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 prodcution traits are as follows:

ISR (HOL)	Slight reductions for a few bulls in number of daughters due to edits and paternity corrections
SVN (ALL)	Some changes in information due to changes in data base related do the pedigree completness and phenotypic data improvement
FRA (ALL)	Some drops in information due to corrections made in pedigree
AUS (ALL)	Decrease in information as a result of data clean up such as pedigree changes, causing also changes in type of proofs. Change of status of bull which leads to a good number of bulls no longer being qualified. Decreases in EDC due to rounding.
AUS (RDC)	Completely different analysis for the red breeds which are now analysed separately from the other breeds holsteins and Jersey
DEA (BSW,SIM)	Base change. Some drops in reliability due to pedigree changes. For SIM few bulls show slight decrease in number of herds/EDC with same number of daughters. This could be expected with herd changes regarding to the movement of cows from alpine pasturing back to herds in the valleys.
POL(HOL)	Test data submission as a result of a new software application. Computational technologies we used so far seems not to be able to deal with still growing data amount in near future. Software upgrade based on new libraries and compilers implementation, improved data workflow without changing mathematical model itself.
JPN (HOL)	Drops in information due to parentage checks
BEL (HOL)	Some decrease in information due to pedigree correction
CHE (HOL)	In-depth corrections and renewal of the database table containing bull information by one of our breeding associations lead to changes in status of bulls and type of proof as well as a fewer number of EBV delivered. Slight changes in number of daughters, number of herds and EDC are due to manual edits in the database.
CHE (SIM)	In-depth corrections and renewal of the database table containing bull information by one of our breeding associations lead to changes in status of bulls and type of proof as well as a fewer number of EBV delivered. Slight changes in number of daughters, number of herds and EDC are due to manual edits in the database.
ITA (SIM)	Small decrease in information due to pedigree correction
NZL (ALL)	Daughter counts â\200\223 affects all traits. New Zealand has continuous DNA parentage testing so daughters will always change Herd Count â\200\223 affects all traits. Affected by continuous DNA parentage testing. EDCs â\200\223 affects all traits. Affected by continuous DNA parentage testing and a bug was found in the EDC calculation so a fix was applied
NZL (ALL)	As above + following changes: Sampling is used to obtain a superior estimate of reliability; Aggressive data filtering to exclude records that are extreme outliers;Both heterosis and recombination loss accounted;Days in milk is fit as a fixed effect - better fit than a polynomial;Age at lactation start is fit as a fixed effect - better fit than a polynomial
LVA (HOL,RDC)	Removed animals with no pedigree information and cross breeeds, affecting mostly HOL and old bulls

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

Post-processing Windows:

According to the decision taken by ITC in Orlando (2015) to review the

post-processing windows every 5 years, during the 2020 the relative working group
has been re-activated and new windows have been identified.

As before, 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. Over the past five years, in fact, the previous adopted lower value (25th percentile) had been found too high
causing estimated and post-processed correlations to differ significantly from each other.
The new lower values have been applied to all breeds and traits.

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.
The new weights are as follows:
No changes   :: 2
Small changes:: 1
Big changes :: 0

More information can be read on https://interbull.org/ib/rg_procedure

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 2021).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	218	145	8665	1851	817	
BEL			2199			
CAN	272	104	13382	835	857	
CHE	3102		3233	96		3459
CZE			4951			
DEA	6244					25409
DEU			23357	209	284	
DFS			13805	2283	7929	
ESP			4291			
EST			1285		472	
FRA	427		17699			499
FRM						4945
GBR	180	364	7792	952	672	94
HUN			3615			237
IRL			2995	162	62	101
ISR			1607			
ITA	2265		9351	171		1861

JPN			6548				
KOR			1615				
LTU			1275		438		
LVA			1390		705		
NLD	208		16366	212	91	457	
NOR					4260		
NZL	81	61	8687	5343	1496		
POL			11714				
PRT			2496				
SVK			1161				
SVN	413		669			725	
URY			1136				
USA	1171	802	41003	5146	768	84	
ZAF			1323	734	144		
HRV			894			1004	
CAM					45		
No.Records	14581	1476	214504	17994	19040	38875	
Pub. Proofs	11689	1169	156662	14377	16894	35052	

^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	654.21										
FRA	0.89	626.36									
USA	0.92	0.88	639.41								
CHE	0.90	0.88	0.87	493.41							
ITA	0.88	0.81	0.88	0.87	608.41						
DEA	0.86	0.82	0.86	0.94	0.89	464.17					
NLD	0.88	0.86	0.87	0.85	0.86	0.86	661.52				
SVN	0.74	0.74	0.74	0.73	0.69	0.71	0.73	9.12			
NZL	0.66	0.73	0.70	0.69	0.64	0.67	0.70	0.64	441.48		
GBR	0.86	0.87	0.85	0.87	0.82	0.80	0.85	0.73	0.70	290.35	
AUS	0.73	0.75	0.70	0.69	0.66	0.64	0.72	0.68	0.82	0.72	387.74

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.87										
FRA	0.88	26.39									
USA	0.90	0.89	23.60								
CHE	0.86	0.87	0.84	19.42							
ITA	0.88	0.83	0.86	0.86	23.23						
DEA	0.83	0.84	0.84	0.94	0.87	17.32					
NLD	0.86	0.85	0.85	0.83	0.85	0.86	26.04				
SVN	0.74	0.74	0.74	0.72	0.68	0.73	0.72	9.55			
NZL	0.70	0.74	0.71	0.76	0.64	0.79	0.68	0.66	20.55		
GBR	0.85	0.89	0.86	0.87	0.82	0.79	0.86	0.72	0.72	10.70	
AUS	0.73	0.72	0.73	0.65	0.66	0.67	0.69	0.66	0.79	0.70	15.39

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.56										
FRA	0.83	20.02									
USA	0.89	0.86	18.88								
CHE	0.84	0.83	0.83	15.78							
ITA	0.84	0.79	0.83	0.84	21.30						
DEA	0.82	0.78	0.82	0.93	0.88	14.49					
NLD	0.85	0.81	0.83	0.82	0.82	0.84	21.77				
SVN	0.72	0.70	0.71	0.69	0.69	0.69	0.71	8.96			
NZL	0.59	0.65	0.64	0.68	0.60	0.71	0.62	0.61	15.07		

GBR	0.84	0.84	0.83	0.84	0.79	0.76	0.84	0.71	0.64	8.58
AUS	0.70	0.66	0.67	0.62	0.61	0.62	0.66	0.62	0.77	0.67	12.02

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	758.86				
USA	0.93	782.51			
AUS	0.79	0.74	468.06		
GBR	0.86	0.82	0.73	247.90	
NZL	0.70	0.67	0.82	0.69	373.32

GUE fat

	CAN	USA	AUS	GBR	NZL
CAN	29.98				
USA	0.93	27.78			
AUS	0.78	0.75	17.33		
GBR	0.86	0.83	0.73	10.18	
NZL	0.70	0.71	0.80	0.70	18.35

GUE pro

	CAN	USA	AUS	GBR	NZL
CAN	23.19				
USA	0.91	21.53			
AUS	0.70	0.65	13.40		
GBR	0.85	0.81	0.68	7.36	
NZL	0.60	0.58	0.78	0.61	12.81

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	794.82																												
DEU	0.93	647.55																											
DFS	0.93	0.94	11.18																										
FRA	0.91	0.91	0.91	655.59																									
ITA	0.89	0.88	0.88	0.88	588.36																								
NLD	0.91	0.94	0.92	0.90	0.87	668.39																							
USA	0.93	0.92	0.90	0.91	0.90	0.89	713.03																						
CHE	0.90	0.92	0.89	0.93	0.88	0.91	0.88	571.35																					
GBR	0.86	0.85	0.84	0.86	0.82	0.86	0.84	0.89	276.90																				
NZL	0.68	0.67	0.68	0.74	0.66	0.70	0.69	0.74	0.69	391.16																			
AUS	0.77	0.74	0.71	0.78	0.71	0.75	0.74	0.77	0.73	0.82	420.32																		
BEL	0.86	0.86	0.81	0.82	0.78	0.82	0.81	0.80	0.77	0.68	0.77	501.16																	
IRL	0.83	0.84	0.83	0.89	0.80	0.86	0.82	0.87	0.81	0.81	0.81	0.79	180.37																
ESP	0.93	0.92	0.90	0.92	0.89	0.90	0.92	0.89	0.84	0.68	0.76	0.86	0.83	533.71															
CZE	0.86	0.88	0.84	0.81	0.82	0.81	0.85	0.78	0.77	0.64	0.70	0.83	0.73	0.85	701.07														
SVN	0.80	0.80	0.79	0.80	0.74	0.78	0.77	0.72	0.71	0.61	0.68	0.77	0.69	0.80	0.78	11.23													
EST	0.89	0.88	0.89	0.85	0.84	0.85	0.89	0.86	0.79	0.67	0.75	0.80	0.75	0.86	0.85	0.74	559.88												
ISR	0.82	0.83	0.83	0.83	0.84	0.82	0.86	0.82	0.80	0.62	0.67	0.81	0.70	0.85	0.81	0.81	0.82	391.85											
HUN	0.86	0.87	0.85	0.87	0.89	0.85	0.89	0.85	0.82	0.64	0.67	0.76	0.78	0.85	0.83	0.73	0.84	0.84	684.77										
POL	0.88	0.90	0.87	0.87	0.86	0.88	0.88	0.85	0.82	0.66	0.74	0.81	0.80	0.88	0.85	0.78	0.87	0.81	0.88	409.85									
ZAF	0.84	0.79	0.79	0.82	0.80	0.77	0.83	0.78	0.77	0.65	0.77	0.77	0.76	0.82	0.79	0.73	0.77	0.81	0.80	0.79	540.53								
JPN	0.94	0.92	0.93	0.91	0.90	0.91	0.92	0.89	0.83	0.68	0.76	0.84	0.82	0.91	0.84	0.82	0.87	0.87	0.85	0.88	0.83	625.25							
LVA	0.76	0.77	0.75	0.78	0.74	0.75	0.77	0.75	0.73	0.60	0.64	0.72	0.72	0.76	0.72	0.71	0.78	0.81	0.76	0.76	0.74	0.75	503.92						
SVK	0.79	0.80	0.81	0.79	0.79	0.76	0.79	0.78	0.77	0.60	0.65	0.78	0.71	0.80	0.80	0.75	0.81	0.82	0.82	0.81	0.75	0.82	0.73	383.55					
LTU	0.73	0.74	0.74	0.75	0.70	0.72	0.72	0.73	0.71	0.61	0.67	0.77	0.70	0.73	0.72	0.73	0.75	0.81	0.71	0.72	0.72	0.75	0.78	0.71	370.44				
PRT	0.78	0.78	0.79	0.79	0.77	0.78	0.79	0.77	0.74	0.60	0.63	0.71	0.72	0.79	0.71	0.74	0.75	0.80	0.76	0.75	0.67	0.77	0.70	0.74	0.67	591.19			
KOR	0.85	0.80	0.81	0.81	0.79	0.79	0.85	0.79	0.76	0.70	0.74	0.82	0.73	0.85	0.80	0.75	0.82	0.81	0.77	0.78	0.80	0.85	0.74	0.79	0.71	0.72	488.79		
URY	0.74	0.74	0.73	0.77	0.74	0.74	0.74	0.74	0.71	0.75	0.74	0.74	0.71	0.75	0.72	0.72	0.75	0.81	0.74	0.72	0.76	0.73	0.73	0.70	0.71	0.67	0.74	168.16	
HRV	0.72	0.72	0.74	0.73	0.71	0.74	0.71	0.68	0.71	0.59	0.63	0.72	0.64	0.72	0.69	0.70	0.73	0.81	0.72	0.72	0.75	0.73	0.70	0.73	0.70	0.68	0.71	0.70	11.45

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	31.63																												
DEU	0.93	24.04																											
DFS	0.92	0.92	10.97																										
FRA	0.91	0.91	0.90	26.56																									
ITA	0.88	0.88	0.85	0.89	24.63																								
NLD	0.89	0.93	0.91	0.88	0.84	25.33																							
USA	0.92	0.92	0.88	0.91	0.91	0.88	26.50																						
CHE	0.87	0.90	0.88	0.90	0.84	0.88	0.85	22.97																					
GBR	0.86	0.88	0.85	0.88	0.83	0.87	0.86	0.89	9.76																				
NZL	0.66	0.65	0.68	0.71	0.63	0.66	0.70	0.71	0.70	15.33																			
AUS	0.74	0.72	0.70	0.75	0.70	0.69	0.75	0.70	0.72	0.78	14.74																		
BEL	0.85	0.86	0.80	0.83	0.79	0.82	0.81	0.79	0.79	0.67	0.75	20.25																	
IRL	0.81	0.80	0.83	0.84	0.74	0.83	0.79	0.83	0.79	0.80	0.79	0.82	6.82																
ESP	0.91	0.91	0.86	0.91	0.90	0.88	0.93	0.85	0.85	0.65	0.75	0.82	0.79	21.22															
CZE	0.84	0.86	0.83	0.81	0.81	0.79	0.84	0.75	0.77	0.56	0.67	0.80	0.68	0.84	22.27														
SVN	0.78	0.79	0.77	0.76	0.74	0.77	0.76	0.71	0.69	0.58	0.62	0.78	0.66	0.78	0.76	11.53													
EST	0.87	0.89	0.90	0.87	0.87	0.85	0.88	0.85	0.80	0.75	0.76	0.85	0.81	0.87	0.84	0.79	22.19												
ISR	0.79	0.81	0.78	0.80	0.79	0.78	0.85	0.77	0.77	0.60	0.61	0.71	0.63	0.81	0.78	0.72	0.79	14.60											
HUN	0.84	0.87	0.79	0.86	0.88	0.81	0.89	0.81	0.80	0.60	0.66	0.75	0.70	0.87	0.80	0.71	0.82	0.82	27.30										
POL	0.89	0.92	0.86	0.88	0.88	0.86	0.90	0.81	0.82	0.65	0.69	0.84	0.76	0.92	0.85	0.78	0.90	0.80	0.87	16.91									
ZAF	0.75	0.74	0.69	0.76	0.75	0.72	0.76	0.72	0.73	0.56	0.66	0.71	0.66	0.77	0.74	0.70	0.76	0.75	0.75	0.76	19.40								
JPN	0.92	0.91	0.92	0.89	0.87	0.89	0.90	0.88	0.84	0.67	0.69	0.83	0.81	0.87	0.81	0.81	0.87	0.80	0.79	0.88	0.72	24.02							
LVA	0.78	0.79	0.75	0.79	0.78	0.76	0.79	0.77	0.75	0.63	0.67	0.79	0.66	0.80	0.76	0.71	0.85	0.80	0.77	0.80	0.75	0.77	20.34						
SVK	0.77	0.79	0.77	0.78	0.80	0.75	0.79	0.74	0.75	0.56	0.64	0.77	0.64	0.80	0.79	0.74	0.84	0.77	0.79	0.81	0.70	0.77	0.77	15.36					
LTU	0.72	0.73	0.71	0.73	0.69	0.71	0.72	0.72	0.70	0.57	0.63	0.76	0.63	0.71	0.71	0.72	0.77	0.72	0.69	0.74	0.71	0.71	0.76	0.70	16.39				
PRT	0.76	0.78	0.75	0.77	0.77	0.75	0.78	0.75	0.76	0.58	0.63	0.69	0.66	0.79	0.69	0.72	0.74	0.70	0.76	0.76	0.66	0.76	0.72	0.69	0.67	23.76			
KOR	0.84	0.81	0.78	0.80	0.80	0.79	0.86	0.79	0.79	0.67	0.76	0.82	0.72	0.85	0.79	0.77	0.82	0.78	0.78	0.83	0.75	0.84	0.77	0.77	0.72	0.71	19.91		
URY	0.76	0.76	0.74	0.79	0.75	0.73	0.77	0.73	0.75	0.72	0.70	0.74	0.72	0.75	0.73	0.71	0.82	0.74	0.74	0.77	0.72	0.74	0.78	0.69	0.70	0.66	0.74	6.70	
HRV	0.71	0.73	0.75	0.73	0.74	0.73	0.73	0.68	0.71	0.56	0.62	0.71	0.62	0.72	0.73	0.71	0.73	0.75	0.71	0.72	0.71	0.74	0.69	0.71	0.69	0.69	0.78	0.70	11.71

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	22.28																												
DEU	0.91	17.89																											
DFS	0.91	0.93	10.59																										
FRA	0.86	0.87	0.89	18.07																									
ITA	0.86	0.85	0.86	0.84	18.19																								
NLD	0.87	0.92	0.89	0.84	0.83	19.08																							
USA	0.90	0.91	0.89	0.88	0.87	0.85	18.47																						
CHE	0.84	0.88	0.85	0.89	0.83	0.85	0.84	16.47																					
GBR	0.85	0.85	0.84	0.85	0.81	0.86	0.84	0.87	7.44																				
NZL	0.57	0.57	0.59	0.64	0.55	0.60	0.59	0.63	0.61	11.57																			
AUS	0.67	0.65	0.65	0.68	0.64	0.66	0.66	0.66	0.67	0.77	10.93																		
BEL	0.80	0.81	0.77	0.76	0.75	0.78	0.77	0.74	0.77	0.58	0.68	14.66																	
IRL	0.75	0.75	0.76	0.80	0.73	0.78	0.74	0.79	0.77	0.75	0.77	0.72	5.51																
ESP	0.91	0.89	0.88	0.88	0.86	0.86	0.89	0.84	0.84	0.58	0.68	0.79	0.77	15.31															
CZE	0.79	0.81	0.78	0.74	0.76	0.75	0.78	0.69	0.73	0.46	0.60	0.77	0.62	0.78	16.94														
SVN	0.75	0.76	0.74	0.76	0.71	0.74	0.73	0.67	0.68	0.52	0.60	0.73	0.64	0.77	0.72	10.73													
EST	0.83	0.87	0.86	0.79	0.79	0.81	0.85	0.83	0.78	0.59	0.66	0.78	0.66	0.81	0.78	0.70	16.78												
ISR	0.79	0.80	0.81	0.82	0.81	0.79	0.82	0.80	0.77	0.47	0.56	0.69	0.61	0.81	0.72	0.71	0.77	10.11											
HUN	0.81	0.85	0.81	0.84	0.85	0.80	0.86	0.83	0.79	0.52	0.60	0.71	0.67	0.81	0.75	0.69	0.80	0.81	21.97										
POL	0.84	0.87	0.84	0.81	0.82	0.83	0.84	0.79	0.79	0.54	0.63	0.78	0.72	0.85	0.79	0.74	0.86	0.75	0.84	11.31									
ZAF	0.78	0.75	0.74	0.77	0.74	0.73	0.77	0.73	0.75	0.59	0.71	0.72	0.67	0.77	0.72	0.69	0.74	0.78	0.75	0.75	14.76								
JPN	0.91	0.89	0.91	0.87	0.88	0.86	0.90	0.85	0.83	0.58	0.67	0.78	0.75	0.88	0.77	0.78	0.85	0.82	0.80	0.85	0.77	17.02							
LVA	0.75	0.75	0.72	0.75	0.73	0.72	0.76	0.72	0.73	0.52	0.59	0.73	0.65	0.75	0.69	0.69	0.79	0.75	0.73	0.75	0.72	0.73	14.79						
SVK	0.78	0.79	0.79	0.78	0.78	0.74	0.77	0.76	0.75	0.50	0.60	0.75	0.65	0.77	0.77	0.70	0.79	0.80	0.79	0.77	0.72	0.80	0.73	10.65					
LTU	0.70	0.70	0.69	0.71	0.68	0.69	0.68	0.68	0.69	0.49	0.60	0.74	0.61	0.69	0.68	0.70	0.71	0.71	0.68	0.67	0.70	0.69	0.74	0.69	11.20				
PRT	0.74	0.75	0.76	0.76	0.74	0.73	0.75	0.73	0.72	0.52	0.56	0.65	0.65	0.76	0.65	0.73	0.71	0.74	0.73	0.71	0.65	0.74	0.70	0.69	0.66	17.90			
KOR	0.82	0.78	0.78	0.77	0.78	0.77	0.82	0.76	0.75	0.58	0.65	0.80	0.66	0.83	0.76	0.72	0.79	0.77	0.74	0.77	0.75	0.81	0.72	0.77	0.69	0.68	13.61		
URY	0.70	0.71	0.70	0.76	0.69	0.69	0.70	0.68	0.68	0.70	0.67	0.68	0.65	0.71	0.68	0.70	0.70	0.71	0.69	0.66	0.71	0.68	0.73	0.68	0.69	0.65	0.69	5.20	
HRV	0.71	0.71	0.72	0.70	0.70	0.72	0.69	0.66	0.69	0.48	0.57	0.73	0.57	0.71	0.68	0.69	0.70	0.70	0.70	0.69	0.70	0.71	0.68	0.69	0.68	0.65	0.69	0.69	11.18

JER mil

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	595.72											
DFS	0.92	9.18										
USA	0.91	0.90	689.94									
NZL	0.73	0.74	0.73	306.71								
AUS	0.80	0.72	0.74	0.81	383.82							
GBR	0.83	0.82	0.79	0.67	0.71	212.32						
NLD	0.91	0.91	0.88	0.69	0.75	0.83	620.91					
ZAF	0.87	0.83	0.84	0.76	0.80	0.75	0.77	377.52				
ITA	0.90	0.88	0.89	0.74	0.79	0.80	0.85	0.89	548.24			
DEU	0.92	0.94	0.92	0.67	0.71	0.83	0.93	0.80	0.87	620.26		
IRL	0.81	0.79	0.77	0.90	0.82	0.73	0.81	0.75	0.79	0.80	177.15	
CHE	0.87	0.87	0.83	0.73	0.76	0.84	0.89	0.79	0.84	0.90	0.82	338.61

JER fat

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	26.70											
DFS	0.89	11.13										
USA	0.90	0.88	26.55									
NZL	0.67	0.67	0.71	14.13								
AUS	0.77	0.70	0.76	0.78	13.79							
GBR	0.82	0.80	0.81	0.67	0.70	9.61						
NLD	0.86	0.85	0.84	0.66	0.68	0.81	25.36					
ZAF	0.78	0.77	0.76	0.61	0.70	0.70	0.71	13.73				
ITA	0.88	0.84	0.87	0.66	0.71	0.78	0.81	0.78	25.86			
DEU	0.92	0.92	0.89	0.65	0.72	0.85	0.90	0.78	0.87	23.25		
IRL	0.78	0.77	0.75	0.83	0.80	0.74	0.79	0.65	0.72	0.77	6.14	
CHE	0.85	0.84	0.82	0.72	0.72	0.81	0.82	0.76	0.82	0.89	0.78	16.40

JER pro

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	19.36											
DFS	0.89	10.51										
USA	0.89	0.90	20.41									
NZL	0.64	0.68	0.67	10.20								
AUS	0.70	0.67	0.67	0.75	10.50							
GBR	0.82	0.82	0.79	0.65	0.68	7.04						
NLD	0.87	0.87	0.84	0.64	0.67	0.81	19.93					
ZAF	0.81	0.78	0.78	0.67	0.69	0.73	0.73	11.02				
ITA	0.86	0.85	0.86	0.61	0.68	0.78	0.82	0.86	19.67			
DEU	0.89	0.93	0.90	0.63	0.65	0.82	0.91	0.77	0.85	19.12		
IRL	0.74	0.75	0.73	0.84	0.79	0.72	0.76	0.67	0.72	0.75	5.61	
CHE	0.81	0.82	0.79	0.67	0.63	0.78	0.82	0.73	0.78	0.87	0.77	11.88

RDC mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	599.57														
NOR	0.87	12.15													
USA	0.92	0.91	703.87												
NZL	0.65	0.70	0.67	369.12											
AUS	0.73	0.73	0.74	0.81	415.74										
GBR	0.83	0.82	0.82	0.68	0.75	260.41									
DFS	0.90	0.90	0.87	0.66	0.72	0.81	10.35								
DEU	0.93	0.83	0.90	0.66	0.71	0.85	0.93	665.84							
ZAF	0.83	0.84	0.84	0.69	0.76	0.75	0.79	0.79	610.12						
EST	0.88	0.86	0.89	0.69	0.73	0.80	0.83	0.81	0.78	504.03					
LVA	0.77	0.80	0.78	0.64	0.68	0.75	0.77	0.76	0.76	0.81	325.28				
LTU	0.76	0.77	0.73	0.63	0.65	0.74	0.71	0.74	0.76	0.73	0.78	316.23			
IRL	0.83	0.76	0.81	0.82	0.82	0.79	0.81	0.83	0.76	0.76	0.73	0.73	178.33		
NLD	0.91	0.91	0.88	0.68	0.74	0.86	0.92	0.94	0.78	0.83	0.76	0.74	0.84	804.21	
CAM	0.84	0.86	0.93	0.67	0.75	0.83	0.83	0.83	0.83	0.84	0.83	0.82	0.80	0.83	449.00

RDC fat

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.37														
NOR	0.86	11.69													
USA	0.90	0.82	26.54												
NZL	0.64	0.75	0.68	15.74											
AUS	0.71	0.71	0.76	0.80	15.29										
GBR	0.83	0.80	0.84	0.67	0.72	8.62									
DFS	0.89	0.88	0.86	0.69	0.72	0.82	10.35								
DEU	0.92	0.87	0.91	0.65	0.70	0.87	0.91	25.20							
ZAF	0.78	0.83	0.82	0.61	0.68	0.73	0.75	0.74	19.31						
EST	0.86	0.79	0.88	0.68	0.72	0.80	0.81	0.84	0.77	19.77					
LVA	0.78	0.77	0.79	0.64	0.65	0.75	0.75	0.79	0.77	0.83	14.01				
LTU	0.74	0.78	0.75	0.64	0.71	0.73	0.71	0.73	0.76	0.76	0.77	15.05			
IRL	0.81	0.74	0.80	0.81	0.80	0.78	0.81	0.80	0.67	0.81	0.69	0.73	7.46		
NLD	0.89	0.86	0.87	0.65	0.69	0.86	0.91	0.93	0.73	0.82	0.77	0.73	0.81	28.35	
CAM	0.84	0.84	0.93	0.65	0.73	0.83	0.83	0.83	0.84	0.84	0.83	0.83	0.80	0.84	22.35

RDC pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.15														
NOR	0.84	11.60													
USA	0.89	0.88	20.11												
NZL	0.57	0.69	0.64	11.44											
AUS	0.65	0.70	0.68	0.76	12.11										
GBR	0.82	0.81	0.82	0.59	0.69	6.93									
DFS	0.89	0.88	0.86	0.63	0.64	0.80	10.53								
DEU	0.91	0.84	0.89	0.58	0.63	0.85	0.92	20.03							
ZAF	0.78	0.83	0.79	0.63	0.71	0.72	0.74	0.75	16.37						
EST	0.83	0.79	0.86	0.63	0.65	0.78	0.78	0.80	0.75	15.50					
LVA	0.75	0.76	0.76	0.56	0.59	0.73	0.72	0.75	0.74	0.76	9.57				
LTU	0.70	0.74	0.68	0.52	0.58	0.69	0.66	0.68	0.72	0.69	0.72	9.51			
IRL	0.75	0.76	0.76	0.78	0.78	0.75	0.75	0.75	0.68	0.69	0.68	0.65	5.45		
NLD	0.87	0.91	0.84	0.59	0.65	0.84	0.90	0.92	0.74	0.78	0.74	0.69	0.77	26.85	
CAM	0.83	0.84	0.91	0.67	0.72	0.82	0.83	0.82	0.83	0.83	0.82	0.80	0.78	0.82	11.11

SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	562.46											
DEA	0.87	507.26										
FRM	0.95	0.85	612.76									
ITA	0.80	0.75	0.76	507.53								
SVN	0.76	0.74	0.76	0.73	8.81							
FRA	0.91	0.88	0.83	0.84	0.79	675.47						
HUN	0.85	0.78	0.83	0.84	0.74	0.85	417.09					
NLD	0.88	0.92	0.89	0.79	0.72	0.87	0.84	758.71				
IRL	0.83	0.73	0.84	0.70	0.72	0.87	0.78	0.80	179.69			
GBR	0.88	0.86	0.87	0.80	0.71	0.86	0.82	0.86	0.78	228.61		
HRV	0.72	0.71	0.82	0.70	0.70	0.71	0.75	0.71	0.69	0.71	10.79	
USA	0.87	0.81	0.82	0.88	0.78	0.91	0.89	0.89	0.79	0.83	0.72	569.42

SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	22.39											
DEA	0.87	19.14										
FRM	0.93	0.89	24.12									
ITA	0.80	0.79	0.77	19.93								
SVN	0.75	0.76	0.74	0.73	8.84							
FRA	0.89	0.90	0.84	0.84	0.76	27.59						
HUN	0.81	0.79	0.83	0.85	0.74	0.85	16.57					
NLD	0.87	0.93	0.89	0.78	0.72	0.87	0.81	28.20				
IRL	0.77	0.73	0.81	0.67	0.70	0.83	0.70	0.78	7.81			

GBR	0.91	0.85	0.86	0.81	0.70	0.88	0.80	0.86	0.76	8.23	
HRV	0.70	0.66	0.81	0.67	0.68	0.70	0.72	0.68	0.68	0.70	10.73
USA	0.85	0.85	0.81	0.89	0.76	0.91	0.89	0.88	0.76	0.86	0.72	21.39

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	16.76											
DEA	0.86	15.48										
FRM	0.92	0.85	18.98									
ITA	0.75	0.73	0.74	16.02								
SVN	0.72	0.71	0.73	0.69	8.95							
FRA	0.88	0.85	0.82	0.80	0.76	21.54						
HUN	0.83	0.78	0.82	0.83	0.72	0.82	13.47					
NLD	0.83	0.91	0.86	0.76	0.71	0.83	0.80	23.55				
IRL	0.75	0.73	0.80	0.64	0.68	0.79	0.68	0.74	6.35			
GBR	0.85	0.85	0.85	0.78	0.69	0.85	0.79	0.85	0.74	7.05		
HRV	0.71	0.68	0.81	0.68	0.69	0.70	0.73	0.69	0.65	0.70	10.80	
USA	0.82	0.77	0.77	0.85	0.74	0.88	0.86	0.85	0.72	0.82	0.70	16.47

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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	89	188	143	140	156	55	37	36	76	97
FRA	78	0	121	165	197	222	86	62	32	63	66
USA	184	81	0	322	250	340	83	47	45	108	127
CHE	122	122	299	0	486	609	100	90	42	85	118
ITA	124	155	177	425	0	762	133	110	44	93	123
DEA	138	163	304	504	661	0	154	120	57	92	131
NLD	51	70	75	94	112	148	0	53	33	44	58
SVN	34	60	38	86	108	111	54	0	16	27	30
NZL	35	24	38	31	36	51	26	14	0	29	39
GBR	75	52	102	65	68	63	38	22	25	0	64
AUS	100	50	120	79	90	94	42	23	31	58	0

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	89	188	143	140	156	55	37	36	76	97
FRA	78	0	121	165	197	222	86	62	32	63	66
USA	184	81	0	322	250	340	83	47	45	108	127
CHE	122	122	299	0	486	610	100	90	42	85	118
ITA	124	155	177	425	0	763	133	110	44	93	123
DEA	138	163	304	504	662	0	154	120	57	92	131
NLD	51	70	75	94	112	148	0	53	33	44	58
SVN	34	60	38	86	108	111	54	0	16	27	30
NZL	35	24	38	31	36	51	26	14	0	29	39
GBR	75	52	102	65	68	63	38	22	25	0	64
AUS	100	50	120	79	90	94	42	23	31	58	0

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	89	188	143	140	156	55	37	36	76	97
FRA	78	0	121	165	197	222	86	62	32	63	66
USA	184	81	0	322	250	340	83	47	45	108	127

CHE	122	122	299	0	486	609	100	90	42	85	118
ITA	124	155	177	425	0	762	133	110	44	93	123
DEA	138	163	304	504	661	0	154	120	57	92	131
NLD	51	70	75	94	112	148	0	53	33	44	58
SVN	34	60	38	86	108	111	54	0	16	27	30
NZL	35	24	38	31	36	51	26	14	0	29	39
GBR	75	52	102	65	68	63	38	22	25	0	64
AUS	100	50	120	79	90	94	42	23	31	58	0

GUE

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common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	73	51	36	14
USA	64	0	68	98	32
AUS	48	65	0	42	27
GBR	29	99	36	0	16
NZL	11	29	27	14	0

GUE

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common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	73	51	36	14
USA	64	0	68	98	32
AUS	48	65	0	42	27
GBR	29	99	36	0	16
NZL	11	29	27	14	0

GUE

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common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	73	51	36	14
USA	64	0	68	98	32
AUS	48	65	0	42	27
GBR	29	99	36	0	16
NZL	11	29	27	14	0

HOL

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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	2467	1579	1538	1760	1647	3727	892	1801	823	1539	871	586	1379	1260	240	289	145	1108	1589	518	1392	537	449	324	1064	750	523	333
DEU	1898	0	2736	2420	2530	3396	3599	1146	2144	1030	1711	1278	874	1588	2012	359	455	174	1301	2735	563	1433	850	698	643	1237	663	496	675
DFS	1373	2038	0	1692	1579	2253	2231	737	1638	900	1369	925	751	1099	1403	283	328	158	981	1766	517	1012	525	422	387	951	526	439	440
FRA	1025	1275	920	0	1629	2032	2549	690	1583	829	1320	974	735	1199	1356	222	278	128	984	1785	485	1221	452	434	312	944	555	417	313
ITA	1412	1643	1181	856	0	1726	2597	726	1574	724	1213	818	615	1279	1301	255	291	142	1047	1728	451	1150	533	391	346	978	612	427	398
NLD	1590	3155	2001	1267	1374	0	2650	928	1862	1133	1547	1352	895	1201	1692	296	400	170	1046	2070	527	1102	588	559	423	1077	531	447	476
USA	4215	2633	1740	1353	1810	2345	0	1028	2376	1167	2055	1030	814	1642	1851	273	379	210	1428	2332	651	2009	716	562	436	1333	916	707	420
CHE	809	1077	689	617	654	927	960	0	727	427	650	625	400	587	562	154	176	67	447	723	264	474	302	241	187	499	284	219	211
GBR	2041	1636	1256	974	1171	1632	2149	690	0	989	1499	913	982	1140	1194	232	281	157	932	1485	522	1077	467	394	333	970	539	468	358
NZL	828	793	646	492	514	1035	1118	361	858	0	1268	555	739	575	712	149	154	121	538	730	377	598	274	274	200	593	345	383	239
AUS	1568	1295	1006	882	874	1369	2095	573	1303	1281	0	792	741	948	957	199	232	123	779	1149	490	936	416	322	277	806	490	460	316
BEL	869	1314	869	955	786	1559	921	638	901	453	701	0	525	721	756	196	213	87	584	893	345	572	326	312	222	683	329	263	292
IRL	550	758	616	572	505	838	731	409	1003	636	640	519	0	515	569	127	145	103	456	628	333	444	226	213	164	497	249	279	192
ESP	926	1037	837	867	904	1078	1093	485	895	439	681	711	490	0	966	215	226	117	831	1166	458	941	403	333	250	855	519	377	304
CZE	969	1610	963	866	929	1552	1503	434	868	535	656	623	452	714	0	250	299	142	1028	1518	441	914	487	534	350	867	528	422	404
SVN	174	347	225	151	213	255	210	110	170	104	139	156	97	157	189	0	104	51	183	295	104	186	139	96	88	177	111	81	128
EST	177	327	204	134	163	290	260	98	161	79	117	136	77	109	188	61	0	53	220	367	112	219	211	123	127	206	134	117	135
ISR	105	135	116	65	90	129	199	39	110	98	78	55	77	67	107	36	33	0	123	158	67	113	78	53	60	110	67	74	72

HUN	1043	1041	790	663	891	884	1406	374	807	421	593	509	399	672	962	136	135	84	0	1066	406	759	374	333	246	738	491	390	286
POL	1405	2503	1466	1181	1348	1945	2279	610	1273	559	884	824	519	839	1284	265	261	124	962	0	429	1045	697	470	475	1048	611	444	512
ZAF	483	441	399	343	341	449	642	224	459	314	433	296	300	411	316	74	57	43	339	325	0	431	175	185	121	447	278	280	160
JPN	715	634	549	428	546	582	891	318	550	313	517	366	279	449	416	101	81	47	414	565	284	0	374	316	237	711	590	406	243
LVA	330	698	334	214	338	402	598	163	273	156	211	198	132	215	330	82	130	50	271	565	100	161	0	198	250	421	254	196	281
SVK	313	513	224	226	221	392	374	124	224	164	161	189	105	168	458	51	54	22	233	327	101	110	100	0	141	329	215	188	151
LTU	174	596	223	118	181	265	298	86	173	96	124	119	80	106	238	46	64	29	151	369	50	79	172	73	0	247	160	129	178
PRT	1105	1128	842	786	887	1076	1395	453	883	484	644	688	450	815	725	138	140	77	731	1044	403	419	322	225	159	0	487	408	333
KOR	734	456	382	321	489	385	1060	203	395	253	361	240	173	369	388	67	64	39	400	512	209	353	150	130	68	406	0	312	158
URY	519	373	319	253	323	360	884	175	397	304	358	206	228	309	329	48	69	39	334	382	240	249	117	122	76	370	255	0	149
HRV	197	700	345	195	289	432	321	139	254	142	198	237	132	229	306	100	98	51	209	460	108	112	219	75	126	271	72	98	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	2467	1579	1538	1761	1647	3727	892	1801	823	1539	871	586	1379	1260	240	289	145	1108	1589	517	1388	537	449	324	1063	750	523	332
DEU	1898	0	2736	2420	2531	3396	3599	1146	2144	1030	1711	1278	874	1588	2012	359	455	174	1301	2735	562	1429	850	698	643	1236	663	496	674
DFS	1373	2038	0	1692	1581	2253	2231	737	1638	900	1369	925	751	1099	1403	283	328	158	981	1766	516	1010	525	422	387	951	526	439	439
FRA	1025	1275	920	0	1630	2032	2549	690	1583	829	1320	974	736	1199	1356	222	278	128	984	1785	484	1218	452	434	312	944	555	417	313
ITA	1416	1646	1185	858	0	1727	2599	727	1575	724	1214	819	615	1279	1302	255	291	142	1047	1729	450	1147	534	392	346	977	612	428	397
NLD	1590	3155	2001	1267	1376	0	2650	928	1862	1133	1547	1352	897	1201	1692	296	400	170	1046	2070	526	1097	588	559	423	1076	531	447	475
USA	4215	2633	1740	1353	1815	2345	0	1028	2376	1167	2055	1030	814	1642	1851	273	379	210	1428	2332	650	2005	716	562	436	1332	916	707	419
CHE	809	1077	689	617	656	927	960	0	727	427	650	625	400	587	562	154	176	67	447	723	263	471	302	241	187	499	284	219	210
GBR	2041	1636	1256	974	1174	1632	2149	690	0	989	1499	913	983	1140	1194	232	281	157	932	1485	521	1073	467	394	333	970	539	468	358
NZL	828	793	646	492	515	1035	1118	361	858	0	1268	555	739	575	712	149	154	121	538	730	376	598	274	274	200	593	345	383	238
AUS	1568	1295	1006	882	876	1369	2095	573	1303	1281	0	792	741	948	957	199	232	123	779	1149	489	934	416	322	277	806	490	460	316
BEL	869	1314	869	955	788	1559	921	638	901	453	701	0	525	721	756	196	213	87	584	893	344	571	326	312	222	683	329	263	291
IRL	550	758	616	572	506	840	731	409	1004	636	640	519	0	515	569	127	145	103	456	628	333	443	226	213	164	497	249	279	191
ESP	926	1037	837	867	906	1078	1093	485	895	439	681	711	490	0	966	215	226	117	831	1166	457	939	403	333	250	854	519	377	304
CZE	969	1610	963	866	932	1552	1503	434	868	535	656	623	452	714	0	250	299	142	1028	1518	440	911	487	534	350	867	528	422	403
SVN	174	347	225	151	213	255	210	110	170	104	139	156	97	157	189	0	104	51	183	295	103	184	139	96	88	176	111	81	128
EST	177	327	204	134	163	290	260	98	161	79	117	136	77	109	188	61	0	53	220	367	112	216	211	123	127	205	134	117	135
ISR	105	135	116	65	90	129	199	39	110	98	78	55	77	67	107	36	33	0	123	158	66	112	78	53	60	110	67	74	72
HUN	1043	1041	790	663	892	884	1406	374	807	421	593	509	399	672	962	136	135	84	0	1066	405	756	374	333	246	737	491	390	286
POL	1405	2503	1466	1181	1350	1945	2279	610	1273	559	884	824	519	839	1284	265	261	124	962	0	428	1040	697	470	475	1047	611	444	511
ZAF	482	440	398	342	342	447	640	223	457	314	432	296	300	410	315	73	57	43	338	324	0	429	174	184	120	446	278	279	159
JPN	709	629	546	424	541	577	883	315	545	312	513	364	278	445	413	99	78	46	410	559	283	0	373	315	237	708	589	405	243
LVA	330	698	334	214	339	402	598	163	273	156	211	198	132	215	330	82	130	50	271	565	100	160	0	198	250	420	254	196	281
SVK	313	513	224	226	223	392	374	124	224	164	161	189	105	168	458	51	54	22	233	327	101	109	100	0	141	329	215	188	151
LTU	174	596	223	118	181	265	298	86	173	96	124	119	80	106	238	46	64	29	151	369	49	79	172	73	0	247	160	129	178
PRT	1105	1128	842	785	890	1076	1395	453	883	484	644	688	450	814	725	138	140	77	731	1043	402	416	322	225	159	0	487	408	331
KOR	734	456	382	321	491	385	1059	203	395	253	361	240	173	369	388	67	64	39	400	512	209	351	150	130	68	406	0	312	158
URY	519	373	319	253	325	360	884	175	397	304	358	206	228	309	329	48	69	39	334	382	240	246	117	122	76	370	255	0	149
HRV	195	698	343	194	287	430	319	137	253	141	197	236	130	229	304	99	98	50	208	458	108	112	219	75	125	269	71	98	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	2467	1579	1538	1760	1647	3721	892	1801	823	1539	871	586	1379	1260	240	289	145	1108	1589	517	1386	537	449	324	1064	750	523	333
DEU	1898	0	2736	2420	2530	3396	3597	1146	2144	1030	1711	1278	874	1588	2012	359	455	174	1301	2735	562	1428	850	698	643	1237	663	496	675
DFS	1373	2038	0	1692	1579	2253	2229	737	1638	900	1369	925	751	1099	1403	283	328	158	981	1766	516	1009	525	422	387	951	526	439	440
FRA	1025	1275	920	0	1629	2032	2548	690	1583	829	1320	974	736	1199	1356	222	278	128	984	1785	484	1218	452	434	312	944	555	417	313
ITA	1413	1644	1182	857	0	1726	2597	726	1574	724	1213	818	615	1279	1301	255	291	142	1047	1728	450	1146	533	391	346	978	612	427	398
NLD	1590	3155	2001	1267	1375	0	2649	928	1862	1133	1547	1352	897	1201	1692	296	400	170	1046	2070	526	1095	588	559	423	1077	531	447	476
USA	4212	2633	1740	1353	1811	2345	0	1028	2375	1167	2052	1029	814	1641	1851	273	379	210	1428	2332	650	2001	716	561	436	1333	917	707	420
CHE	809	1077	689	617	655	927	959	0	727	427	650	625	400	587	562	154	176	67	447	723	263	469	302	241	187	499	284	219	211
GBR	2041	1636	1256	974	1172	1632	2149	690	0	989	1499	913	983	1140	1194	232	281	157	932	1485	521	1072	467	394	333	970	539	468	358
NZL	828	793	646	492	515	1035	1118	361	858	0	1268	555	739	575	712	149	154	121	538	730	376	598	274	274	200	593	345	383	239
AUS	1568	1295	1006	882	875	1369	2094	573	1303	1281	0	792	741	948	957	199	232	123	779	1149	489	933	416	322	277	806	490	460	316
BEL	869	1314	869	955	787	1559	920	638	901	453	701	0	525	721	756	196	213	87	584	893	344	570	326	312	222	683	329	263	292
IRL	550	758	616	572	506	840	731	409	1004	636	640	519	0	515	569	127	145	103	456	628	333	443	226	213	164	497	249	279	192
ESP	926	1037	837	867	905	1078	1093	485	895	439	681	711	490	0	966	215	226	117	831	1166	457	939	403	333	250	855	519	377	304
CZE	969	1610	963	866	930	1552	1503	434	868	535	656	623	452	714	0	250	299	142	1028	1518	440	911	487	534	350	867	528	422	404

SVN	174	347	225	151	213	255	210	110	170	104	139	156	97	157	189	0	104	51	183	295	103	184	139	96	88	177	111	81	128
EST	177	327	204	134	163	290	260	98	161	79	117	136	77	109	188	61	0	53	220	367	112	215	211	123	127	206	134	117	135
ISR	105	135	116	65	90	129	199	39	110	98	78	55	77	67	107	36	33	0	123	158	66	112	78	53	60	110	67	74	72
HUN	1043	1041	790	663	892	884	1406	374	807	421	593	509	399	672	962	136	135	84	0	1066	405	756	374	333	246	738	491	390	286
POL	1405	2503	1466	1181	1348	1945	2279	610	1273	559	884	824	519	839	1284	265	261	124	962	0	428	1040	697	470	475	1048	611	444	512
ZAF	482	440	398	342	341	447	640	223	457	314	432	296	300	410	315	73	57	43	338	324	0	429	174	184	120	446	278	279	159
JPN	706	627	544	423	539	574	880	314	543	312	512	363	278	445	413	99	76	46	409	559	283	0	373	315	237	707	589	405	243
LVA	330	698	334	214	338	402	598	163	273	156	211	198	132	215	330	82	130	50	271	565	100	160	0	198	250	421	254	196	281
SVK	313	513	224	226	222	392	373	124	224	164	161	189	105	168	458	51	54	22	233	327	101	109	100	0	141	329	215	188	151
LTU	174	596	223	118	181	265	298	86	173	96	124	119	80	106	238	46	64	29	151	369	49	79	172	73	0	247	160	129	178
PRT	1105	1128	842	785	888	1076	1394	453	883	484	643	688	450	815	725	138	140	77	731	1044	402	415	321	225	159	0	487	408	333
KOR	734	456	382	321	489	385	1061	203	395	253	361	240	173	369	388	67	64	39	400	512	209	351	150	130	68	406	0	312	158
URY	519	373	319	253	323	360	884	175	397	304	358	206	228	309	329	48	69	39	334	382	240	245	117	122	76	370	255	0	149
HRV	196	699	344	194	288	431	320	138	253	142	197	237	131	229	305	99	98	50	208	459	108	112	219	75	125	270	71	98	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	119	468	192	277	171	44	160	70	75	9	40
DFS	112	0	209	165	163	180	140	158	108	127	37	59
USA	496	190	0	392	516	250	98	308	100	138	39	70
NZL	199	143	468	0	469	232	86	212	85	90	105	55
AUS	282	133	558	518	0	235	79	249	84	90	51	57
GBR	173	172	272	237	234	0	94	175	104	100	65	72
NLD	40	142	105	82	70	86	0	79	56	84	27	40
ZAF	156	139	322	220	234	174	75	0	90	86	34	57
ITA	67	109	107	84	79	106	55	83	0	60	19	44
DEU	72	125	138	85	81	97	80	83	61	0	21	49
IRL	6	33	40	117	48	67	25	34	18	21	0	18
CHE	34	59	71	46	48	69	34	50	43	45	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	119	468	192	276	171	44	160	70	75	9	40
DFS	112	0	209	165	163	180	140	158	108	127	37	59
USA	496	190	0	392	515	250	98	308	100	138	39	70
NZL	199	143	468	0	469	231	86	212	85	90	105	56
AUS	281	133	557	518	0	233	78	249	84	89	51	57
GBR	173	172	272	237	233	0	94	175	104	100	65	72
NLD	40	142	105	82	69	86	0	79	56	84	27	40
ZAF	156	139	322	220	234	174	75	0	90	86	34	57
ITA	67	109	107	84	79	106	55	83	0	60	19	44
DEU	72	125	138	85	80	97	80	83	61	0	21	49
IRL	6	33	40	117	48	67	25	34	18	21	0	18
CHE	34	59	71	46	48	69	34	50	43	45	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	119	468	192	277	171	44	160	70	75	9	40
DFS	112	0	209	165	163	180	140	158	108	127	37	59
USA	496	190	0	392	516	250	98	308	100	138	39	70
NZL	199	143	468	0	469	232	86	212	85	90	105	55
AUS	282	133	558	518	0	235	79	249	84	90	51	57
GBR	173	172	272	237	234	0	94	175	104	100	65	72
NLD	40	142	105	82	70	86	0	79	56	84	27	40
ZAF	156	139	322	220	234	174	75	0	90	86	34	57
ITA	67	109	107	84	79	106	55	83	0	60	19	44
DEU	72	125	138	85	81	97	80	83	61	0	21	49

IRL	6	33	40	117	48	67	25	34	18	21	0	18	
CHE	34	59	71	46	48	69	34	50	43	45	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	7	220	94	105	87	181	14	75	3	10	17	2	6	0
NOR	6	0	79	46	73	58	134	14	0	26	19	26	48	45	0
USA	203	80	0	134	143	119	206	23	64	23	25	35	24	45	25
NZL	94	46	135	0	156	90	187	18	39	13	17	30	10	22	12
AUS	106	62	144	156	0	88	201	40	38	38	39	46	14	36	12
GBR	86	61	112	86	87	0	110	14	41	11	17	28	18	39	0
DFS	186	108	201	185	175	106	0	55	53	122	125	113	14	53	0
DEU	13	13	22	18	39	14	46	0	1	24	35	30	4	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	26	22	12	34	10	110	24	0	0	52	26	0	20	0
LVA	10	17	22	14	35	16	84	29	2	45	0	55	2	14	0
LTU	16	22	29	26	42	25	99	28	5	25	49	0	4	15	0
IRL	2	47	24	10	13	17	11	4	2	0	2	4	0	9	0
NLD	6	44	44	22	33	38	50	14	2	19	13	13	9	0	0
CAM	0	0	25	12	12	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	7	220	94	105	87	181	14	75	3	10	17	2	6	0
NOR	6	0	79	46	73	58	134	14	0	26	19	26	48	45	0
USA	203	80	0	134	143	119	206	23	64	23	25	35	24	45	25
NZL	94	46	135	0	156	90	187	18	39	13	17	30	10	22	12
AUS	106	62	144	156	0	88	201	40	38	38	39	46	14	36	12
GBR	86	61	112	86	87	0	110	14	41	11	17	28	18	39	0
DFS	186	108	201	185	175	106	0	55	53	122	125	113	14	53	0
DEU	13	13	22	18	39	14	46	0	1	24	35	30	4	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	26	22	12	34	10	110	24	0	0	52	26	0	20	0
LVA	10	17	22	14	35	16	84	29	2	45	0	55	2	14	0
LTU	16	22	29	26	42	25	99	28	5	25	49	0	4	15	0
IRL	2	47	24	10	13	17	11	4	2	0	2	4	0	9	0
NLD	6	44	44	22	33	38	50	14	2	19	13	13	9	0	0
CAM	0	0	25	12	12	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	7	220	94	105	87	181	14	75	3	10	17	2	6	0
NOR	6	0	79	46	73	58	134	14	0	26	19	26	48	45	0
USA	203	80	0	134	143	119	206	23	64	23	25	35	24	45	25
NZL	94	46	135	0	156	90	187	18	39	13	17	30	10	22	12
AUS	106	62	144	156	0	88	201	40	38	38	39	46	14	36	12
GBR	86	61	112	86	87	0	110	14	41	11	17	28	18	39	0
DFS	186	108	201	185	175	106	0	55	53	122	125	112	14	53	0
DEU	13	13	22	18	39	14	46	0	1	24	35	30	4	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	26	22	12	34	10	110	24	0	0	52	26	0	20	0
LVA	10	17	22	14	35	16	84	29	2	45	0	55	2	14	0
LTU	16	22	29	26	42	25	98	28	5	25	49	0	4	15	0
IRL	2	47	24	10	13	17	11	4	2	0	2	4	0	9	0
NLD	6	44	44	22	33	38	50	14	2	19	13	13	9	0	0
CAM	0	0	25	12	12	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	HUN	NLD	IRL	GBR	HRV	USA
CHE	0	368	221	96	6	12	2	91	57	55	2	32
DEA	335	0	284	996	248	277	52	353	65	54	679	34
FRM	273	335	0	176	17	3	3	125	72	72	2	64
ITA	99	906	202	0	141	157	24	231	64	47	310	33
SVN	6	229	17	133	0	62	15	67	4	0	121	1
FRA	9	236	1	140	59	0	12	78	4	0	110	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	372	148	227	64	75	8	0	56	52	149	26
IRL	54	58	77	61	4	4	2	50	0	40	7	17
GBR	63	57	93	52	0	0	0	53	34	0	0	19
HRV	2	711	1	297	110	100	21	147	6	0	0	4
USA	31	40	79	39	1	3	0	28	16	27	4	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	0	367	221	96	6	12	2	91	57	55	2	32
DEA	335	0	284	997	248	277	52	353	65	54	677	34
FRM	273	335	0	176	17	3	3	125	72	72	2	64
ITA	99	907	202	0	141	157	24	231	64	47	309	33
SVN	6	229	17	133	0	62	15	67	4	0	121	1
FRA	9	236	1	140	59	0	12	78	4	0	110	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	372	148	227	64	75	8	0	56	52	149	26
IRL	54	58	77	61	4	4	2	50	0	40	7	17
GBR	63	57	93	52	0	0	0	53	34	0	0	19
HRV	2	709	1	296	110	100	21	147	6	0	0	4
USA	31	40	79	39	1	3	0	28	16	27	4	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	0	367	221	96	6	12	2	91	57	55	2	32
DEA	335	0	284	996	248	277	52	353	65	54	678	34
FRM	273	335	0	176	17	3	3	125	72	72	2	64
ITA	99	906	202	0	141	157	24	231	64	47	309	33
SVN	6	229	17	133	0	62	15	67	4	0	121	1
FRA	9	236	1	140	59	0	12	78	4	0	110	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	372	148	227	64	75	8	0	56	52	149	26
IRL	54	58	77	61	4	4	2	50	0	40	7	17
GBR	63	57	93	52	0	0	0	53	34	0	0	19
HRV	2	710	1	296	110	100	21	147	6	0	0	4
USA	31	40	79	39	1	3	0	28	16	27	4	0