

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:

NOR (RDC)	New models with: Regression on level of Heterozygosity; Fixed effect of milking-system within lactation; Fourth and fifth lactation included from 2009, New definition of genetic groups. Genetic parameters were re-estimated. Some daughters lost due to new criterion of phenotype being outside +- 4 std within lactation and calving year. The rolling definition of hys is causing the daughters to distribute somewhat differently over hys-classes at each evaluation. Therefore some bulls occasionally may loose EDC although the number of daughters stay the same.	
IRL (ALL)	Few drops in information due to pedigree verification	
BEL (HOL)	Some bulls with type of proof showing an unexpected change are due to the program used to determine the type of proof for bulls	
AUS (ALL)	Drops of information due to data clean up such as pedigree changes or status changes leading to a good number of bulls no longer being qualified.	Decreases in EDC are also due to rounding.
ITA (SIM)	Base change, some drops in information due to parentage verification.	
ITA (HOL)	Base change plus 1 year cutoff data	
ZAF (HOL)	Clean-up done on the data resulting in some of the lactations' test-day records not conforming to the BLUP-specs and were therefore omitted.	
DEU (ALL)	Base change	
CHE (ALL)	Base change. Decrease in information due to manual edits in the database	
ITA (BSW)	Base change	
NZL (ALL)	Daughter counts: New Zealand has continuous DNA parentage testing so daughters will always change. Herd Count: Affected by continuous DNA parentage testing. EDCs: Affected by continuous DNA parentage testing. Reliability changes.	
HRV (ALL)	Drops in information due to data checks and pedigree verification, affecting especially SIM bulls	
URY (HOL)	Drop in information due to pedigree verification	
CAN (ALL)	Base change	
GBR (ALL)	Drop in information due to data clean up	
LTU (HOL)	Base change	
USA (ALL)	Drops in information due to pedigree corrections and herd-year minimum edits. In this run a larger number of drops will be seen in yield traits, as the inclusion of Milk-only records in the evaluation is impacting herd-year editing.	
FRA (ALL)	Base change	

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 2022).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	221	146	8695	1856	824	
BEL			2227			
CAN	273	106	13489	847	863	
CHE	3129		3269	97		3500
CZE			4994			
DEA	6294					25601
DEU			23547	216	288	
DFS			13866	2293	7945	
ESP			4291			
EST			1306		475	
FRA	435		17777			504
FRM						4980
GBR	182	368	7874	968	689	95
HUN			3615			237
IRL			3003	163	62	101
ISR			1624			
ITA	2287		8988	173		1888
JPN			6556			
KOR			1657			
LTU			1353		438	
LVA			1421		706	
NLD	216		16497	223	93	464
NOR					4275	
NZL	82	62	8700	5346	1499	
POL			11920			
PRT			2472			
SVK			1174			
SVN	413		689			741
URY			1142			
USA	1182	804	41309	5193	783	87
ZAF			1315	738	144	
HRV			910			1019

CAM 45

No. Records	14714	1486	215680	18113	19129	39217
Pub. Proofs	11766	1175	157018	14447	16950	35281

^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	654.44										
FRA	0.88	633.10									
USA	0.92	0.88	630.96								
CHE	0.90	0.88	0.87	494.79							
ITA	0.87	0.80	0.88	0.87	610.81						
DEA	0.85	0.81	0.86	0.94	0.89	464.48					
NLD	0.88	0.85	0.87	0.85	0.86	0.86	668.66				
SVN	0.72	0.71	0.71	0.70	0.67	0.68	0.71	9.02			
NZL	0.66	0.74	0.69	0.69	0.64	0.67	0.70	0.64	449.84		
GBR	0.85	0.87	0.84	0.86	0.79	0.78	0.84	0.69	0.70	296.82	
AUS	0.73	0.75	0.69	0.68	0.66	0.63	0.71	0.67	0.82	0.71	391.06

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.93										
FRA	0.88	26.47									
USA	0.90	0.89	23.61								
CHE	0.86	0.87	0.84	19.47							
ITA	0.88	0.82	0.86	0.86	23.31						
DEA	0.83	0.83	0.84	0.94	0.87	17.30					
NLD	0.86	0.84	0.85	0.83	0.85	0.86	25.83				
SVN	0.72	0.72	0.72	0.70	0.66	0.70	0.70	9.44			
NZL	0.69	0.74	0.71	0.76	0.64	0.77	0.68	0.65	20.90		
GBR	0.84	0.87	0.85	0.85	0.79	0.78	0.85	0.68	0.71	10.91	
AUS	0.73	0.71	0.72	0.64	0.66	0.66	0.68	0.64	0.79	0.69	15.67

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.51										
FRA	0.83	20.12									
USA	0.89	0.86	18.83								
CHE	0.84	0.83	0.83	15.78							
ITA	0.84	0.78	0.83	0.84	21.38						
DEA	0.80	0.76	0.82	0.93	0.87	14.47					
NLD	0.85	0.81	0.83	0.81	0.82	0.84	21.66				
SVN	0.70	0.67	0.69	0.66	0.66	0.65	0.68	8.87			
NZL	0.59	0.66	0.63	0.67	0.60	0.70	0.63	0.59	15.34		
GBR	0.84	0.84	0.82	0.82	0.76	0.73	0.83	0.66	0.64	8.90	
AUS	0.69	0.65	0.66	0.61	0.59	0.60	0.65	0.59	0.77	0.65	12.32

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	755.31				
USA	0.93	774.66			
AUS	0.79	0.74	470.98		
GBR	0.86	0.82	0.72	249.90	
NZL	0.70	0.68	0.82	0.69	373.83

GUE fat

JER fat												
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	26.89											
DFS	0.88	11.14										
USA	0.90	0.88	26.34									
NZL	0.67	0.67	0.71	14.09								
AUS	0.77	0.69	0.76	0.79	13.80							
GBR	0.81	0.79	0.81	0.66	0.70	9.44						
NLD	0.86	0.85	0.83	0.66	0.67	0.80	25.97					
ZAF	0.77	0.75	0.75	0.61	0.69	0.67	0.68	13.67				
ITA	0.88	0.84	0.87	0.66	0.71	0.77	0.80	0.78	26.02			
DEU	0.91	0.92	0.89	0.65	0.71	0.84	0.89	0.77	0.87	23.45		
IRL	0.78	0.77	0.74	0.83	0.80	0.74	0.79	0.64	0.72	0.77	6.18	
CHE	0.84	0.84	0.81	0.73	0.71	0.79	0.81	0.73	0.81	0.89	0.78	16.07

JER pro												
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	19.46											
DFS	0.89	10.53										
USA	0.89	0.89	20.42									
NZL	0.64	0.67	0.67	10.19								
AUS	0.69	0.66	0.66	0.75	10.49							
GBR	0.82	0.82	0.78	0.64	0.68	6.97						
NLD	0.87	0.87	0.84	0.64	0.67	0.80	20.07					
ZAF	0.81	0.77	0.77	0.67	0.69	0.72	0.72	10.91				
ITA	0.87	0.85	0.86	0.61	0.67	0.78	0.82	0.85	19.63			
DEU	0.89	0.94	0.90	0.63	0.63	0.82	0.91	0.76	0.85	19.32		
IRL	0.74	0.75	0.73	0.84	0.78	0.72	0.76	0.67	0.72	0.75	5.59	
CHE	0.80	0.82	0.77	0.68	0.61	0.76	0.81	0.70	0.76	0.87	0.77	11.31

RDC mil															
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	601.31														
NOR	0.85	12.86													
USA	0.91	0.90	727.47												
NZL	0.65	0.70	0.68	369.35											
AUS	0.74	0.70	0.73	0.81	418.14										
GBR	0.82	0.83	0.82	0.68	0.74	258.46									
DFS	0.90	0.90	0.87	0.66	0.71	0.81	10.35								
DEU	0.93	0.83	0.90	0.67	0.71	0.85	0.92	665.25							
ZAF	0.83	0.81	0.83	0.70	0.77	0.74	0.79	0.79	610.50						
EST	0.87	0.84	0.88	0.70	0.72	0.79	0.82	0.80	0.76	505.28					
LVA	0.76	0.77	0.78	0.64	0.68	0.73	0.76	0.75	0.74	0.80	327.99				
LTU	0.74	0.74	0.71	0.63	0.64	0.71	0.68	0.72	0.73	0.71	0.77	316.88			
IRL	0.83	0.75	0.81	0.82	0.82	0.78	0.81	0.83	0.76	0.75	0.73	0.72	174.59		
NLD	0.91	0.91	0.88	0.69	0.74	0.86	0.92	0.94	0.77	0.82	0.75	0.71	0.83	801.53	
CAM	0.82	0.83	0.92	0.67	0.74	0.81	0.81	0.81	0.82	0.82	0.81	0.80	0.79	0.81	442.85

RDC fat															
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.48														
NOR	0.85	12.34													
USA	0.90	0.82	26.32												
NZL	0.64	0.75	0.68	15.79											
AUS	0.70	0.69	0.75	0.80	15.27										
GBR	0.83	0.80	0.83	0.67	0.72	8.50									
DFS	0.90	0.89	0.86	0.69	0.71	0.82	10.35								
DEU	0.92	0.86	0.91	0.65	0.69	0.87	0.91	25.49							
ZAF	0.78	0.80	0.81	0.61	0.68	0.71	0.73	0.73	19.29						
EST	0.86	0.76	0.88	0.69	0.72	0.79	0.81	0.83	0.76	19.84					
LVA	0.77	0.73	0.78	0.64	0.64	0.73	0.74	0.79	0.75	0.82	14.18				
LTU	0.72	0.74	0.74	0.64	0.70	0.71	0.69	0.71	0.74	0.74	0.76	15.08			

IRL	0.81	0.74	0.80	0.81	0.80	0.78	0.81	0.80	0.66	0.81	0.68	0.71	7.28		
NLD	0.89	0.86	0.87	0.65	0.68	0.86	0.91	0.93	0.71	0.82	0.76	0.70	0.81	28.40	
CAM	0.83	0.81	0.93	0.65	0.71	0.81	0.82	0.81	0.82	0.83	0.81	0.81	0.79	0.82	22.06

RDC pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.25														
NOR	0.83	12.23													
USA	0.89	0.87	20.26												
NZL	0.57	0.68	0.64	11.50											
AUS	0.64	0.67	0.68	0.76	12.01										
GBR	0.81	0.82	0.82	0.60	0.68	6.83									
DFS	0.89	0.88	0.86	0.63	0.64	0.80	10.54								
DEU	0.91	0.83	0.89	0.58	0.62	0.85	0.92	20.07							
ZAF	0.78	0.79	0.78	0.64	0.72	0.69	0.73	0.74	16.27						
EST	0.82	0.77	0.85	0.63	0.64	0.77	0.77	0.79	0.73	15.54					
LVA	0.74	0.72	0.75	0.56	0.57	0.71	0.70	0.74	0.72	0.74	9.63				
LTU	0.68	0.68	0.66	0.52	0.56	0.67	0.64	0.66	0.70	0.67	0.71	9.52			
IRL	0.75	0.75	0.76	0.78	0.78	0.75	0.75	0.75	0.68	0.68	0.66	0.63	5.36		
NLD	0.87	0.91	0.84	0.60	0.64	0.84	0.90	0.92	0.72	0.77	0.72	0.66	0.77	26.65	
CAM	0.81	0.81	0.90	0.67	0.70	0.81	0.81	0.80	0.82	0.81	0.80	0.79	0.76	0.81	11.01

SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	567.30											
DEA	0.87	507.59										
FRM	0.95	0.85	612.63									
ITA	0.79	0.73	0.74	509.29								
SVN	0.74	0.73	0.74	0.71	8.84							
FRA	0.91	0.87	0.82	0.84	0.79	674.63						
HUN	0.85	0.77	0.81	0.83	0.72	0.84	417.09					
NLD	0.88	0.92	0.89	0.77	0.70	0.87	0.84	750.27				
IRL	0.83	0.73	0.85	0.69	0.71	0.87	0.77	0.80	179.35			
GBR	0.87	0.86	0.87	0.79	0.69	0.86	0.81	0.86	0.78	229.97		
HRV	0.69	0.68	0.80	0.67	0.68	0.68	0.73	0.68	0.68	0.68	10.73	
USA	0.86	0.81	0.82	0.87	0.77	0.90	0.89	0.89	0.79	0.83	0.69	598.62

SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	22.68											
DEA	0.87	19.14										
FRM	0.93	0.89	24.12									
ITA	0.79	0.78	0.76	20.01								
SVN	0.73	0.76	0.72	0.71	8.87							
FRA	0.89	0.90	0.82	0.83	0.75	27.52						
HUN	0.81	0.79	0.82	0.85	0.71	0.84	16.57					
NLD	0.87	0.93	0.88	0.77	0.71	0.86	0.80	27.64				
IRL	0.77	0.73	0.81	0.66	0.70	0.83	0.70	0.78	7.69			
GBR	0.91	0.86	0.86	0.80	0.67	0.88	0.80	0.86	0.75	8.18		
HRV	0.68	0.64	0.80	0.65	0.65	0.67	0.71	0.66	0.67	0.68	10.64	
USA	0.85	0.85	0.81	0.89	0.74	0.91	0.89	0.88	0.76	0.85	0.71	21.32

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	16.91											
DEA	0.86	15.48										
FRM	0.92	0.84	18.99									
ITA	0.73	0.70	0.72	16.06								
SVN	0.70	0.68	0.70	0.67	9.05							
FRA	0.88	0.84	0.80	0.80	0.75	21.52						
HUN	0.82	0.77	0.80	0.83	0.69	0.82	13.47					

NLD	0.83	0.91	0.86	0.74	0.68	0.83	0.80	23.28			
IRL	0.75	0.73	0.80	0.62	0.67	0.79	0.67	0.74	6.25		
GBR	0.84	0.85	0.85	0.76	0.66	0.85	0.79	0.85	0.73	7.09	
HRV	0.68	0.64	0.80	0.65	0.66	0.66	0.71	0.66	0.62	10.79	
USA	0.82	0.77	0.76	0.84	0.72	0.88	0.86	0.85	0.72	0.82	16.14

^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	89	189	145	142	157	57	37	36	76	98
FRA	78	0	122	168	200	225	87	62	32	65	68
USA	184	82	0	327	252	343	88	47	45	108	128
CHE	124	124	304	0	491	623	106	91	42	86	121
ITA	126	158	179	431	0	770	137	111	46	96	127
DEA	139	166	307	517	671	0	158	120	58	94	134
NLD	53	70	80	98	115	152	0	53	34	45	61
SVN	34	60	38	87	110	111	54	0	16	28	32
NZL	35	24	38	31	38	52	27	14	0	29	40
GBR	75	54	102	66	71	65	39	23	25	0	67
AUS	101	52	121	82	94	97	45	25	32	61	0

BSW

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	89	189	145	142	157	57	37	36	76	98
FRA	78	0	122	168	200	225	87	62	32	65	68
USA	184	82	0	327	252	343	88	47	45	108	128
CHE	124	124	304	0	491	624	106	91	42	86	121
ITA	126	158	179	431	0	771	137	111	46	96	127
DEA	139	166	307	517	672	0	158	120	58	94	134
NLD	53	70	80	98	115	152	0	53	34	45	61
SVN	34	60	38	87	110	111	54	0	16	28	32
NZL	35	24	38	31	38	52	27	14	0	29	40
GBR	75	54	102	66	71	65	39	23	25	0	67
AUS	101	52	121	82	94	97	45	25	32	61	0

BSW

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	89	189	145	142	157	57	37	36	76	98
FRA	78	0	122	168	200	225	87	62	32	65	68
USA	184	82	0	327	252	343	88	47	45	108	128
CHE	124	124	304	0	491	623	106	91	42	86	121
ITA	126	158	179	431	0	770	137	111	46	96	127
DEA	139	166	307	517	671	0	158	120	58	94	134
NLD	53	70	80	98	115	152	0	53	34	45	61
SVN	34	60	38	87	110	111	54	0	16	28	32
NZL	35	24	38	31	38	52	27	14	0	29	40
GBR	75	54	102	66	71	65	39	23	25	0	67
AUS	101	52	121	82	94	97	45	25	32	61	0

GUE

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0				
USA		0			
AUS			0		
GBR				0	
NZL					0

CAN	0	74	52	36	14
USA	66	0	69	98	32
AUS	49	66	0	43	27
GBR	30	100	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	74	52	36	14
USA	66	0	69	98	32
AUS	49	66	0	43	27
GBR	30	100	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	74	52	36	14
USA	66	0	69	98	32
AUS	49	66	0	43	27
GBR	30	100	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	2515	1596	1554	1758	1685	3808	904	1828	826	1550	881	591	1380	1275	247	297	146	1109	1636	514	1398	551	456	350	1065	770	524	333	
DEU	1949	0	2761	2443	2487	3457	3663	1161	2183	1036	1727	1297	881	1588	2033	371	467	174	1304	2801	559	1441	867	705	687	1228	681	497	681	
DFS	1394	2064	0	1704	1521	2286	2259	743	1662	904	1375	935	754	1102	1410	293	338	159	983	1800	514	1015	539	426	410	947	538	440	452	
FRA	1041	1303	932	0	1564	2056	2568	699	1597	833	1330	990	741	1208	1367	224	286	130	989	1822	482	1228	462	435	329	937	566	419	315	
ITA	1423	1622	1166	853	0	1690	2562	719	1543	686	1168	800	579	1242	1271	261	294	137	1017	1727	417	1119	542	386	369	945	621	413	393	
NLD	1630	3227	2032	1289	1357	0	2700	945	1895	1143	1559	1374	900	1205	1712	304	410	171	1048	2112	523	1113	603	566	458	1069	550	449	486	
USA	4304	2710	1773	1370	1831	2395	0	1037	2417	1174	2072	1042	820	1645	1875	281	393	211	1430	2397	646	2012	737	569	470	1330	937	709	422	
CHE	824	1093	696	627	650	944	972	0	739	431	657	638	408	587	564	161	179	67	447	734	260	476	309	244	196	498	293	220	212	
GBR	2070	1674	1281	988	1157	1668	2196	704	0	998	1511	922	989	1143	1206	242	288	157	933	1517	518	1081	477	397	361	966	551	470	361	
NZL	829	798	649	494	494	1042	1123	366	864	0	1279	558	743	576	715	151	155	122	540	737	375	599	278	274	210	594	350	384	241	
AUS	1578	1310	1014	893	857	1377	2116	578	1317	1289	0	800	744	949	961	201	239	123	782	1165	486	938	423	325	296	806	502	461	318	
BEL	880	1333	881	970	778	1583	933	651	912	454	708	0	527	722	761	198	219	88	585	908	342	575	335	315	232	680	336	265	293	
IRL	553	763	619	577	475	841	735	416	1010	638	641	519	0	518	571	130	147	104	457	637	330	445	232	214	171	496	255	280	194	
ESP	926	1039	839	877	862	1085	1094	486	896	440	682	713	492	0	969	217	231	117	831	1175	455	945	409	335	263	849	532	378	305	
CZE	984	1635	973	874	912	1573	1529	437	879	538	660	627	453	715	0	255	305	142	1032	1539	438	919	498	537	371	856	539	423	406	
SVN	180	359	235	154	216	263	217	118	174	106	140	157	98	159	191	0	106	53	184	305	103	188	144	96	91	176	118	81	129	
EST	184	336	212	141	165	298	273	101	167	80	122	141	78	112	193	62	0	53	223	378	112	222	214	127	135	203	136	117	139	
ISR	106	135	118	66	87	130	200	39	110	99	78	56	78	67	109	37	33	0	123	158	67	113	79	54	61	110	70	74	72	
HUN	1044	1042	791	669	866	888	1409	375	808	421	596	510	400	672	964	137	136	84	0	1067	404	762	379	334	258	734	505	392	286	
POL	1464	2585	1508	1227	1375	1999	2375	630	1312	567	907	844	526	854	1317	273	271	125	969	0	426	1057	712	475	509	1040	630	445	522	
ZAF	478	437	395	339	318	444	634	221	454	311	428	293	297	408	312	73	57	43	336	322	0	429	175	184	123	439	278	279	160	
JPN	721	642	553	434	542	590	897	320	553	315	520	369	280	453	422	104	84	47	419	577	281	0	381	318	246	711	603	407	243	
LVA	339	714	342	220	340	412	618	170	279	159	215	206	132	217	340	84	131	50	274	577	101	165	0	200	257	423	261	199	283	
SVK	320	519	226	227	220	399	382	126	227	164	162	192	106	170	460	52	54	22	233	332	101	113	101	0	143	324	219	190	151	
LTU	196	637	244	127	192	294	327	90	192	100	134	124	82	109	256	46	68	29	156	400	49	84	177	73	0	249	164	133	185	
PRT	1106	1115	837	783	862	1064	1398	449	879	484	645	679	446	802	717	138	137	76	727	1041	395	423	320	223	158	0	495	407	331	
KOR	753	469	391	328	496	399	1083	210	402	256	369	245	178	377	392	71	65	39	408	525	208	361	155	131	69	411	0	315	159	
URY	522	375	320	254	312	363	889	176	399	308	361	207	230	311	330	48	69	40	336	384	239	251	119	123	76	369	256	0	150	
HRV	199	706	358	200	285	443	325	140	259	143	201	239	134	230	310	102	99	51	211	472	108	112	220	75	131	266	73	97	0	

HOL

common bulls below diagonal

JER

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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  478  194  278  175  45  161  71  76  9  41
DFS   113    0  210  166  163  184  148  158  109  131  37  60
USA   507  192    0  395  518  257  102  312  101  142  39  71
NZL   201  144  470    0  473  239  86  213  86  91  106  56
AUS   283  134  560  522    0  241  79  249  86  90  53  58
GBR   176  176  278  241  238    0  99  177  104  105  65  74
NLD   40  150  108  82  70  91  0  79  57  86  27  40
ZAF   157  140  326  221  234  176  75  0  91  87  34  58
ITA   67  109  108  86  80  105  57  84  0  61  20  45
DEU   73  129  142  86  81  102  82  84  61  0  21  50
IRL    6  33  40  118  50  68  25  34  19  21  0  18
CHE   35  60  72  47  49  71  34  51  43  46  13  0
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JER

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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  478  194  277  174  45  161  71  76  9  41
DFS   113    0  210  166  163  184  148  158  109  131  37  60
USA   507  192    0  395  517  256  102  311  101  142  39  71
NZL   201  144  470    0  473  237  86  213  86  91  106  57
AUS   282  134  559  522    0  238  78  249  86  89  53  58
GBR   176  176  278  241  237    0  99  177  104  105  65  74
NLD   40  150  108  82  69  91  0  79  57  86  27  40
ZAF   157  140  325  221  234  176  75  0  91  87  34  58
ITA   67  109  108  86  80  105  57  84  0  61  20  45
DEU   73  129  142  86  80  102  82  84  61  0  21  50
IRL    6  33  40  118  50  68  25  34  19  21  0  18
CHE   35  60  72  47  49  71  34  51  43  46  13  0
-----

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JER

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-----
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  478  194  278  174  45  161  71  76  9  41
DFS   113    0  210  166  163  184  148  158  109  131  37  60
USA   507  192    0  395  518  256  102  311  101  142  39  71
NZL   201  144  470    0  473  238  86  213  86  91  106  56
AUS   283  134  560  522    0  240  79  249  86  90  53  58
GBR   176  176  278  241  238    0  99  177  104  105  65  74
NLD   40  150  108  82  70  91  0  79  57  86  27  40
ZAF   157  140  325  221  234  176  75  0  91  87  34  58
ITA   67  109  108  86  80  105  57  84  0  61  20  45
DEU   73  129  142  86  81  102  82  84  61  0  21  50
IRL    6  33  40  118  50  68  25  34  19  21  0  18
CHE   35  60  72  47  49  71  34  51  43  46  13  0
-----

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RDC

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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  223  94  106  90  182  14  75  3  10  17  2  6  0
NOR    6    0  81  47  74  64  135  15  0  27  19  25  48  47  0
USA   206  82  0  134  147  123  214  23  64  24  25  34  24  47  25
NZL   94  47  135  0  160  92  188  19  39  14  17  29  10  22  12
AUS  107  63  148  160  0  93  204  44  38  40  39  45  14  38  13
GBR   88  67  115  88  92  0  117  15  41  13  17  27  18  40  0
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DFS	187	109	210	186	179	112	0	59	53	125	126	111	14	54	0
DEU	13	14	22	19	43	15	50	0	1	24	35	29	4	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	27	23	13	36	11	111	24	0	0	53	26	0	20	0
LVA	10	17	22	14	35	16	85	29	2	46	0	55	2	14	0
LTU	16	22	29	26	42	25	99	28	5	25	49	0	4	14	0
IRL	2	47	24	10	13	17	11	4	2	0	2	4	0	9	0
NLD	6	46	46	22	36	39	51	14	2	19	13	13	9	0	0
CAM	0	0	25	12	13	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	222	94	106	90	182	14	75	3	10	17	2	6	0
NOR	6	0	80	47	74	64	135	15	0	27	19	25	48	47	0
USA	205	81	0	134	147	122	211	23	64	24	25	34	24	47	25
NZL	94	47	135	0	160	92	188	19	39	14	17	29	10	22	12
AUS	107	63	148	160	0	93	204	44	38	40	39	45	14	38	13
GBR	88	67	114	88	92	0	117	15	41	13	17	27	18	40	0
DFS	187	109	207	186	179	112	0	59	53	125	126	111	14	54	0
DEU	13	14	22	19	43	15	50	0	1	24	35	29	4	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	27	23	13	36	11	111	24	0	0	53	26	0	20	0
LVA	10	17	22	14	35	16	85	29	2	46	0	55	2	14	0
LTU	16	22	29	26	42	25	99	28	5	25	49	0	4	14	0
IRL	2	47	24	10	13	17	11	4	2	0	2	4	0	9	0
NLD	6	46	46	22	36	39	51	14	2	19	13	13	9	0	0
CAM	0	0	25	12	13	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	222	94	106	90	182	14	75	3	10	17	2	6	0
NOR	6	0	80	47	74	64	135	15	0	27	19	25	48	47	0
USA	205	81	0	134	147	122	211	23	64	24	25	34	24	47	25
NZL	94	47	135	0	160	92	188	19	39	14	17	29	10	22	12
AUS	107	63	148	160	0	93	204	44	38	40	39	45	14	38	13
GBR	88	67	114	88	92	0	117	15	41	13	17	27	18	40	0
DFS	187	109	207	186	179	112	0	59	53	125	126	110	14	54	0
DEU	13	14	22	19	43	15	50	0	1	24	35	29	4	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	27	23	13	36	11	111	24	0	0	53	26	0	20	0
LVA	10	17	22	14	35	16	85	29	2	46	0	55	2	14	0
LTU	16	22	29	26	42	25	98	28	5	25	49	0	4	14	0
IRL	2	47	24	10	13	17	11	4	2	0	2	4	0	9	0
NLD	6	46	46	22	36	39	51	14	2	19	13	13	9	0	0
CAM	0	0	25	12	13	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	372	228	96	6	12	2	91	57	56	2	32
DEA	338	0	284	1009	259	281	52	358	65	55	691	34
FRM	279	334	0	177	17	3	3	127	72	73	2	67
ITA	99	922	202	0	149	160	24	233	64	48	312	33
SVN	6	237	17	140	0	62	15	69	4	0	125	1
FRA	9	240	1	143	59	0	12	79	4	0	110	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	377	149	230	66	76	8	0	56	53	152	28
IRL	54	58	76	61	4	4	2	50	0	40	7	17

GBR	64	58	93	52	0	0	0	54	34	0	0	19
HRV	2	724	1	300	114	100	21	150	6	0	0	4
USA	31	40	81	40	1	3	0	30	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	371	228	96	6	12	2	91	57	56	2	32
DEA	338	0	284	1010	259	281	52	358	65	55	689	34
FRM	279	334	0	177	17	3	3	127	72	73	2	67
ITA	99	923	202	0	149	160	24	233	64	48	311	33
SVN	6	237	17	140	0	62	15	69	4	0	125	1
FRA	9	240	1	143	59	0	12	79	4	0	110	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	377	149	230	66	76	8	0	56	53	152	28
IRL	54	58	76	61	4	4	2	50	0	40	7	17
GBR	64	58	93	52	0	0	0	54	34	0	0	19
HRV	2	722	1	299	114	100	21	150	6	0	0	4
USA	31	40	81	40	1	3	0	30	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	371	228	96	6	12	2	91	57	56	2	32
DEA	338	0	284	1009	259	281	52	358	65	55	690	34
FRM	279	334	0	177	17	3	3	127	72	73	2	67
ITA	99	922	202	0	149	160	24	233	64	48	311	33
SVN	6	237	17	140	0	62	15	69	4	0	125	1
FRA	9	240	1	143	59	0	12	79	4	0	110	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	377	149	230	66	76	8	0	56	53	152	28
IRL	54	58	76	61	4	4	2	50	0	40	7	17
GBR	64	58	93	52	0	0	0	54	34	0	0	19
HRV	2	723	1	299	114	100	21	150	6	0	0	4
USA	31	40	81	40	1	3	0	30	16	27	4	0