279	194	667	363	410	257
AUS	1704	1427	1108	1039	921	1460	2296	620	1418	1352	0	836	789	1006	1003	185	269	138	795	1283	486	983	458	336	266	946	537	481	339
BEL	943	1431	952	1152	813	1672	996	687	979	481	742	0	557	766	794	181	236	97	598	974	340	603	350	322	187	767	357	273	308
IRL	599	818	658	674	475	909	810	442	1086	692	679	545	0	545	604	117	156	118	467	698	331	469	244	222	156	536	273	296	207
ESP	1038	1147	946	1175	955	1185	1216	516	962	471	731	752	512	0	1024	213	251	125	842	1339	454	984	433	350	243	979	569	388	330
CZE	1074	1765	1070	1058	995	1682	1678	452	944	562	691	653	475	769	0	241	345	160	1041	1680	438	972	522	556	306	974	570	436	436
SVN	186	384	227	178	239	263	224	106	168	93	127	142	87	152	177	0	104	53	162	320	73	175	138	83	72	179	117	66	129
EST	227	403	281	173	208	349	333	120	206	90	145	153	81	121	223	63	0	65	231	454	114	233	229	139	102	242	146	126	153
ISR	120	151	133	92	103	151	257	42	129	108	88	63	91	75	127	36	37	0	124	192	67	132	88	58	56	124	77	80	78
HUN	1048	1053	803	773	828	897	1408	379	819	428	601	518	405	681	972	120	138	85	0	1085	403	776	392	339	248	828	521	402	299
POL	1700	2993	1748	1595	1742	2288	2830	691	1539	631	1018	910	578	1011	1458	285	339	152	983	0	426	1141	777	505	418	1263	684	468	565
ZAF	478	437	395	408	278	446	634	220	455	312	428	293	298	407	312	52	57	43	335	322	0	429	175	183	107	449	278	280	161
JPN	794	708	611	522	580	655	993	340	598	331	554	394	294	485	462	94	86	56	424	640	282	0	406	327	229	804	636	417	263
LVA	371	781	373	289	364	444	684	182	302	167	235	213	142	233	356	83	139	57	281	638	101	175	0	206	206	481	275	210	297
SVK	334	547	238	267	234	417	404	129	237	167	168	195	107	178	479	39	58	24	235	362	101	115	104	0	106	354	226	193	159
LTU	171	514	213	122	166	225	283	59	181	91	121	92	74	97	199	31	46	25	150	325	40	74	133	48	0	245	159	134	166
PRT	1329	1363	1032	1043	1017	1283	1706	517	1021	543	790	782	478	949	824	142	165	81	822	1295	404	489	372	237	153	0	553	430	366
KOR	813	512	433	398	523	437	1164	222	433	269	397	266	190	413	415	73	71	41	422	579	208	387	167	136	71	472	0	325	173
URY	539	391	332	311	301	376	926	180	421	333	381	210	241	315	342	38	74	44	342	405	241	256	124	123	78	384	263	0	155
HRV	218	754	395	286	296	476	350	148	280	154	215	249	142	245	337	103	110	54	218	515	109	122	232	79	113	300	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	144	518	215	300	192	53	168	70	97	9	44
DFS	141	0	240	193	182	205	176	166	109	178	37	62
USA	548	225	0	431	545	279	119	323	100	170	39	76
NZL	225	172	509	0	510	260	105	225	86	111	106	58
AUS	307	155	590	566	0	256	88	259	84	109	53	60
GBR	192	197	303	263	253	0	111	182	104	125	65	76
NLD	47	180	123	101	78	103	0	83	56	122	27	43
ZAF	164	148	337	232	243	183	79	0	90	96	34	59
ITA	67	110	107	85	79	106	56	83	0	60	19	44
DEU	93	177	169	106	100	122	118	93	61	0	21	53
IRL	6	33	40	118	50	68	25	34	18	21	0	18
CHE	38	62	77	49	50	73	36	52	43	49	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	144	518	215	300	192	53	168	70	97	9	44
DFS	141	0	240	193	182	205	176	166	109	178	37	62
USA	548	225	0	431	545	278	119	323	100	170	39	76
NZL	225	172	509	0	510	260	105	225	86	111	106	59
AUS	307	155	590	566	0	256	88	259	84	109	53	60
GBR	192	197	302	263	253	0	111	182	104	125	65	76
NLD	47	180	123	101	78	103	0	83	56	122	27	43
ZAF	164	148	337	232	243	183	79	0	90	96	34	59
ITA	67	110	107	85	79	106	56	83	0	60	19	44
DEU	93	177	169	106	100	122	118	93	61	0	21	53
IRL	6	33	40	118	50	68	25	34	18	21	0	18
CHE	38	62	77	49	50	73	36	52	43	49	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	144	518	215	300	192	53	168	70	97	9	44
DFS	141	0	240	193	182	205	176	166	109	178	37	62
USA	548	225	0	431	545	280	119	323	100	170	39	76
NZL	225	172	509	0	510	261	105	225	86	111	106	58
AUS	307	155	590	566	0	257	88	259	84	109	53	60
GBR	193	198	305	265	254	0	111	182	104	125	65	76
NLD	47	180	123	101	78	103	0	83	56	122	27	43
ZAF	164	148	337	232	243	183	79	0	90	96	34	59
ITA	67	110	107	85	79	106	56	83	0	60	19	44
DEU	93	177	169	106	100	122	118	93	61	0	21	53
IRL	6	33	40	118	50	68	25	34	18	21	0	18
CHE	38	62	77	49	50	73	36	52	43	49	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	235	99	108	102	198	14	75	3	10	22	3	7	0
NOR	7	0	88	56	81	77	147	17	0	34	20	25	49	55	0
USA	220	89	0	144	155	140	228	27	64	28	25	41	25	51	32
NZL	100	56	144	0	175	101	210	23	39	23	19	25	11	28	13
AUS	109	70	157	175	0	106	219	48	38	49	40	46	15	46	14
GBR	100	81	132	97	104	0	135	16	43	15	17	29	19	47	0
DFS	205	122	225	206	193	129	0	68	53	147	132	107	15	60	0
DEU	13	16	25	23	47	16	59	0	1	33	36	28	5	19	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	34	27	21	44	13	134	33	0	0	56	22	0	24	0
LVA	10	18	22	16	36	16	91	30	2	48	0	48	3	17	0
LTU	21	22	36	24	43	27	92	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	50	27	44	46	57	18	2	23	16	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	234	99	108	102	198	14	75	3	10	22	3	7	0
NOR	7	0	87	56	81	77	147	17	0	34	20	25	49	55	0
USA	219	88	0	144	155	139	225	27	64	28	25	41	25	51	32
NZL	100	56	144	0	175	101	210	23	39	23	19	25	11	28	13
AUS	109	70	157	175	0	106	219	48	38	49	40	46	15	46	14
GBR	100	81	131	97	104	0	135	16	43	15	17	29	19	47	0
DFS	205	122	222	206	193	129	0	68	53	147	132	107	15	60	0
DEU	13	16	25	23	47	16	59	0	1	33	36	28	5	19	0

ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	34	27	21	44	13	134	33	0	0	56	22	0	24	0
LVA	10	18	22	16	36	16	91	30	2	48	0	48	3	17	0
LTU	21	22	36	24	43	27	92	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	50	27	44	46	57	18	2	23	16	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	234	99	108	102	198	14	75	3	10	22	3	7	0
NOR	7	0	87	56	81	77	147	17	0	34	20	25	49	55	0
USA	219	88	0	144	155	140	225	27	64	28	25	41	25	51	32
NZL	100	56	144	0	175	101	210	23	39	23	19	25	11	28	13
AUS	109	70	157	175	0	106	219	48	38	49	40	46	15	46	14
GBR	100	81	132	97	104	0	135	16	43	15	17	29	19	47	0
DFS	205	122	222	206	193	129	0	68	53	147	132	107	15	60	0
DEU	13	16	25	23	47	16	59	0	1	33	36	28	5	19	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	34	27	21	44	13	134	33	0	0	56	22	0	24	0
LVA	10	18	22	16	36	16	91	30	2	48	0	48	3	17	0
LTU	21	22	36	24	43	27	92	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	50	27	44	46	57	18	2	23	16	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	389	247	104	2	15	94	57	56	2	34
DEA	358	0	292	1107	280	262	408	68	55	741	40
FRM	299	335	0	194	11	2	135	72	73	2	92
ITA	106	1015	219	0	159	148	267	66	48	348	39
SVN	2	263	10	150	0	55	87	6	0	135	2
FRA	12	220	1	132	51	0	82	6	0	105	3
NLD	96	427	158	261	81	78	0	59	53	172	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	2	775	1	331	125	94	166	9	0	0	5
USA	33	43	107	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	388	247	104	2	15	94	57	56	2	34
DEA	358	0	292	1108	280	262	408	68	55	739	40
FRM	299	335	0	194	11	2	135	72	73	2	92
ITA	106	1016	219	0	159	148	267	66	48	347	39
SVN	2	263	10	150	0	55	87	6	0	135	2
FRA	12	220	1	132	51	0	82	6	0	105	3
NLD	96	427	158	261	81	78	0	59	53	172	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	2	773	1	330	125	94	166	9	0	0	5
USA	33	43	107	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	388	247	104	2	15	94	57	56	2	34
DEA	358	0	292	1107	280	262	408	68	55	740	40
FRM	299	335	0	194	11	2	135	72	73	2	92
ITA	106	1015	219	0	159	148	267	66	48	347	39
SVN	2	263	10	150	0	55	87	6	0	135	2
FRA	12	220	1	132	51	0	82	6	0	105	3
NLD	96	427	158	261	81	78	0	59	53	172	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	2	774	1	330	125	94	166	9	0	0	5
USA	33	43	107	46	2	3	33	17	28	5	0