

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 conformation traits are as follows:

AUS (ALL)	Decrease in information due to pedigree updates, and status changes of some bulls which then leads to no longer being qualified for the >10 threshold
FRA (ALL)	Base change
EST (RDC, HOL)	Decrease in number of daughters/EDC-s of some bulls is due to the pedigree correction and deleted incorrect first lactation information of some cows.
SVN (ALL)	Base change. Decrease in information due to changes in pedigree completeness as well as phenotypic data improvement.
JPN (HOL)	Decrease in information due to pedigree changes
ITA (HOL)	One year cut-off of data causing drops in information, base change
ITA (BSW)	Base change
ITA (SIM)	Base change
USA (ALL)	Drops in information are due to pedigree corrections and herd-year minimum edits
ISR (HOL)	Drops in information due to edits and parentage corrections
CAN (ALL)	Base change
DEU (ALL)	Base change
NZL (ALL)	Changed pedigree extract so that Holstein and Friesian breed proportions re-balanced for all animals based on a more realistic assumption of Holstein and Friesian ancestry. Specifically, any HF animals from NZ, Australia or the UK in the pedigree which have one or both parents missing, instead of merely assuming the missing parent(s) to have no Holstein genetics, now assumes a mixture of Holstein and Friesian genetic equal to the average of their herd contemporaries. These changes are also carried down to all progeny in the pedigree. Updated days-in-milk to include all data collected up to 305 days of lactation. Excluded any records where a cow has not calved within 365 days of her last parturition.
NLD (ALL)	Base change
ZAF (JER)	Correction of a bug in the data recording pipeline affecting protein and fat. An automated system for capturing data from farm software has been established. These milk yields are included in the genetic evaluations, but only fat and prot yields from official milk recording are used. Unfortunately the fat and prot yields were duplicated for the additional milk yields, wreaking havoc for certain bulls' ebvs. This has been resolved.
CHE (ALL)	Improvements in recording of pedigree validity and handling of animals with uncertain parentage on the database as well as the recomputation of breed percentages for all animals born after 01.01.1990 led to (great) changes in all pedigrees and in consequences in all genetic evaluation results.
LTU (HOL,RDC)	New database, moved database selection limit of test day date to remove very old info from 1990 to 2000. Base change
GBR (ALL)	Modified the way fixed curves are fitted, season and age effects within calving year. Previously these were fitted within calving-year groups especially for the more recent years. Instead the above mentioned effects are now fitted with individual calving years. Plus the models analysis 305 records (early years) and Test day data together. The changes have resulted in some bulls dropping in reliabilities by 1-4 percent and some loss of information for some bull
NOR (RDC)	Changes in the data extraction pipeline affecting bulls with daughter phenotypes prior to 2004.
PRT (HOL)	Pedigree updates and corrections in database extraction are causing some drops in information

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 (April Routine Evaluation 2023).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	227	147	8853	1884	843	
BEL			2287			
CAN	278	110	13799	873	876	
CHE	3193		3361	97		3611
CZE			5124			
DEA	6389					26170
DEU			24062	240	299	
DFS			14162	2329	8020	
ESP			4450			
EST			1379		487	
FRA	492		18489			484
FRM						5093
GBR	188	376	8074	996	716	94
HUN			3615			237
IRL			3160	163	62	101
ISR			1695			
ITA	2355		8873	175		1986

JPN			6743								
KOR			1766								
LTU			897					374			
LVA			1505					717			
NLD	228		16834		244			97		498	
NOR								4321			
NZL	85	63	8969		5484			1531			
POL			12449								
PRT			2969								
SVK			1195								
SVN	333		670							666	
URY			1167								
USA	1207	824	42070		5323			804		103	
ZAF			1316		746			144			
HRV			972							1059	
CAM								49			

No. Records	14975	1520	220905	18554	19340	40102
Pub. Proofs	11894	1202	158698	14730	17082	36025

^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	661.91										
FRA	0.88	642.39									
USA	0.92	0.88	638.45								
CHE	0.90	0.88	0.87	493.55							
ITA	0.87	0.79	0.88	0.87	612.05						
DEA	0.83	0.81	0.85	0.94	0.89	465.71					
NLD	0.88	0.85	0.87	0.85	0.85	0.86	660.85				
SVN	0.69	0.73	0.71	0.70	0.63	0.72	0.67	10.30			
NZL	0.68	0.74	0.70	0.72	0.67	0.72	0.71	0.65	462.51		
GBR	0.84	0.86	0.83	0.85	0.77	0.76	0.83	0.67	0.71	287.91	
AUS	0.73	0.74	0.69	0.69	0.65	0.63	0.71	0.65	0.82	0.69	392.60

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.81										
FRA	0.87	26.86									
USA	0.89	0.89	23.60								
CHE	0.85	0.86	0.84	19.44							
ITA	0.87	0.83	0.86	0.86	23.23						
DEA	0.81	0.83	0.83	0.94	0.87	17.34					
NLD	0.85	0.84	0.84	0.83	0.84	0.85	25.73				
SVN	0.76	0.77	0.72	0.73	0.68	0.78	0.67	10.91			
NZL	0.70	0.76	0.72	0.77	0.67	0.78	0.68	0.66	21.83		
GBR	0.83	0.86	0.84	0.84	0.77	0.76	0.84	0.67	0.72	10.12	
AUS	0.73	0.71	0.73	0.64	0.65	0.65	0.68	0.61	0.79	0.67	15.57

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.74										
FRA	0.83	20.50									
USA	0.88	0.86	18.68								
CHE	0.83	0.82	0.82	15.70							
ITA	0.83	0.77	0.83	0.85	21.35						
DEA	0.78	0.75	0.81	0.93	0.87	14.50					
NLD	0.84	0.80	0.83	0.81	0.82	0.84	21.67				
SVN	0.66	0.69	0.68	0.65	0.62	0.68	0.64	10.00			
NZL	0.61	0.67	0.64	0.68	0.62	0.70	0.63	0.61	15.81		

GBR	0.83	0.82	0.81	0.81	0.74	0.69	0.82	0.65	0.65	8.44	
AUS	0.68	0.64	0.66	0.60	0.57	0.58	0.63	0.55	0.78	0.63	12.26

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	770.78				
USA	0.93	784.76			
AUS	0.78	0.73	474.21		
GBR	0.86	0.82	0.71	267.13	
NZL	0.71	0.68	0.83	0.70	372.14

GUE fat

	CAN	USA	AUS	GBR	NZL
CAN	29.89				
USA	0.92	27.34			
AUS	0.77	0.74	17.49		
GBR	0.86	0.82	0.71	10.31	
NZL	0.70	0.73	0.81	0.71	18.29

GUE pro

	CAN	USA	AUS	GBR	NZL
CAN	23.16				
USA	0.90	20.67			
AUS	0.68	0.64	13.80		
GBR	0.84	0.80	0.66	7.73	
NZL	0.61	0.59	0.79	0.63	12.57

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	799.22																														
DEU	0.94	646.92																													
DFS	0.93	0.94	11.17																												
FRA	0.91	0.92	0.91	656.83																											
ITA	0.89	0.88	0.87	0.88	600.42																										
NLD	0.91	0.94	0.92	0.89	0.87	666.15																									
USA	0.93	0.91	0.90	0.90	0.90	0.89	713.15																								
CHE	0.90	0.92	0.88	0.93	0.87	0.91	0.88	567.90																							
GBR	0.86	0.85	0.83	0.86	0.82	0.86	0.84	0.89	275.47																						
NZL	0.69	0.68	0.68	0.75	0.67	0.71	0.70	0.75	0.70	390.12																					
AUS	0.77	0.74	0.71	0.78	0.70	0.75	0.74	0.77	0.73	0.82	420.04																				
BEL	0.86	0.86	0.81	0.83	0.78	0.83	0.81	0.81	0.76	0.67	0.77	500.97																			
IRL	0.83	0.84	0.83	0.89	0.79	0.85	0.81	0.87	0.81	0.82	0.81	0.79	179.40																		
ESP	0.93	0.92	0.90	0.92	0.89	0.90	0.92	0.89	0.83	0.68	0.76	0.86	0.82	531.43																	
CZE	0.87	0.88	0.84	0.81	0.81	0.81	0.84	0.77	0.74	0.64	0.71	0.83	0.73	0.84	703.98																
SVN	0.80	0.84	0.81	0.83	0.71	0.80	0.80	0.73	0.68	0.60	0.66	0.72	0.66	0.76	12.16																
EST	0.87	0.87	0.89	0.82	0.82	0.83	0.87	0.84	0.77	0.67	0.73	0.79	0.74	0.83	0.83	564.99															
ISR	0.82	0.83	0.82	0.82	0.83	0.81	0.86	0.81	0.79	0.62	0.67	0.79	0.70	0.85	0.79	0.78	0.80	396.46													
HUN	0.85	0.86	0.84	0.86	0.88	0.85	0.89	0.85	0.81	0.65	0.66	0.74	0.77	0.85	0.83	0.72	0.83	0.83	684.75												
POL	0.87	0.90	0.86	0.86	0.86	0.87	0.87	0.84	0.81	0.67	0.74	0.81	0.79	0.88	0.85	0.78	0.85	0.80	0.87	410.52											
ZAF	0.83	0.78	0.78	0.82	0.79	0.75	0.82	0.78	0.75	0.66	0.76	0.75	0.75	0.82	0.78	0.67	0.71	0.81	0.79	0.78	539.62										
JPN	0.93	0.91	0.92	0.91	0.89	0.91	0.92	0.89	0.83	0.68	0.76	0.84	0.81	0.91	0.84	0.86	0.84	0.86	0.84	0.88	0.83	624.89									
LVA	0.74	0.75	0.71	0.76	0.69	0.71	0.75	0.74	0.69	0.61	0.63	0.68	0.72	0.73	0.67	0.64	0.76	0.79	0.73	0.74	0.71	0.72	505.99								
SVK	0.78	0.79	0.79	0.78	0.77	0.73	0.78	0.76	0.74	0.61	0.63	0.76	0.69	0.79	0.80	0.75	0.79	0.80	0.81	0.79	0.71	0.81	0.69	384.13							
LTU	0.74	0.73	0.70	0.75	0.66	0.68	0.70	0.70	0.66	0.60	0.63	0.70	0.64	0.74	0.69	0.76	0.63	0.79	0.68	0.69	0.63	0.74	0.67	0.72	398.34						
PRT	0.76	0.77	0.77	0.77	0.75	0.76	0.77	0.76	0.70	0.60	0.60	0.68	0.72	0.78	0.66	0.75	0.68	0.79	0.73	0.73	0.61	0.76	0.66	0.70	0.61	596.94					
KOR	0.85	0.80	0.80	0.81	0.78	0.77	0.85	0.77	0.72	0.70	0.74	0.82	0.73	0.84	0.80	0.76	0.79	0.80	0.75	0.77	0.79	0.85	0.72	0.77	0.67	0.68	481.83				
URY	0.71	0.71	0.68	0.76	0.70	0.70	0.71	0.71	0.66	0.76	0.73	0.70	0.71	0.71	0.68	0.64	0.67	0.79	0.69	0.70	0.74	0.69	0.70	0.64	0.67	0.61	0.71	166.18			
HRV	0.66	0.67	0.68	0.68	0.66	0.69	0.64	0.63	0.64	0.59	0.60	0.67	0.60	0.67	0.63	0.62	0.68	0.79	0.67	0.68	0.71	0.68	0.63	0.68	0.61	0.62	0.65	0.64	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	31.98																												
DEU	0.93	24.06																											
DFS	0.91	0.91	10.95																										
FRA	0.91	0.92	0.89	26.62																									
ITA	0.88	0.88	0.85	0.89	25.45																								
NLD	0.89	0.93	0.90	0.87	0.84	25.33																							
USA	0.92	0.92	0.88	0.91	0.90	0.87	26.56																						
CHE	0.87	0.90	0.87	0.90	0.84	0.88	0.85	22.88																					
GBR	0.86	0.88	0.84	0.88	0.83	0.87	0.85	0.88	9.47																				
NZL	0.67	0.67	0.68	0.73	0.64	0.67	0.71	0.73	0.71	15.31																			
AUS	0.73	0.72	0.68	0.76	0.70	0.69	0.74	0.70	0.71	0.79	14.72																		
BEL	0.85	0.86	0.81	0.84	0.79	0.82	0.81	0.79	0.79	0.68	0.75	20.21																	
IRL	0.81	0.80	0.83	0.84	0.73	0.82	0.79	0.84	0.78	0.80	0.78	0.81	6.76																
ESP	0.91	0.91	0.86	0.91	0.90	0.87	0.92	0.85	0.83	0.66	0.74	0.82	0.78	21.06															
CZE	0.83	0.85	0.82	0.81	0.80	0.78	0.84	0.72	0.75	0.57	0.67	0.80	0.68	0.83	22.17														
SVN	0.77	0.80	0.78	0.76	0.73	0.79	0.74	0.71	0.67	0.61	0.58	0.77	0.64	0.77	0.72	12.51													
EST	0.87	0.89	0.89	0.86	0.85	0.86	0.88	0.86	0.78	0.75	0.75	0.85	0.80	0.85	0.83	0.80	22.64												
ISR	0.78	0.81	0.75	0.79	0.79	0.77	0.85	0.76	0.72	0.62	0.61	0.65	0.62	0.81	0.75	0.63	0.77	14.88											
HUN	0.83	0.86	0.78	0.86	0.88	0.80	0.89	0.81	0.79	0.63	0.65	0.73	0.69	0.87	0.79	0.64	0.81	0.83	27.30										
POL	0.88	0.92	0.85	0.88	0.88	0.85	0.89	0.82	0.81	0.67	0.70	0.84	0.76	0.90	0.84	0.78	0.89	0.80	0.87	17.03									
ZAF	0.72	0.70	0.62	0.74	0.71	0.68	0.75	0.69	0.68	0.57	0.65	0.65	0.64	0.76	0.70	0.62	0.71	0.72	0.72	0.74	19.20								
JPN	0.92	0.91	0.92	0.89	0.87	0.89	0.90	0.87	0.84	0.68	0.69	0.83	0.80	0.87	0.80	0.85	0.85	0.77	0.79	0.87	0.68	24.00							
LVA	0.77	0.79	0.73	0.79	0.76	0.74	0.79	0.76	0.71	0.64	0.68	0.79	0.65	0.79	0.74	0.66	0.84	0.79	0.75	0.80	0.73	0.75	20.31						
SVK	0.74	0.76	0.73	0.76	0.79	0.70	0.78	0.71	0.71	0.58	0.61	0.74	0.60	0.78	0.79	0.73	0.80	0.71	0.77	0.79	0.64	0.74	0.74	15.35					
LTU	0.69	0.70	0.64	0.71	0.67	0.62	0.70	0.67	0.64	0.57	0.57	0.69	0.57	0.69	0.65	0.73	0.66	0.66	0.63	0.70	0.63	0.69	0.78	0.69	17.83				
PRT	0.75	0.77	0.72	0.77	0.76	0.72	0.78	0.74	0.73	0.60	0.60	0.64	0.64	0.78	0.64	0.69	0.70	0.64	0.75	0.75	0.60	0.74	0.70	0.63	0.61	23.94			
KOR	0.84	0.81	0.78	0.82	0.80	0.78	0.86	0.78	0.77	0.70	0.75	0.83	0.72	0.85	0.78	0.76	0.82	0.76	0.76	0.83	0.72	0.84	0.74	0.74	0.69	0.67	19.74		
URY	0.75	0.74	0.71	0.78	0.72	0.69	0.75	0.71	0.71	0.73	0.70	0.71	0.71	0.72	0.69	0.63	0.80	0.69	0.71	0.76	0.69	0.71	0.77	0.64	0.61	0.60	0.71	6.66	
HRV	0.64	0.68	0.70	0.68	0.70	0.68	0.69	0.63	0.64	0.56	0.58	0.64	0.58	0.68	0.67	0.61	0.65	0.69	0.66	0.68	0.66	0.69	0.63	0.64	0.61	0.63	0.76	0.63	11.66

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	17.88																											
DFS	0.91	0.93	10.59																										
FRA	0.87	0.88	0.89	18.17																									
ITA	0.85	0.86	0.85	0.84	18.58																								
NLD	0.87	0.92	0.89	0.84	0.82	18.96																							
USA	0.90	0.90	0.88	0.88	0.87	0.85	18.21																						
CHE	0.85	0.89	0.84	0.90	0.83	0.85	0.84	16.41																					
GBR	0.84	0.85	0.83	0.84	0.80	0.85	0.83	0.87	7.35																				
NZL	0.59	0.58	0.60	0.67	0.57	0.61	0.61	0.65	0.63	11.47																			
AUS	0.66	0.64	0.63	0.68	0.60	0.65	0.65	0.65	0.66	0.78	10.83																		
BEL	0.81	0.82	0.76	0.75	0.72	0.77	0.76	0.74	0.75	0.58	0.67	14.70																	
IRL	0.75	0.76	0.76	0.81	0.72	0.77	0.75	0.80	0.76	0.76	0.76	0.72	5.45																
ESP	0.90	0.89	0.87	0.88	0.86	0.86	0.89	0.84	0.82	0.59	0.67	0.80	0.76	15.19															
CZE	0.78	0.81	0.77	0.71	0.72	0.72	0.77	0.65	0.68	0.47	0.56	0.76	0.58	0.76	16.96														
SVN	0.75	0.80	0.77	0.79	0.68	0.75	0.76	0.69	0.64	0.50	0.56	0.68	0.58	0.79	0.66	11.38													
EST	0.81	0.84	0.82	0.76	0.78	0.80	0.83	0.83	0.73	0.58	0.62	0.75	0.61	0.76	0.73	0.66	16.99												
ISR	0.78	0.79	0.79	0.81	0.80	0.77	0.83	0.79	0.73	0.49	0.54	0.61	0.59	0.81	0.66	0.70	0.71	10.26											
HUN	0.81	0.84	0.80	0.84	0.84	0.80	0.86	0.82	0.78	0.54	0.54	0.67	0.66	0.80	0.72	0.66	0.77	0.80	21.97										
POL	0.84	0.87	0.83	0.81	0.81	0.82	0.84	0.80	0.77	0.55	0.61	0.78	0.72	0.84	0.79	0.73	0.82	0.73	0.83	11.17									
ZAF	0.77	0.72	0.70	0.76	0.70	0.69	0.75	0.71	0.72	0.60	0.70	0.68	0.67	0.74	0.67	0.60	0.65	0.76	0.83	0.73	14.77								
JPN	0.90	0.89	0.90	0.86	0.87	0.86	0.90	0.85	0.82	0.59	0.66	0.77	0.74	0.89	0.75	0.82	0.79	0.80	0.79	0.84	0.74	17.03							
LVA	0.72	0.73	0.68	0.72	0.68	0.68	0.73	0.72	0.68																				

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	607.34											
DFS	0.91	9.17										
USA	0.91	0.89	712.40									
NZL	0.73	0.74	0.74	305.91								
AUS	0.79	0.71	0.74	0.81	384.44							
GBR	0.83	0.80	0.77	0.67	0.71	220.75						
NLD	0.91	0.91	0.88	0.71	0.75	0.81	603.31					
ZAF	0.87	0.82	0.84	0.76	0.80	0.72	0.76	373.03				
ITA	0.90	0.87	0.89	0.74	0.79	0.80	0.85	0.89	543.09			
DEU	0.91	0.94	0.91	0.69	0.70	0.83	0.93	0.79	0.87	615.73		
IRL	0.80	0.80	0.78	0.90	0.82	0.71	0.81	0.76	0.78	0.80	176.96	
CHE	0.86	0.87	0.82	0.73	0.76	0.83	0.89	0.78	0.83	0.90	0.82	339.00

JER fat

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	27.28											
DFS	0.88	11.14										
USA	0.89	0.88	26.34									
NZL	0.67	0.67	0.71	14.17								
AUS	0.77	0.69	0.75	0.79	13.84							
GBR	0.81	0.79	0.80	0.71	0.68	9.23						
NLD	0.85	0.84	0.83	0.66	0.67	0.78	25.55					
ZAF	0.76	0.74	0.74	0.61	0.70	0.65	0.66	14.79				
ITA	0.87	0.84	0.86	0.66	0.71	0.76	0.79	0.77	25.89			
DEU	0.92	0.92	0.90	0.67	0.72	0.85	0.89	0.76	0.87	23.87		
IRL	0.78	0.76	0.74	0.83	0.79	0.74	0.79	0.63	0.70	0.76	6.16	
CHE	0.84	0.83	0.80	0.74	0.70	0.79	0.80	0.71	0.81	0.89	0.77	16.60

JER pro

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	19.70											
DFS	0.88	10.52										
USA	0.88	0.88	20.40									
NZL	0.63	0.66	0.67	10.09								
AUS	0.69	0.65	0.66	0.76	10.54							
GBR	0.82	0.81	0.77	0.65	0.68	7.05						
NLD	0.86	0.87	0.84	0.65	0.66	0.78	19.77					
ZAF	0.81	0.77	0.76	0.66	0.68	0.69	0.71	11.64				
ITA	0.86	0.84	0.86	0.61	0.67	0.77	0.81	0.84	19.49			
DEU	0.89	0.94	0.89	0.63	0.63	0.82	0.91	0.75	0.85	19.18		
IRL	0.73	0.75	0.72	0.84	0.77	0.72	0.76	0.66	0.71	0.75	5.55	
CHE	0.80	0.82	0.75	0.67	0.60	0.75	0.81	0.67	0.74	0.87	0.76	11.30

RDC mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	607.71														
NOR	0.84	12.58													
USA	0.91	0.89	725.31												
NZL	0.67	0.69	0.68	365.93											
AUS	0.74	0.69	0.72	0.82	422.78										
GBR	0.82	0.80	0.81	0.69	0.75	257.87									
DFS	0.89	0.90	0.87	0.67	0.70	0.80	10.35								
DEU	0.93	0.83	0.89	0.68	0.70	0.84	0.92	658.77							
ZAF	0.83	0.78	0.82	0.71	0.77	0.72	0.78	0.78	607.60						
EST	0.85	0.81	0.85	0.66	0.68	0.77	0.83	0.78	0.71	508.88					
LVA	0.74	0.74	0.75	0.64	0.66	0.71	0.73	0.74	0.72	0.79	330.31				
LTU	0.73	0.74	0.72	0.65	0.62	0.71	0.63	0.72	0.69	0.65	0.74	368.79			
IRL	0.82	0.75	0.80	0.83	0.82	0.78	0.80	0.83	0.75	0.73	0.73	0.72	177.68		
NLD	0.91	0.90	0.87	0.69	0.73	0.85	0.91	0.93	0.75	0.81	0.73	0.69	0.83	786.86	
CAM	0.81	0.82	0.91	0.66	0.72	0.79	0.78	0.80	0.79	0.79	0.79	0.76	0.78	0.78	430.15

RDC	fat														
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.41														
NOR	0.84	12.05													
USA	0.90	0.81	26.03												
NZL	0.65	0.74	0.69	15.70											
AUS	0.70	0.67	0.74	0.81	15.41										
GBR	0.82	0.74	0.82	0.68	0.73	8.48									
DFS	0.89	0.88	0.86	0.71	0.71	0.81	10.33								
DEU	0.92	0.85	0.91	0.67	0.69	0.87	0.91	26.16							
ZAF	0.77	0.79	0.80	0.62	0.67	0.67	0.72	0.71	20.49						
EST	0.86	0.69	0.88	0.67	0.72	0.78	0.82	0.84	0.73	20.12					
LVA	0.75	0.69	0.77	0.64	0.63	0.71	0.71	0.78	0.74	0.82	14.43				
LTU	0.70	0.73	0.74	0.62	0.65	0.68	0.67	0.73	0.69	0.73	0.79	17.01			
IRL	0.81	0.74	0.79	0.82	0.80	0.77	0.81	0.80	0.65	0.79	0.67	0.67	7.30		
NLD	0.89	0.85	0.86	0.66	0.69	0.85	0.90	0.93	0.68	0.82	0.74	0.67	0.81	28.07	
CAM	0.81	0.80	0.92	0.65	0.69	0.79	0.80	0.80	0.81	0.80	0.79	0.78	0.77	0.80	22.44

RDC	pro														
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.41														
NOR	0.82	12.02													
USA	0.89	0.87	20.18												
NZL	0.57	0.67	0.64	11.30											
AUS	0.63	0.66	0.66	0.77	12.10										
GBR	0.80	0.80	0.81	0.60	0.67	6.93									
DFS	0.88	0.88	0.85	0.63	0.63	0.78	10.53								
DEU	0.90	0.81	0.89	0.59	0.62	0.84	0.92	20.17							
ZAF	0.76	0.77	0.77	0.65	0.73	0.66	0.71	0.72	17.19						
EST	0.80	0.68	0.80	0.57	0.55	0.72	0.77	0.79	0.67	15.67					
LVA	0.72	0.68	0.74	0.57	0.55	0.69	0.66	0.72	0.70	0.70	9.69				
LTU	0.66	0.63	0.66	0.57	0.51	0.66	0.59	0.66	0.67	0.63	0.70	10.82			
IRL	0.74	0.75	0.76	0.79	0.77	0.75	0.75	0.75	0.68	0.63	0.65	0.61	5.36		
NLD	0.87	0.91	0.84	0.60	0.64	0.83	0.89	0.92	0.70	0.72	0.69	0.63	0.76	26.24	
CAM	0.79	0.79	0.89	0.66	0.68	0.79	0.79	0.78	0.80	0.77	0.77	0.75	0.74	0.78	10.58

SIM	mil											
	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	562.38											
DEA	0.87	507.39										
FRM	0.95	0.85	612.23									
ITA	0.77	0.71	0.71	506.75								
SVN	0.75	0.74	0.79	0.71	9.61							
FRA	0.90	0.87	0.81	0.84	0.78	669.45						
NLD	0.88	0.92	0.88	0.76	0.74	0.87	758.60					
IRL	0.84	0.73	0.85	0.68	0.72	0.86	0.80	174.54				
GBR	0.87	0.86	0.86	0.77	0.69	0.85	0.85	0.78	221.87			
HRV	0.66	0.65	0.77	0.63	0.62	0.64	0.66	0.64	0.66	10.47		
USA	0.86	0.80	0.81	0.87	0.79	0.90	0.88	0.79	0.82	0.65	600.87	
HUN	0.84	0.75	0.79	0.82	0.72	0.83	0.83	0.76	0.80	0.67	0.89	417.09

SIM	fat											
	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	22.54											
DEA	0.87	19.11										
FRM	0.93	0.89	24.12									
ITA	0.77	0.77	0.74	19.78								
SVN	0.72	0.78	0.79	0.73	9.66							
FRA	0.89	0.90	0.81	0.82	0.75	27.04						
NLD	0.86	0.92	0.88	0.75	0.77	0.86	28.14					
IRL	0.78	0.72	0.81	0.64	0.70	0.83	0.77	7.37				
GBR	0.90	0.86	0.85	0.80	0.68	0.87	0.85	0.75	7.91			

HRV	0.65	0.62	0.77	0.62	0.61	0.63	0.62	0.66	0.64	10.45		
USA	0.85	0.84	0.81	0.88	0.74	0.91	0.87	0.76	0.85	0.68	20.60	
HUN	0.81	0.77	0.79	0.84	0.68	0.84	0.79	0.69	0.78	0.68	0.89	16.57

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	16.81											
DEA	0.86	15.48										
FRM	0.92	0.84	19.11									
ITA	0.71	0.68	0.69	15.98								
SVN	0.70	0.69	0.76	0.68	9.73							
FRA	0.87	0.84	0.78	0.78	0.79	21.31						
NLD	0.82	0.90	0.86	0.71	0.71	0.83	23.50					
IRL	0.76	0.74	0.80	0.59	0.65	0.79	0.73	6.05				
GBR	0.83	0.85	0.84	0.75	0.65	0.84	0.84	0.73	6.81			
HRV	0.63	0.61	0.75	0.60	0.59	0.62	0.61	0.60	0.62	10.57		
USA	0.81	0.74	0.74	0.84	0.75	0.87	0.84	0.71	0.81	0.63	17.11	
HUN	0.82	0.75	0.76	0.82	0.68	0.81	0.78	0.66	0.77	0.66	0.86	13.47

^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	98	190	151	146	163	59	32	37	77	102
FRA	89	0	135	196	232	261	94	51	35	73	79
USA	184	99	0	331	256	351	92	40	48	110	133
CHE	129	153	308	0	514	646	112	77	44	87	125
ITA	130	193	181	456	0	802	143	94	48	97	133
DEA	144	209	315	536	701	0	163	102	59	95	139
NLD	54	80	84	104	119	155	0	46	34	45	67
SVN	29	50	32	72	91	94	46	0	13	22	27
NZL	36	26	40	33	40	53	27	11	0	30	41
GBR	76	62	103	67	72	66	39	17	26	0	69
AUS	105	62	125	85	98	101	50	20	33	63	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	98	190	151	146	163	59	32	37	77	102
FRA	89	0	135	196	232	261	94	51	35	73	79
USA	184	99	0	331	256	351	92	40	48	110	133
CHE	129	153	308	0	514	647	112	77	44	87	125
ITA	130	193	181	456	0	803	143	94	48	97	133
DEA	144	209	315	536	702	0	163	102	59	95	139
NLD	54	80	84	104	119	155	0	46	34	45	67
SVN	29	50	32	72	91	94	46	0	13	22	27
NZL	36	26	40	33	40	53	27	11	0	30	41
GBR	76	62	103	67	72	66	39	17	26	0	69
AUS	105	62	125	85	98	101	50	20	33	63	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	98	190	151	146	163	59	32	37	77	102
FRA	89	0	135	196	232	261	94	51	35	73	79
USA	184	99	0	331	256	351	92	40	48	110	133

CHE	129	153	308	0	514	647	112	77	44	87	125
ITA	130	193	181	456	0	803	143	94	48	97	133
DEA	144	209	315	536	702	0	163	102	59	95	139
NLD	54	80	84	104	119	155	0	46	34	45	67
SVN	29	50	32	72	91	94	46	0	13	22	27
NZL	36	26	40	33	40	53	27	11	0	30	41
GBR	76	62	103	67	72	66	39	17	26	0	69
AUS	105	62	125	85	98	101	50	20	33	63	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal
CAN USA AUS GBR NZL

CAN	0	78	53	39	14
USA	70	0	70	101	32
AUS	50	67	0	44	27
GBR	33	102	37	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	78	53	39	14
USA	70	0	70	101	32
AUS	50	67	0	44	27
GBR	33	102	37	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	78	53	39	14
USA	70	0	70	101	32
AUS	50	67	0	44	27
GBR	33	102	37	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	2631	1694	1692	1818	1783	3980	935	1908	860	1611	913	624	1424	1326	226	322	161	1110	1751	515	1438	586	468	300	1264	824	533	348
DEU	2078	0	2903	2717	2524	3629	3796	1201	2269	1083	1796	1340	922	1645	2097	363	508	188	1306	2990	560	1478	916	717	553	1448	721	507	721
DFS	1505	2210	0	1885	1544	2403	2379	774	1724	947	1429	974	786	1144	1465	267	380	174	989	1929	515	1048	566	434	357	1109	580	448	485
FRA	1245	1671	1177	0	1652	2274	2729	779	1723	906	1428	1097	797	1362	1487	227	315	145	1043	2052	514	1293	519	473	288	1135	627	452	384
ITA	1527	1690	1223	1002	0	1719	2611	731	1560	674	1160	796	573	1260	1284	252	313	146	990	1831	393	1118	565	392	324	1091	643	412	399
NLD	1744	3439	2156	1606	1415	0	2816	979	1990	1203	1609	1412	946	1256	1770	284	445	185	1053	2252	524	1148	635	575	368	1257	585	460	516
USA	4531	2865	1910	1603	1956	2531	0	1068	2526	1219	2151	1075	866	1691	1942	261	423	241	1430	2590	647	2060	788	585	401	1593	1000	725	442
CHE	860	1139	732	721	666	983	1005	0	768	459	680	660	431	604	575	144	191	71	453	767	259	490	324	249	145	565	308	224	221
GBR	2157	1757	1350	1174	1198	1765	2322	738	0	1039	1564	953	1035	1182	1241	220	317	170	941	1620	519	1110	504	403	326	1102	580	483	381
NZL	856	837	685	591	507	1097	1167	388	901	0	1318	577	774	599	733	130	166	131	545	781	376	614	292	279	193	660	361	399	251
AUS	1650	1371	1060	1019	882	1421	2214	606	1373	1326	0	819	775	976	983	177	252	132	791	1226	487	962	453	332	265	940	533	473	330
BEL	914	1383	919	1126	780	1627	965	677	946	471	728	0	548	744	774	175	231	93	593	939	341	587	344	318	185	758	349	269	306
IRL	583	800	645	668	480	884	778	439	1055	668	669	538	0	533	591	111	154	112	465	671	330	463	240	221	156	535	268	289	204
ESP	970	1085	885	1129	888	1125	1145	502	926	455	706	729	503	0	995	195	242	121	838	1250	455	960	423	339	242	966	558	383	320
CZE	1031	1700	1022	1038	946	1633	1602	447	907	552	677	639	461	741	0	232	324	152	1040	1617	439	941	516	545	306	966	563	433	428
SVN	174	356	217	171	209	249	210	104	161	88	123	135	83	140	169	0	98	51	161	299	74	167	137	79	71	177	115	62	127
EST	208	373	251	171	181	327	304	113	188	86	133	148	82	118	209	58	0	58	229	419	114	229	226	132	101	235	143	122	148
ISR	115	142	128	90	92	141	231	42	123	104	84	58	85	72	120	36	34	0	124	179	68	122	87	56	56	124	75	78	77

HUN	1046	1049	799	767	851	893	1409	379	816	424	600	513	403	676	969	119	138	85	0	1078	404	767	391	337	248	828	520	396	295
POL	1582	2787	1635	1519	1498	2152	2599	665	1423	603	966	873	553	927	1398	267	312	141	977	0	427	1093	759	489	415	1250	673	457	557
ZAF	479	438	396	409	304	445	635	221	456	312	429	293	297	408	313	53	57	43	336	323	0	431	176	184	108	451	279	280	162
JPN	754	674	582	511	558	619	938	331	577	326	543	383	292	467	435	91	86	48	422	602	283	0	396	320	227	795	629	413	257
LVA	362	761	361	283	351	433	671	180	295	166	232	209	137	227	352	83	138	56	280	618	101	169	0	203	205	480	271	205	293
SVK	329	532	231	266	228	404	394	127	228	166	164	192	107	171	466	37	55	23	234	345	101	114	102	0	106	351	225	192	158
LTU	171	512	211	120	162	227	281	59	177	90	121	91	73	95	198	31	46	25	150	321	41	74	132	48	0	245	158	131	165
PRT	1325	1353	1018	1033	1040	1272	1702	516	1016	537	784	773	478	933	818	140	160	81	822	1284	405	483	372	234	153	0	552	425	361
KOR	807	502	429	392	527	430	1153	220	427	266	393	261	187	405	410	72	69	41	420	569	208	380	163	135	71	472	0	322	168
URY	529	383	328	310	313	371	907	178	411	321	372	208	235	313	338	36	71	42	338	394	240	255	121	123	76	379	262	0	153
HRV	214	747	391	279	290	473	341	148	273	150	210	249	142	239	329	103	107	54	218	509	109	118	228	79	114	299	82	99	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	2630	1693	1692	1820	1783	3976	935	1908	860	1611	913	624	1423	1326	227	322	161	1110	1751	514	1433	586	468	300	1264	824	533	347
DEU	2078	0	2903	2717	2525	3629	3793	1201	2269	1083	1796	1340	922	1645	2097	363	508	188	1306	2990	559	1474	916	717	553	1447	721	507	720
DFS	1505	2209	0	1885	1545	2403	2377	774	1724	947	1429	974	785	1143	1464	267	380	174	988	1928	514	1045	566	434	357	1109	580	448	484
FRA	1245	1671	1177	0	1653	2274	2728	779	1723	906	1428	1097	798	1362	1487	228	315	145	1043	2052	513	1289	519	473	288	1135	627	452	383
ITA	1530	1692	1225	1003	0	1720	2612	732	1561	675	1161	797	574	1260	1286	253	313	146	992	1831	394	1116	565	392	324	1093	644	412	398
NLD	1744	3439	2156	1606	1417	0	2814	979	1990	1203	1609	1412	948	1256	1770	285	445	185	1053	2252	523	1143	635	575	368	1257	585	460	515
USA	4525	2860	1907	1602	1958	2530	0	1068	2525	1218	2151	1074	865	1689	1941	262	422	241	1429	2589	646	2055	787	585	401	1591	1000	725	440
CHE	860	1139	732	721	667	983	1005	0	768	459	680	660	431	604	575	145	191	71	453	767	258	486	324	249	145	565	308	224	220
GBR	2157	1757	1350	1174	1199	1765	2320	738	0	1039	1564	953	1036	1182	1241	221	317	170	941	1620	518	1106	504	403	326	1102	580	483	381
NZL	856	837	685	591	507	1097	1166	388	901	0	1318	577	774	599	733	131	166	131	545	781	375	614	292	279	193	660	361	399	250
AUS	1650	1371	1060	1019	882	1421	2213	606	1373	1326	0	819	775	976	983	178	252	132	791	1226	486	960	453	332	265	940	533	473	330
BEL	914	1383	919	1126	781	1627	964	677	946	471	728	0	548	744	774	176	231	93	593	939	340	585	344	318	185	758	349	269	305
IRL	583	800	645	668	481	886	778	439	1056	668	669	538	0	532	591	112	154	112	465	672	330	462	240	221	156	535	268	289	203
ESP	970	1085	884	1129	890	1125	1143	502	926	455	706	729	503	0	994	196	242	121	837	1249	454	957	423	339	242	966	558	383	320
CZE	1031	1700	1022	1038	948	1633	1601	447	907	552	677	639	461	741	0	233	324	152	1040	1617	438	939	516	545	306	966	563	433	427
SVN	174	355	216	171	209	249	210	104	161	88	123	135	83	140	169	0	98	51	161	300	74	167	138	80	72	178	115	63	128
EST	208	373	251	171	181	327	303	113	188	86	133	148	82	118	209	58	0	58	229	419	114	226	226	132	101	235	143	122	148
ISR	115	142	128	90	92	141	231	42	123	104	84	58	85	72	120	36	34	0	124	179	67	121	87	56	56	124	75	78	77
HUN	1046	1049	799	767	853	893	1408	379	816	424	600	513	403	676	969	119	138	85	0	1078	404	767	391	337	248	828	520	396	295
POL	1582	2785	1634	1519	1497	2152	2596	665	1423	603	966	873	553	927	1398	267	312	141	977	0	426	1088	759	489	415	1249	672	457	556
ZAF	478	437	395	408	305	444	634	220	455	312	428	293	297	407	312	52	57	43	335	322	0	429	175	183	107	450	278	279	161
JPN	749	670	579	506	555	614	929	327	572	325	539	380	291	463	433	91	83	47	420	596	282	0	395	319	227	792	628	412	257
LVA	362	761	361	283	352	433	670	180	295	166	232	209	137	227	352	83	138	56	280	618	101	168	0	203	205	479	271	205	293
SVK	329	532	231	266	228	404	393	127	228	166	164	192	107	171	466	37	55	23	234	345	101	113	102	0	106	351	225	192	158
LTU	171	512	211	120	162	227	281	59	177	90	121	91	73	95	198	31	46	25	150	321	40	74	132	48	0	245	158	131	165
PRT	1324	1351	1017	1031	1043	1271	1699	516	1015	537	783	772	478	932	818	140	160	81	822	1283	404	479	371	234	153	0	552	425	360
KOR	807	502	429	392	528	430	1152	220	427	266	393	261	187	405	410	72	69	41	420	569	208	378	163	135	71	472	0	322	168
URY	529	383	328	310	313	371	907	178	411	321	372	208	235	313	338	36	71	42	338	394	240	252	121	123	76	379	262	0	153
HRV	212	745	389	277	289	471	338	146	272	149	209	248	140	239	327	102	107	53	217	507	109	118	228	79	113	297	81	99	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	2630	1693	1692	1818	1783	3970	935	1908	860	1611	913	624	1423	1326	226	322	161	1110	1751	514	1431	586	468	300	1264	824	533	348
DEU	2078	0	2903	2717	2524	3629	3791	1201	2270	1083	1796	1340	922	1645	2097	363	508	188	1306	2990	559	1473	916	717	553	1448	721	507	721
DFS	1505	2209	0	1885	1543	2403	2375	774	1725	947	1429	974	785	1143	1464	267	380	174	988	1928	514	1044	566	434	357	1109	580	448	485
FRA	1245	1671	1177	0	1652	2274	2727	779	1724	906	1428	1097	798	1362	1487	227	315	145	1043	2052	513	1289	519	473	288	1135	627	452	384
ITA	1527	1689	1223	1002	0	1719	2610	731	1561	674	1160	796	573	1259	1284	252	313	146	990	1831	392	1114	565	392	324	1091	643	412	399
NLD	1744	3439	2156	1606	1414	0	2813	979	1991	1203	1609	1412	948	1256	1770	284	445	185	1053	2252	523	1141	635	575	368	1257	585	460	516
USA	4522	2860	1907	1602	1956	2530	0	1068	2524	1218	2148	1073	865	1688	1941	261	422	241	1429	2589	646	2051	787	584	401	1591	1001	725	441
CHE	860	1139	732	721	666	983	1004	0																					

SVN	174	356	217	171	209	249	210	104	161	88	123	135	83	140	169	0	98	51	161	299	73	167	137	79	71	177	115	62	127
EST	208	373	251	171	181	327	303	113	188	86	133	148	82	118	209	58	0	58	229	419	114	225	226	132	101	235	143	122	148
ISR	115	142	128	90	92	141	231	42	123	104	84	58	85	72	120	36	34	0	124	179	67	121	87	56	56	124	75	78	77
HUN	1046	1049	799	767	851	892	1408	379	816	424	600	513	403	676	969	119	138	85	0	1078	403	765	391	337	248	828	520	396	295
POL	1582	2785	1634	1519	1497	2152	2596	665	1425	603	966	873	553	927	1398	267	312	141	977	0	426	1087	759	489	415	1250	672	457	557
ZAF	478	437	395	408	303	444	634	220	455	312	428	293	297	407	312	52	57	43	335	322	0	429	175	183	107	450	278	279	161
JPN	747	669	578	506	553	612	927	326	572	325	538	379	290	463	433	91	82	47	420	595	282	0	395	319	227	792	628	412	257
LVA	362	761	361	283	351	433	670	180	296	166	232	209	137	227	352	83	138	56	280	618	101	168	0	203	205	480	271	205	293
SVK	329	532	231	266	228	404	392	127	228	166	164	192	107	171	466	37	55	23	234	345	101	113	102	0	106	351	225	192	158
LTU	171	512	211	120	162	227	281	59	178	90	121	91	73	95	198	31	46	25	150	321	40	74	132	48	0	245	158	131	165
PRT	1325	1353	1018	1032	1040	1271	1699	516	1018	537	783	773	478	933	818	140	160	81	822	1284	404	480	371	234	153	0	552	425	361
KOR	807	502	429	392	527	430	1154	220	427	266	393	261	187	405	410	72	69	41	420	569	208	378	163	135	71	472	0	322	168
URY	529	383	328	310	313	371	907	178	411	321	372	208	235	313	338	36	71	42	338	394	240	252	121	123	76	379	262	0	153
HRV	213	746	390	278	289	472	339	147	274	150	209	249	141	239	328	102	107	53	217	508	109	118	228	79	113	298	81	99	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	132	497	203	289	184	47	165	71	80	9	42
DFS	126	0	225	178	174	194	162	164	112	149	37	60
USA	526	207	0	410	535	270	109	318	102	151	39	71
NZL	212	156	488	0	490	244	93	221	87	96	106	56
AUS	295	145	579	545	0	251	83	255	86	94	53	59
GBR	184	186	293	249	250	0	101	180	105	110	65	75
NLD	42	164	116	89	74	93	0	82	57	97	27	41
ZAF	161	146	332	229	240	181	78	0	93	91	34	58
ITA	67	112	109	86	80	106	57	86	0	61	20	44
DEU	77	147	151	91	85	107	94	88	61	0	21	51
IRL	6	33	40	118	50	68	25	34	19	21	0	18
CHE	36	60	72	48	49	72	35	51	42	48	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	132	496	203	289	184	47	165	71	80	9	42
DFS	126	0	225	178	174	194	162	163	112	149	37	60
USA	525	207	0	409	535	269	109	317	102	151	39	71
NZL	212	156	487	0	490	244	93	220	87	96	106	57
AUS	295	145	579	545	0	251	83	254	86	94	53	59
GBR	184	186	292	249	250	0	101	179	105	110	65	75
NLD	42	164	116	89	74	93	0	81	57	97	27	41
ZAF	161	145	331	228	239	180	77	0	93	90	34	58
ITA	67	112	109	86	80	106	57	86	0	61	20	44
DEU	77	147	151	91	85	107	94	87	61	0	21	51
IRL	6	33	40	118	50	68	25	34	19	21	0	18
CHE	36	60	72	48	49	72	35	51	42	48	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	132	496	203	289	184	47	165	71	80	9	42
DFS	126	0	225	178	174	194	162	163	112	149	37	60
USA	525	207	0	409	535	271	109	317	102	151	39	71
NZL	212	156	487	0	490	245	93	220	87	96	106	56
AUS	295	145	579	545	0	252	83	254	86	94	53	59
GBR	185	187	295	251	251	0	101	179	105	110	65	75
NLD	42	164	116	89	74	93	0	81	57	97	27	41
ZAF	161	145	331	228	239	180	77	0	93	90	34	58
ITA	67	112	109	86	80	106	57	86	0	61	20	44
DEU	77	147	151	91	85	107	94	87	61	0	21	51

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	0	381	238	100	2	14	92	57	56	2	33	2
DEA	348	0	287	1073	255	256	387	65	54	727	38	52
FRM	290	334	0	185	11	2	129	71	72	2	82	3
ITA	103	990	211	0	149	146	250	63	47	337	33	24
SVN	2	240	10	141	0	49	78	4	0	130	1	10
FRA	11	214	1	131	47	0	79	4	0	101	3	11
NLD	94	407	152	246	73	75	0	56	52	163	29	8
IRL	54	58	76	60	4	4	50	0	39	8	18	2
GBR	64	57	93	51	0	0	53	33	0	0	20	0
HRV	2	761	1	325	119	91	160	7	0	0	4	23
USA	32	42	97	40	1	3	30	17	28	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	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	HUN
CHE	0	380	238	100	2	14	92	57	56	2	33	2
DEA	348	0	287	1074	255	256	387	65	54	725	38	52
FRM	290	334	0	185	11	2	129	71	72	2	82	3
ITA	103	991	211	0	149	146	250	63	47	336	33	24
SVN	2	240	10	141	0	49	78	4	0	130	1	10
FRA	11	214	1	131	47	0	79	4	0	101	3	11
NLD	94	407	152	246	73	75	0	56	52	163	29	8
IRL	54	58	76	60	4	4	50	0	39	8	18	2
GBR	64	57	93	51	0	0	53	33	0	0	20	0
HRV	2	759	1	324	119	91	160	7	0	0	4	23
USA	32	42	97	40	1	3	30	17	28	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	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	HUN
CHE	0	380	238	100	2	14	92	57	56	2	33	2
DEA	348	0	287	1073	255	256	386	65	54	726	38	52
FRM	290	334	0	185	11	2	129	71	72	2	82	3
ITA	103	990	211	0	149	146	249	63	47	336	33	24
SVN	2	240	10	141	0	49	78	4	0	130	1	10
FRA	11	214	1	131	47	0	79	4	0	101	3	11
NLD	94	406	152	245	73	75	0	56	52	162	29	8
IRL	54	58	76	60	4	4	50	0	39	8	18	2
GBR	64	57	93	51	0	0	53	33	0	0	20	0
HRV	2	760	1	324	119	91	159	7	0	0	4	23
USA	32	42	97	40	1	3	30	17	28	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	0	0
