

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:

EST (ALL)	Decrease in information due to the pedigree correction and updated herd information
NOR (RDC)	Decrease in information due to the rolling definition of hys.
IRL (HOL,RDC)	Decrease in information due to the parentage correction and pedigree editing/cleaning, and more data due to the seasonal calving.
JPN (HOL)	Decrease in information due to the poedigree changes.
AUS (ALL)	Decrease in information due to the pedigree updates, and status changes of some bulls which then leads to no longer being qualified for the >10 threshold
CHE (ALL)	Decrease in information due to the manual edits/ data correction in data base, change of hys assignment
SVN (All)	Decrease in information due to the changes in database regarding pedigree completeness and pheontype improvement.
BEL (HOL)	Decrease in information due to the pedigree correction (alias errors/correction), and some bulls are not qualified for having enough herds (>10) to be submitted.
ITA (SIM)	Decrease in information due to the pedigree editing regarding very old bulls.
NZL (ALL)	Decrease in information due to the parentage testing and some records changes.
ESP (HOL)	Base change, drop in information.
GBR (HOL, JER, RDC, SIM)	Decrease in information due to the data updates, and pedigree correction.

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

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	230	150	8897	1890	849	
BEL			2312			
CAN	278	110	13895	883	879	
CHE	3209		3378	100		3631
CZE			5179			
DEA	6410					26353
DEU			24227	257	302	
DFS			14315	2355	8044	
ESP			4579			
EST			1390		490	
FRA	495		18544			488
FRM						5130
GBR	189	376	8125	1000	721	121
HUN			3614			237
IRL			3262	164	62	102
ISR			1720			
ITA	2379		9400	173		1988
JPN			6865			
KOR			1775			
LTU			897		374	
LVA			1532		721	
NLD	232		16932	255	102	506
NOR					4335	
NZL	85	63	8983	5494	1536	
POL			12610			
PRT			2970			
SVK			1198			
SVN	334		682			674
URY			1169			
USA	1218	828	42356	5373	807	107
ZAF			1316	749	144	
HRV			972			1059
CAM					50	
=====						
No. Records	15059	1527	223094	18693	19416	40396
Pub. Proofs	11958	1206	160462	14803	17120	36306
=====						

^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	661.40										
FRA	0.88	644.32									
USA	0.92	0.88	639.95								
CHE	0.90	0.88	0.87	494.05							
ITA	0.87	0.79	0.88	0.87	613.90						
DEA	0.83	0.81	0.85	0.94	0.89	466.73					
NLD	0.88	0.85	0.87	0.85	0.85	0.86	661.59				
SVN	0.69	0.73	0.71	0.70	0.63	0.72	0.67	10.21			
NZL	0.68	0.74	0.70	0.72	0.67	0.72	0.71	0.65	469.12		
GBR	0.84	0.86	0.83	0.85	0.77	0.76	0.83	0.67	0.71	288.71	
AUS	0.73	0.74	0.69	0.69	0.65	0.63	0.71	0.65	0.82	0.69	385.85

BSW	fat										
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.75										
FRA	0.87	26.57									
USA	0.89	0.89	23.53								
CHE	0.85	0.86	0.84	19.44							
ITA	0.87	0.83	0.86	0.86	23.26						
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	25.55				
SVN	0.76	0.77	0.72	0.73	0.68	0.78	0.67	10.78			
NZL	0.70	0.76	0.72	0.77	0.67	0.78	0.68	0.66	22.28		
GBR	0.83	0.86	0.84	0.84	0.77	0.76	0.84	0.67	0.72	10.09	
AUS	0.73	0.71	0.73	0.64	0.65	0.65	0.68	0.61	0.79	0.67	15.47

BSW	pro										
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.59										
FRA	0.83	20.40									
USA	0.88	0.86	18.71								
CHE	0.83	0.82	0.82	15.71							
ITA	0.83	0.77	0.83	0.85	21.43						
DEA	0.78	0.75	0.81	0.93	0.87	14.56					
NLD	0.84	0.80	0.83	0.81	0.82	0.84	21.87				
SVN	0.66	0.69	0.68	0.65	0.62	0.68	0.64	9.93			
NZL	0.61	0.67	0.64	0.68	0.62	0.70	0.63	0.61	16.10		
GBR	0.83	0.82	0.81	0.81	0.74	0.69	0.82	0.65	0.65	8.48	
AUS	0.68	0.64	0.66	0.60	0.57	0.58	0.63	0.55	0.78	0.63	12.05

GUE	mil										
	CAN	USA	AUS	GBR	NZL						
CAN	773.04										
USA	0.93	783.12									
AUS	0.78	0.73	475.31								
GBR	0.86	0.82	0.71	266.57							
NZL	0.71	0.68	0.83	0.70	372.88						

GUE	fat										
	CAN	USA	AUS	GBR	NZL						
CAN	29.97										
USA	0.92	27.25									
AUS	0.77	0.74	17.50								
GBR	0.86	0.82	0.71	10.29							
NZL	0.70	0.73	0.81	0.71	18.32						

AUS	0.77	0.69	0.75	0.79	13.82										
GBR	0.81	0.79	0.80	0.68	0.71	9.25									
NLD	0.85	0.84	0.83	0.66	0.67	0.78	25.62								
ZAF	0.76	0.74	0.74	0.61	0.70	0.65	0.66	14.70							
ITA	0.87	0.84	0.86	0.66	0.71	0.76	0.79	0.77	25.86						
DEU	0.92	0.92	0.90	0.67	0.72	0.85	0.89	0.76	0.87	23.68					
IRL	0.78	0.76	0.74	0.83	0.79	0.74	0.79	0.63	0.70	0.76	6.12				
CHE	0.84	0.83	0.80	0.74	0.70	0.79	0.80	0.71	0.81	0.89	0.77	16.97			

JER pro

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE			
CAN	19.73														
DFS	0.88	10.47													
USA	0.88	0.88	20.27												
NZL	0.63	0.66	0.67	10.10											
AUS	0.69	0.65	0.66	0.76	10.53										
GBR	0.82	0.81	0.77	0.65	0.68	7.07									
NLD	0.86	0.87	0.84	0.65	0.66	0.78	19.68								
ZAF	0.81	0.77	0.76	0.66	0.68	0.69	0.71	11.65							
ITA	0.86	0.84	0.86	0.61	0.67	0.77	0.81	0.84	19.50						
DEU	0.89	0.94	0.89	0.63	0.63	0.82	0.91	0.75	0.85	18.93					
IRL	0.73	0.75	0.72	0.84	0.77	0.72	0.76	0.66	0.71	0.75	5.53				
CHE	0.80	0.82	0.75	0.67	0.60	0.75	0.81	0.67	0.74	0.87	0.76	11.56			

RDC mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	612.36														
NOR	0.84	12.58													
USA	0.91	0.89	724.34												
NZL	0.67	0.69	0.68	364.01											
AUS	0.74	0.69	0.72	0.82	423.55										
GBR	0.82	0.80	0.81	0.69	0.75	259.65									
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	663.70							
ZAF	0.83	0.78	0.82	0.71	0.77	0.72	0.78	0.78	611.33						
EST	0.85	0.81	0.85	0.66	0.68	0.77	0.83	0.78	0.71	509.97					
LVA	0.74	0.74	0.75	0.64	0.66	0.71	0.73	0.74	0.72	0.79	330.10				
LTU	0.73	0.74	0.72	0.65	0.62	0.71	0.63	0.72	0.69	0.65	0.74	368.82			
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	176.51		
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	791.71	
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	424.59

RDC fat

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.48														
NOR	0.84	12.03													
USA	0.90	0.81	26.00												
NZL	0.65	0.74	0.69	15.72											
AUS	0.70	0.67	0.74	0.81	15.37										
GBR	0.82	0.74	0.82	0.68	0.73	8.55									
DFS	0.89	0.88	0.86	0.71	0.71	0.81	10.34								
DEU	0.92	0.85	0.91	0.67	0.69	0.87	0.91	26.31							
ZAF	0.77	0.79	0.80	0.62	0.67	0.67	0.72	0.71	20.60						
EST	0.86	0.69	0.88	0.67	0.72	0.78	0.82	0.84	0.73	20.42					
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	7.29		
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	28.39	
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	22.34

RDC pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.54														
NOR	0.82	12.02													
USA	0.89	0.87	20.12												
NZL	0.57	0.67	0.64	11.31											
AUS	0.63	0.66	0.66	0.77	12.12										
GBR	0.80	0.80	0.81	0.60	0.67	6.95									
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	20.26							
ZAF	0.76	0.77	0.77	0.65	0.73	0.66	0.71	0.72	17.32						
EST	0.80	0.68	0.80	0.57	0.55	0.72	0.77	0.79	0.67	15.78					
LVA	0.72	0.68	0.74	0.57	0.55	0.69	0.66	0.72	0.70	0.70	9.77				
LTU	0.66	0.63	0.66	0.57	0.51	0.66	0.59	0.66	0.67	0.63	0.70	10.81			
IRL	0.74	0.75	0.76	0.79	0.77	0.75	0.75	0.68	0.68	0.63	0.65	0.61	5.32		
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	26.13	
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	10.43

SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	562.75											
DEA	0.87	507.95										
FRM	0.95	0.85	612.72									
ITA	0.77	0.71	0.71	506.29								
SVN	0.75	0.74	0.79	0.71	9.44							
FRA	0.90	0.87	0.81	0.84	0.78	669.09						
NLD	0.88	0.92	0.88	0.76	0.74	0.87	763.70					
IRL	0.84	0.73	0.85	0.68	0.72	0.86	0.80	175.22				
GBR	0.87	0.86	0.86	0.77	0.69	0.85	0.85	0.78	225.35			
HRV	0.66	0.65	0.77	0.63	0.62	0.64	0.64	0.66	0.64	10.47		
USA	0.86	0.80	0.81	0.87	0.79	0.90	0.88	0.79	0.82	0.65	612.01	
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	22.58											
DEA	0.87	19.10										
FRM	0.93	0.89	24.10									
ITA	0.77	0.77	0.74	19.71								
SVN	0.72	0.78	0.79	0.73	9.46							
FRA	0.89	0.90	0.81	0.82	0.75	27.13						
NLD	0.86	0.92	0.88	0.75	0.77	0.86	28.56					
IRL	0.78	0.72	0.81	0.64	0.70	0.83	0.77	7.33				
GBR	0.90	0.86	0.85	0.80	0.68	0.87	0.85	0.75	8.00			
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	20.30	
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	16.80											
DEA	0.86	15.49										
FRM	0.92	0.84	19.08									
ITA	0.71	0.68	0.69	15.92								
SVN	0.70	0.69	0.76	0.68	9.47							
FRA	0.87	0.84	0.78	0.79	0.73	21.26						
NLD	0.82	0.90	0.86	0.71	0.71	0.83	23.81					
IRL	0.76	0.74	0.80	0.59	0.65	0.79	0.73	6.07				
GBR	0.83	0.85	0.84	0.75	0.65	0.84	0.84	0.73	7.11			
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	16.88	
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	191	151	148	163	60	32	37	77	104
FRA	89	0	135	195	229	257	96	51	35	72	79
USA	185	99	0	332	259	352	94	40	48	110	135
CHE	129	154	310	0	519	648	116	76	44	87	126
ITA	132	194	185	461	0	817	147	95	48	96	134
DEA	144	212	319	540	715	0	167	103	59	93	141
NLD	55	82	86	107	122	158	0	47	34	45	68
SVN	29	50	32	72	91	94	47	0	13	22	28
NZL	36	26	40	33	40	53	27	11	0	30	41
GBR	76	61	103	67	71	65	38	17	26	0	68
AUS	107	63	127	86	99	103	51	20	33	62	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	191	151	148	163	60	32	37	77	104
FRA	89	0	135	195	229	257	96	51	35	72	79
USA	185	99	0	332	259	352	94	40	48	110	135
CHE	129	154	310	0	519	649	116	76	44	87	126
ITA	132	194	185	461	0	818	147	95	48	96	134
DEA	144	212	319	540	716	0	167	103	59	93	141
NLD	55	82	86	107	122	158	0	47	34	45	68
SVN	29	50	32	72	91	94	47	0	13	22	28
NZL	36	26	40	33	40	53	27	11	0	30	41
GBR	76	61	103	67	71	65	38	17	26	0	68
AUS	107	63	127	86	99	103	51	20	33	62	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	191	151	148	163	60	32	37	77	104
FRA	89	0	135	195	229	257	96	51	35	72	79
USA	185	99	0	332	259	352	94	40	48	110	135
CHE	129	154	310	0	519	649	116	76	44	87	126
ITA	132	194	185	461	0	818	147	95	48	96	134
DEA	144	212	319	540	716	0	167	103	59	93	141
NLD	55	82	86	107	122	158	0	47	34	45	68
SVN	29	50	32	72	91	94	47	0	13	22	28
NZL	36	26	40	33	40	53	27	11	0	30	41
GBR	76	61	103	67	71	65	38	17	26	0	68
AUS	107	63	127	86	99	103	51	20	33	62	0

GUE

common bulls below diagonal

common three quarter	sib		group		above diagonal
CAN	USA	AUS	GBR	NZL	
CAN	0	78	55	39	14
USA	70	0	72	102	32
AUS	52	69	0	45	27
GBR	33	103	38	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   78   55   39   14
USA   70    0   72  102   32
AUS   52   69    0   45   27
GBR   33  103   38    0   16
NZL   11   29   27   14    0
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GUE
-----
common bulls below diagonal
common three quarter sib group above diagonal
  CAN  USA  AUS  GBR  NZL
-----
CAN    0   78   55   39   14
USA   70    0   72  102   32
AUS   52   69    0   45   27
GBR   33  103   38    0   16
NZL   11   29   27   14    0
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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 2659 1737 1704 1932 1805 4037  944 1930  863 1626  930  633 1472 1353  232 328  167 1111 1785  515 1467  591 472  300 1263  827  534  348
DEU 2120    0 2958 2730 2710 3677 3840 1218 2290 1093 1810 1359  934 1697 2124  373 517  192 1307 3042  560 1498  935 721  553 1449  725  508  722
DFS 1550 2270    0 1899 1667 2445 2443  788 1753  952 1446  992  798 1187 1493  273 391  175  990 1973  515 1062  577 441  358 1111  583  449  485
FRA 1263 1693 1194    0 1709 2289 2741  784 1730  912 1436 1102  798 1379 1496  231 318  146 1044 2072  514 1300  524 475  288 1139  631  452  385
ITA 1666 1928 1355 1061    0 1854 2809  756 1629  687 1206  826  589 1347 1348  271 331  160 1009 1991  394 1155  594 404  332 1110  652  414  411
NLD 1768 3500 2193 1623 1569    0 2843  981 2005 1207 1615 1427  957 1291 1794  289 452  187 1052 2292  522 1164  645 577  368 1259  586  460  516
USA 4611 2926 1984 1618 2210 2560    0 1078 2554 1228 2171 1093  882 1751 1977  265 432  252 1431 2660  647 2099  798 589  403 1594 1004  727  443
CHE  871 1153  749  728  695  983 1014    0  776  463  688  664  435  617  579  145 196  71  453  772  259  498  328  250  145  566  309  224  221
GBR 2183 1785 1375 1185 1285 1785 2361  743    0 1043 1573  968 1048 1208 1256  223 324  174  941 1650  519 1129  510 406  327 1102  581  485  381
NZL  860  847  689  598  519 1099 1177  391  906    0 1324  581  791  609  740  132 169  132  549  790  376  618  294  279  193  663  362  401  251
AUS 1668 1397 1083 1027  935 1427 2240  614 1384 1334    0  826  781  996  994  182 257  133  792 1245  487  975  454  333  265  941  536  474  331
BEL  928 1406  936 1131  818 1640  981  679  959  475  735    0  551  757  785  176 234  94  596  954  341  596  348  319  186  762  353  270  306
IRL  592  811  657  674  497  895  798  442 1070  684  672  541    0  544  598  116 155  116  466  687  330  469  242  223  156  535  271  290  204
ESP 1020 1133  923 1152  974 1159 1201  515  949  464  722  743  513    0 1015  205 246  124  842 1295  455  977  431  346  243  976  566  384  323
CZE 1052 1727 1040 1046 1009 1649 1639  450  921  556  687  644  470  757    0  236 329  157 1041 1644  439  956  519  548  306  972  567  434  428
SVN  178  363  221  175  231  252  214  104  165  89  124  136  86  146  172    0  100  52  162  308  74  169  138  80  72  179  116  64  127
EST  213  382  260  172  196  332  311  115  194  87  136  149  82  119  212  59    0  61  230  431  114  231  227  135  102  238  144  123  148
ISR  119  145  131  92  106  143  243  42  126  106  85  59  89  75  123  36  36    0  124  187  68  129  88  57  56  124  76  79  77
HUN 1048 1053  802  769  869  889 1409  379  816  426  602  515  405  680  972  119 138  85    0 1081  404  774  392  337  248  828  521  397  295
POL 1628 2856 1682 1546 1676 2197 2691  670 1455  611  987  885  568  974 1419  272 320  146  979  0  427 1120  775 493  417 1254  677  458  558
ZAF  479  438  396  409  305  442  635  221  456  312  429  293  297  408  313  53  57  43  336  322  0  431  176  184  108  451  279  280  162
JPN  778  692  593  517  581  634  967  337  588  328  553  389  296  480  451  93  87  54  426  619  283  0  403  324  229  805  633  415  259
LVA  368  780  371  288  379  441  685  182  298  167  234  211  141  232  354  83  138  57  281  636  101  175  0  206  206  481  274  207  293
SVK  331  536  235  265  238  407  396  128  231  166  165  193  108  176  470  37  56  23  234  348  101  114  103  0  106  351  226  192  158
LTU  171  512  212  121  170  226  283  59  178  90  121  91  74  96  198  31  46  25  150  323  41  74  133  48  0  245  159  131  165
PRT 1326 1355 1023 1036 1058 1272 1704  517 1016  539  790  775  479  945  822  141 161  81  822 1288  405  491  373  234  153  0  552  426  361
KOR  811  508  431  394  536  430 1158  221  428  266  396  262  188  410  413  73  69  41  422  572  208  387  166  136  71  472  0  323  168
URY  531  383  328  309  314  368  909  177  412  324  373  207  235  312  340  36  72  43  338  395  240  255  122  123  76  380  261  0  154
HRV  214  748  391  280  300  473  342  148  273  150  211  249  142  242  329  103 107  54  218  510  109  120  228  79  114  299  82  99  0
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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 2659 1735 1704 1934 1805 4032  944 1930  863 1626  930  633 1471 1353  233 328  167 1111 1785  514 1463  591 472  300 1263  827  534  347
DEU 2120    0 2958 2730 2710 3677 3835 1218 2290 1093 1810 1359  934 1697 2124  373 517  192 1307 3042  559 1494  935 721  553 1448  725  508  721
DFS 1550 2270    0 1899 1668 2445 2439  788 1753  952 1446  992  797 1186 1491  274 391  175  989 1971  514 1060  577 441  358 1111  583  449  484
FRA 1263 1693 1194    0 1710 2289 2740  784 1730  912 1436 1102  799 1379 1496  232 318  146 1044 2072  513 1297  524 475  288 1139  631  452  384
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ITA	1669	1931	1357	1062	0	1855	2810	757	1630	688	1207	827	590	1347	1350	272	331	160	1011	1991	395	1153	594	404	332	1112	653	414	410
NLD	1768	3500	2193	1623	1571	0	2841	981	2005	1207	1615	1427	959	1291	1794	290	452	187	1052	2292	521	1160	645	577	368	1259	586	460	515
USA	4606	2920	1979	1617	2211	2559	0	1076	2553	1227	2169	1090	881	1749	1976	266	431	252	1430	2658	646	2095	797	589	403	1592	1004	727	441
CHE	871	1153	749	728	696	983	1012	0	776	463	688	664	435	617	579	146	196	71	453	772	258	495	328	250	145	566	309	224	220
GBR	2183	1785	1375	1185	1286	1785	2360	743	0	1043	1573	968	1049	1208	1256	224	324	174	941	1650	518	1125	510	406	327	1102	581	485	381
NZL	860	847	689	598	519	1099	1176	391	906	0	1324	581	791	609	740	133	169	132	549	790	375	618	294	279	193	663	362	401	250
AUS	1668	1397	1083	1027	935	1427	2238	614	1384	1334	0	826	781	996	994	183	257	133	792	1245	486	972	454	333	265	941	536	474	331
BEL	928	1406	936	1131	819	1640	978	679	959	475	735	0	551	757	785	177	234	94	596	954	340	595	348	319	186	762	353	270	305
IRL	592	811	657	674	498	897	798	442	1071	684	672	541	0	543	598	117	155	116	466	688	330	467	242	223	156	535	271	290	203
ESP	1020	1133	922	1152	976	1159	1199	515	949	464	722	743	513	0	1014	206	246	124	841	1294	454	975	431	346	243	976	566	384	323
CZE	1052	1727	1040	1046	1011	1649	1638	450	921	556	687	644	470	757	0	237	329	157	1041	1644	438	954	519	548	306	972	567	434	427
SVN	178	363	221	175	231	252	214	104	165	89	124	136	86	146	172	0	100	52	162	309	74	169	139	81	73	180	116	65	128
EST	213	382	260	172	196	332	310	115	194	87	136	149	82	119	212	59	0	61	230	431	114	228	227	135	102	238	144	123	148
ISR	119	145	131	92	106	143	243	42	126	106	85	59	89	75	123	36	36	0	124	187	67	128	88	57	56	124	76	79	77
HUN	1048	1053	802	769	871	889	1408	379	816	426	602	515	405	680	972	119	138	85	0	1081	403	772	392	337	248	828	521	397	295
POL	1628	2856	1682	1546	1676	2197	2688	670	1455	611	987	885	568	974	1419	272	320	146	979	0	426	1115	775	493	417	1253	677	458	557
ZAF	478	437	395	408	306	441	634	220	455	312	428	293	297	407	312	52	57	43	335	321	0	429	175	183	107	450	278	279	161
JPN	772	687	590	512	577	629	959	333	583	327	548	387	294	476	448	93	84	53	424	612	282	0	402	323	229	801	632	414	259
LVA	368	780	371	288	380	441	684	182	298	167	234	211	141	232	354	83	138	57	281	636	101	174	0	206	206	480	274	207	293
SVK	331	536	235	265	238	407	396	128	231	166	165	193	108	176	470	37	56	23	234	348	101	113	103	0	106	351	226	192	158
LTU	171	512	212	121	170	226	283	59	178	90	121	91	74	96	198	31	46	25	150	323	40	74	133	48	0	245	159	131	165
PRT	1325	1353	1022	1034	1061	1271	1702	517	1015	539	789	774	479	944	822	141	161	81	822	1287	404	486	372	234	153	0	552	426	360
KOR	811	508	431	394	537	430	1157	221	428	266	396	262	188	410	413	73	69	41	422	572	208	384	166	136	71	472	0	323	168
URY	531	383	328	309	314	368	909	177	412	324	373	207	235	312	340	36	72	43	338	395	240	252	122	123	76	380	261	0	154
HRV	212	746	389	278	299	471	339	146	272	149	210	248	140	242	327	102	107	53	217	508	109	120	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	2659	1735	1704	1932	1805	4026	944	1930	863	1626	930	633	1471	1353	232	328	167	1111	1785	514	1461	591	472	300	1263	827	534	348	
DEU	2120	0	2958	2730	2709	3677	3833	1218	2291	1093	1810	1359	934	1697	2124	372	517	192	1307	3042	559	1494	935	721	553	1449	725	508	722	
DFS	1550	2270	0	1899	1666	2445	2437	788	1754	952	1446	992	797	1186	1491	273	391	175	989	1971	514	1060	577	441	358	1111	583	449	485	
FRA	1263	1693	1194	0	1709	2289	2739	784	1731	912	1436	1102	799	1379	1496	231	318	146	1044	2072	513	1297	524	475	288	1139	631	452	385	
ITA	1666	1928	1355	1061	0	1854	2808	756	1630	687	1206	826	589	1346	1348	271	331	160	1009	1991	393	1152	594	404	332	1110	652	414	411	
NLD	1768	3500	2193	1623	1569	0	2840	981	2006	1207	1615	1427	959	1291	1794	289	452	187	1052	2292	521	1158	645	577	368	1259	586	460	516	
USA	4603	2920	1979	1617	2209	2559	0	1076	2552	1227	2166	1089	881	1748	1976	265	431	252	1430	2658	646	2091	797	588	403	1592	1005	727	442	
CHE	871	1153	749	728	695	983	1011	0	776	463	688	664	435	617	579	145	196	71	453	772	258	494	328	250	145	566	309	224	221	
GBR	2183	1787	1377	1187	1286	1787	2360	743	0	1044	1573	969	1050	1209	1256	223	324	174	941	1651	518	1125	510	406	327	1103	581	485	382	
NZL	860	847	689	598	519	1099	1176	391	906	0	1324	581	791	609	740	132	169	132	549	790	375	618	294	279	193	663	362	401	251	
AUS	1668	1397	1083	1027	935	1427	2237	614	1384	1334	0	826	781	996	994	182	257	133	792	1245	486	971	454	333	265	941	536	474	331	
BEL	928	1406	936	1131	818	1640	977	679	960	475	735	0	551	757	785	176	234	94	596	954	340	594	348	319	186	762	353	270	306	
IRL	592	811	657	674	497	897	798	442	1073	684	672	541	0	543	598	116	155	116	466	688	330	467	242	223	156	535	271	290	204	
ESP	1020	1133	922	1152	974	1159	1199	515	950	464	722	743	513	0	1014	205	246	124	841	1294	454	975	431	346	243	976	566	384	323	
CZE	1052	1727	1040	1046	1009	1649	1638	450	922	556	687	644	470	757	0	236	329	157	1041	1644	438	954	519	548	306	972	567	434	428	
SVN	178	363	221	175	231	252	214	104	165	89	124	136	86	146	172	0	100	52	162	308	73	169	138	80	72	179	116	64	127	
EST	213	382	260	172	196	332	310	115	194	87	136	149	82	119	212	59	0	61	230	431	114	227	227	135	102	238	144	123	148	
ISR	119	145	131	92	106	143	243	42	126	106	85	59	89	75	123	36	36	0	124	187	67	128	88	57	56	124	76	79	77	
HUN	1048	1053	802	769	869	889	1408	379	816	426	602	515	405	680	972	119	138	85	0	1081	403	772	392	337	248	828	521	397	295	
POL	1628	2856	1682	1546	1676	2197	2688	670	1457	611	987	885	568	974	1419	272	320	146	979	0	426	1115	775	493	417	1254	677	458	558	
ZAF	478	437	395	408	304	441	634	220	455	312	428	293	297	407	312	52	57	43	335	321	0	429	175	183	107	450	278	279	161	
JPN	770	687	590	512	576	627	957	333	584	327	547	386	294	476	448	93	83	53	424	612	282	0	401	323	229	800	632	414	259	
LVA	368	780	371	288	379	441	684	182	299	167	234	211	141	232	354	83	138	57	281	636	101	173	0	206	206	481	274	207	293	
SVK	331	536	235	265	238	407	395	128	231	166	165	193	108	176	470	37	56	23	234	348	101	113	103	0	106	351	226	192	158	
LTU	171																													

DFS	135	0	234	183	177	198	168	166	110	163	37	61
USA	536	218	0	413	536	271	112	320	101	158	39	74
NZL	213	161	490	0	494	250	96	221	86	103	106	56
AUS	296	149	581	548	0	252	83	257	85	99	53	59
GBR	188	190	295	253	251	0	102	182	105	116	65	75
NLD	42	171	118	92	74	94	0	82	56	104	27	42
ZAF	163	148	334	229	241	183	78	0	91	94	34	58
ITA	67	110	108	85	80	106	56	84	0	61	20	44
DEU	85	162	158	98	90	113	101	91	61	0	21	52
IRL	6	33	40	119	50	68	25	34	19	21	0	18
CHE	36	61	75	48	49	72	36	51	42	49	13	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	139	505	204	290	187	47	167	71	88	9	42
DFS	135	0	234	183	177	198	168	165	110	163	37	61
USA	535	218	0	412	536	270	112	319	101	158	39	74
NZL	213	161	489	0	494	250	96	220	86	103	106	57
AUS	296	149	581	548	0	252	83	256	85	99	53	59
GBR	188	190	294	253	251	0	102	181	105	116	65	75
NLD	42	171	118	92	74	94	0	81	56	104	27	42
ZAF	163	147	333	228	240	182	77	0	91	93	34	58
ITA	67	110	108	85	80	106	56	84	0	61	20	44
DEU	85	162	158	98	90	113	101	90	61	0	21	52
IRL	6	33	40	119	50	68	25	34	19	21	0	18
CHE	36	61	75	48	49	72	36	51	42	49	13	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	139	505	204	290	187	47	167	71	88	9	42
DFS	135	0	234	183	177	198	168	165	110	163	37	61
USA	535	218	0	412	536	272	112	319	101	158	39	74
NZL	213	161	489	0	494	251	96	220	86	103	106	56
AUS	296	149	581	548	0	253	83	256	85	99	53	59
GBR	189	191	297	255	252	0	102	181	105	116	65	75
NLD	42	171	118	92	74	94	0	81	56	104	27	42
ZAF	163	147	333	228	240	182	77	0	91	93	34	58
ITA	67	110	108	85	80	106	56	84	0	61	20	44
DEU	85	162	158	98	90	113	101	90	61	0	21	52
IRL	6	33	40	119	50	68	25	34	19	21	0	18
CHE	36	61	75	48	49	72	36	51	42	49	13	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	7	230	96	106	96	193	14	75	3	10	22	3	6	0
NOR	6	0	86	51	77	73	138	16	0	30	19	25	49	52	0
USA	214	87	0	141	152	137	224	25	64	26	25	41	25	49	31
NZL	96	51	141	0	168	97	201	22	39	20	19	25	11	26	13
AUS	107	66	154	169	0	99	212	46	38	45	40	45	15	43	14
GBR	94	77	129	92	97	0	130	16	43	14	17	29	19	45	0
DFS	199	113	221	198	187	124	0	66	53	139	132	108	15	59	0
DEU	13	15	23	22	45	16	57	0	1	32	36	28	5	19	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	30	25	19	41	12	127	32	0	0	56	22	0	24	0
LVA	10	17	22	16	36	16	91	30	2	49	0	48	3	17	0
LTU	21	22	36	24	42	27	93	27	5	22	43	0	6	16	0
IRL	3	48	25	11	14	18	12	5	2	0	3	6	0	10	0

NLD	6	51	48	26	41	44	56	18	2	23	16	15	10	0	0
CAM	0	0	31	13	14	0	0	0	0	0	0	0	0	0	0

RDC

common bulls below diagonal															
common	three	quarter	sib	group	above diagonal										
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	7	229	96	106	96	193	14	75	3	10	22	3	6	0
NOR	6	0	85	51	77	73	138	16	0	30	19	25	49	52	0
USA	213	86	0	141	152	136	221	25	64	26	25	41	25	49	31
NZL	96	51	141	0	168	97	201	22	39	20	19	25	11	26	13
AUS	107	66	154	169	0	99	212	46	38	45	40	45	15	43	14
GBR	94	77	128	92	97	0	130	16	43	14	17	29	19	45	0
DFS	199	113	218	198	187	124	0	66	53	139	132	108	15	59	0
DEU	13	15	23	22	45	16	57	0	1	32	36	28	5	19	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	30	25	19	41	12	127	32	0	0	56	22	0	24	0
LVA	10	17	22	16	36	16	91	30	2	49	0	48	3	17	0
LTU	21	22	36	24	42	27	93	27	5	22	43	0	6	16	0
IRL	3	48	25	11	14	18	12	5	2	0	3	6	0	10	0
NLD	6	51	48	26	41	44	56	18	2	23	16	15	10	0	0
CAM	0	0	31	13	14	0	0	0	0	0	0	0	0	0	0

RDC

common bulls below diagonal															
common	three	quarter	sib	group	above diagonal										
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	7	229	96	106	96	193	14	75	3	10	22	3	6	0
NOR	6	0	85	51	77	73	138	16	0	30	19	25	49	52	0
USA	213	86	0	141	152	137	221	25	64	26	25	41	25	49	31
NZL	96	51	141	0	168	97	201	22	39	20	19	25	11	26	13
AUS	107	66	154	169	0	99	212	46	38	45	40	45	15	43	14
GBR	94	77	129	92	97	0	130	16	43	14	17	29	19	45	0
DFS	199	113	218	198	187	124	0	66	53	139	132	108	15	59	0
DEU	13	15	23	22	45	16	57	0	1	32	36	28	5	19	0
ZAF	77	0	58	34	39	37	50	1	0	0	2	5	2	2	0
EST	2	30	25	19	41	12	127	32	0	0	56	22	0	24	0
LVA	10	17	22	16	36	16	91	30	2	49	0	48	3	17	0
LTU	21	22	36	24	42	27	93	27	5	22	43	0	6	16	0
IRL	3	48	25	11	14	18	12	5	2	0	3	6	0	10	0
NLD	6	51	48	26	41	44	56	18	2	23	16	15	10	0	0
CAM	0	0	31	13	14	0	0	0	0	0	0	0	0	0	0

SIM

common bulls below diagonal												
common	three	quarter	sib	group	above diagonal							
	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	0	384	240	102	2	14	94	57	56	2	34	2
DEA	352	0	289	1073	261	258	393	66	54	727	39	52
FRM	292	334	0	188	11	2	131	71	72	2	86	3
ITA	104	982	213	0	151	146	255	64	47	338	34	24
SVN	2	246	10	143	0	50	82	5	0	131	1	10
FRA	11	216	1	129	48	0	80	5	0	102	3	11
NLD	96	413	154	249	77	76	0	57	52	165	31	8
IRL	54	59	76	60	5	5	51	0	39	9	18	2
GBR	64	57	93	51	0	0	53	33	0	0	20	0
HRV	2	761	1	321	120	92	161	8	0	0	4	23
USA	33	42	101	41	1	3	32	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	383	240	102	2	14	94	57	56	2	34	2
DEA	352	0	289	1074	261	258	393	66	54	725	39	52
FRM	292	334	0	188	11	2	131	71	72	2	86	3
ITA	104	983	213	0	151	146	255	64	47	337	34	24
SVN	2	246	10	143	0	50	82	5	0	131	1	10
FRA	11	216	1	129	48	0	80	5	0	102	3	11
NLD	96	413	154	249	77	76	0	57	52	165	31	8
IRL	54	59	76	60	5	5	51	0	39	9	18	2
GBR	64	57	93	51	0	0	53	33	0	0	20	0
HRV	2	759	1	320	120	92	161	8	0	0	4	23
USA	33	42	101	41	1	3	32	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	383	240	102	2	14	94	57	56	2	34	2
DEA	352	0	289	1073	261	258	393	66	54	726	39	52
FRM	292	334	0	188	11	2	131	71	72	2	86	3
ITA	104	982	213	0	151	146	255	64	47	337	34	24
SVN	2	246	10	143	0	50	82	5	0	131	1	10
FRA	11	216	1	129	48	0	80	5	0	102	3	11
NLD	96	413	154	249	77	76	0	57	52	165	31	8
IRL	54	59	76	60	5	5	51	0	39	9	18	2
GBR	64	57	93	51	0	0	53	33	0	0	20	0
HRV	2	760	1	320	120	92	161	8	0	0	4	23
USA	33	42	101	41	1	3	32	17	28	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	0	0