

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 the data clean-up, pedigree changes, bulls' statue changes and rounding effect
FRA (ALL)	All proofs sent to MACE are now "genomic-free" single-step proofs, issued from a BLUP evaluation running on single-step preadjusted performances, as suggested as one of the methods of choice to provide unbiased "genomic-free" proofs to Interbull by the Interbull working group on this topic. In addition to these changes, unknown parent groups have been modified for all traits.
ISR (HOL)	Decrease in information due to the data edits, paternity correction and updated UPG grouping and number of iterations.
EST (HOL,RDC)	Decrease in information due to the edits in data inclusion (current run from Jan 1995, previous run from Jan 1994), updated definition of herd (different dairy farms of owner have different herd code now for all owners), and updated definition of fixed lactation curve in the model, and additional criteria for exclusion of test-day info (status of cow, ill status of test day information -suspecious).
PRT (HOL)	EDC affected by changes in pedigree.
DFS (ALL)	Updated way to define groups for animals with unknown parents (UPGs).
JPN (HOL)	Small decrease in information due to the pedigree modification
GBR (HOL,JER)	Decrease in information due to the update in data input.
NLD (JER)	Decrease in information due to pedigree changes /correction.
CHE (HOL,SIM)	Decrease in information due to the edits in database, and change in hys assignment.
DEA (BSW,SIM)	Base change, decrease in info due to the pedigree correction based on genotyping , and type of proof changes for some bulls
IRL (HOL)	Drop in information due to pedigree correction (cow genotyping)
ITA (SIM)	Drop in information due to pedigree editing.

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 were national genetic evaluations of AI sampled bulls with at least 10 daughters or 10 EDC (for clinical mastitis and maternal calving traits at least 50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at least 10 herds. Table 1 presents the amount of data included in this Interbull evaluation for all breeds.

National proofs were first de-regressed within country and then analysed jointly with a linear model including the effects of evaluation country, genetic group of bull and bull merit. Heritability estimates used in both the de-regression and international evaluation were as in each country's national evaluation.

Table 2 presents the date of evaluation as supplied by each country

Estimated genetic parameters and sire standard deviations are shown in APPENDIX I and the corresponding number of common bulls are listed in APPENDIX II.

SCIENTIFIC LITERATURE

The international genetic evaluation procedure is based on international work described in the following scientific publications:

International genetic evaluation computation:

Schaeffer. 1994. J. Dairy Sci. 77:2671-2678
Klei, 1998. Interbull Bulletin 17:3-7

Verification and Genetic trend validation:

Klei et al., 2002. Interbull Bulletin 29:178-182.
Boichard et al., 1995. J. Dairy Sci. 78:431-437

Weighting factors:

Fikse and Banos, 2001. J. Dairy Sci. 84:1759-1767

De-regression:

Sigurdsson and G. Banos. 1995. Acta Agric. Scand. 45:207-219
Jairath et al. 1998. J. Dairy Sci. Vol. 81:550-562

Genetic parameter estimation:

Klei and Weigel, 1998, Interbull Bulletin 17:8-14
Sullivan, 1999. Interbull Bulletin 22:146-148

Post-processing of estimated genetic correlations:

Mark et al., 2003, Interbull Bulletin 30:126-135
Jorjani et al., 2003. J. Dairy Sci. 86:677-679
<https://wiki.interbull.org/public/rG%20procedure?action=print>

Time edits

Weigel and Banos. 1997. J. Dairy Sci. 80:3425-3430

International reliability estimation

Harris and Johnson. 1998. Interbull Bulletin 17:31-36

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for the next routine evaluation can be found on <http://www.interbull.org/ib/servicecalendar>.

NEXT TEST INTERNATIONAL EVALUATION

Dates for the next test run can be found on <http://www.interbull.org/ib/servicecalendar>.

PUBLICATION OF INTERBULL ROUTINE RUN

 Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honor the agreed code of practice, decided by the Interbull Steering Committee, and only publish international evaluations on their own country scale. Evaluations expressed on another country scale are confidential and may only be used internally for research and review purposes.

 PUBLICATION OF INTERBULL TEST RUN

Test evaluation results are meant for review purposes only and should not be published.

^LTable 1. National evaluation data considered in the Interbull evaluation for dairy production traits (December Routine Evaluation 2023). Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	231	151	8959	1908	859	
BEL			2326			
CAN	285	110	14005	895	886	
CHE	3225		3389	101		3648
CZE			5216			
DEA	6439					26512
DEU			24359	270	304	
DFS			14368	2365	8058	
ESP			4626			
EST			1412		495	
FRA	497		18652			491
FRM						5161
GBR	193	378	8199	1013	728	122
HUN			3614			237
IRL			3268	164	62	103
ISR			1737			
ITA	2385		9518	171		2017
JPN			6948			
KOR			1778			
LTU			897		374	
LVA			1532		721	
NLD	235		17024	264	102	513
NOR					4356	
NZL	87	63	9226	5644	1560	
POL			12744			
PRT			2969			
SVK			1206			
SVN	341		697			686
URY			1186			
USA	1230	831	42640	5429	814	114
ZAF			1316	750	144	
HRV			972			1060
CAM					50	
=====						
No. Records	15148	1533	224783	18974	19513	40664
Pub. Proofs	12013	1211	161363	15004	17173	36527

^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	660.84										
FRA	0.90	640.31									
USA	0.91	0.89	637.31								
CHE	0.90	0.90	0.86	495.96							
ITA	0.87	0.83	0.87	0.87	613.80						
DEA	0.83	0.85	0.84	0.94	0.89	466.04					
NLD	0.88	0.86	0.86	0.85	0.85	0.86	660.20				
SVN	0.69	0.74	0.71	0.71	0.63	0.72	0.68	10.28			
NZL	0.67	0.76	0.70	0.72	0.67	0.72	0.71	0.65	466.69		
GBR	0.84	0.86	0.83	0.85	0.77	0.76	0.83	0.67	0.71	291.22	
AUS	0.73	0.76	0.70	0.69	0.64	0.64	0.71	0.65	0.83	0.69	383.19

BSW fat											
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.48										
FRA	0.88	26.69									
USA	0.89	0.89	23.57								
CHE	0.85	0.89	0.83	19.52							
ITA	0.87	0.87	0.86	0.86	23.25						
DEA	0.81	0.87	0.83	0.94	0.87	17.33					
NLD	0.85	0.84	0.84	0.82	0.83	0.85	25.38				
SVN	0.77	0.79	0.72	0.73	0.69	0.78	0.67	10.73			
NZL	0.70	0.79	0.73	0.78	0.68	0.78	0.68	0.67	22.15		
GBR	0.83	0.86	0.83	0.83	0.78	0.76	0.83	0.68	0.72	10.29	
AUS	0.73	0.72	0.73	0.64	0.65	0.65	0.68	0.61	0.80	0.67	15.40

BSW pro											
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.56										
FRA	0.86	20.72									
USA	0.88	0.86	18.68								
CHE	0.83	0.85	0.82	15.85							
ITA	0.83	0.81	0.83	0.85	21.44						
DEA	0.78	0.80	0.80	0.93	0.87	14.53					
NLD	0.84	0.81	0.82	0.80	0.81	0.84	21.83				
SVN	0.66	0.73	0.68	0.66	0.63	0.69	0.64	9.96			
NZL	0.61	0.71	0.64	0.69	0.63	0.70	0.63	0.61	16.05		
GBR	0.83	0.82	0.80	0.81	0.74	0.70	0.81	0.64	0.65	8.47	
AUS	0.68	0.68	0.66	0.60	0.57	0.58	0.62	0.56	0.78	0.63	11.92

GUE mil					
	CAN	USA	AUS	GBR	NZL
CAN	777.12				
USA	0.93	783.59			
AUS	0.77	0.73	476.89		
GBR	0.86	0.82	0.71	266.86	
NZL	0.71	0.68	0.83	0.71	374.27

GUE fat					
	CAN	USA	AUS	GBR	NZL
CAN	30.08				
USA	0.92	27.25			
AUS	0.76	0.74	17.39		
GBR	0.86	0.82	0.71	10.38	
NZL	0.71	0.73	0.82	0.72	18.34

GUE	pro				
	CAN	USA	AUS	GBR	NZL
CAN	23.27				
USA	0.90	20.64			
AUS	0.67	0.63	13.77		
GBR	0.84	0.80	0.66	7.79	
NZL	0.62	0.59	0.79	0.63	12.60

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	799.36																												
DEU	0.94	645.76																											
DFS	0.92	0.93	11.16																										
FRA	0.91	0.92	0.90	620.92																									
ITA	0.89	0.88	0.87	0.88	600.96																								
NLD	0.91	0.94	0.91	0.89	0.87	664.33																							
USA	0.93	0.91	0.89	0.90	0.90	0.89	712.90																						
CHE	0.90	0.92	0.88	0.93	0.87	0.90	0.88	568.38																					
GBR	0.86	0.85	0.83	0.85	0.82	0.85	0.84	0.89	274.69																				
NZL	0.69	0.69	0.69	0.76	0.67	0.71	0.70	0.75	0.70	395.13																			
AUS	0.77	0.74	0.71	0.78	0.70	0.74	0.74	0.74	0.77	0.73	422.33																		
BEL	0.86	0.87	0.81	0.82	0.78	0.83	0.81	0.81	0.76	0.67	0.77	499.87																	
IRL	0.83	0.84	0.82	0.89	0.79	0.85	0.81	0.87	0.81	0.82	0.81	0.79	179.44																
ESP	0.93	0.92	0.89	0.92	0.89	0.90	0.92	0.89	0.82	0.68	0.76	0.86	0.83	530.44															
CZE	0.87	0.88	0.83	0.80	0.81	0.81	0.84	0.77	0.74	0.64	0.71	0.84	0.73	0.84	707.21														
SVN	0.80	0.84	0.80	0.83	0.71	0.80	0.79	0.74	0.68	0.60	0.67	0.74	0.66	0.82	0.76	11.92													
EST	0.87	0.87	0.89	0.84	0.82	0.84	0.87	0.84	0.78	0.67	0.72	0.79	0.74	0.83	0.82	0.73	574.74												
ISR	0.82	0.83	0.83	0.82	0.84	0.81	0.86	0.81	0.79	0.62	0.66	0.79	0.70	0.84	0.79	0.78	0.80	396.93											
HUN	0.85	0.86	0.83	0.86	0.88	0.85	0.89	0.85	0.81	0.66	0.66	0.74	0.77	0.85	0.83	0.72	0.83	0.84	684.76										
POL	0.87	0.90	0.86	0.87	0.86	0.87	0.87	0.85	0.81	0.67	0.74	0.81	0.80	0.87	0.85	0.78	0.85	0.80	0.87	409.06									
ZAF	0.83	0.78	0.77	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	0.80	0.79	0.78	540.19								
JPN	0.93	0.91	0.92	0.91	0.90	0.90	0.92	0.89	0.83	0.68	0.76	0.84	0.81	0.91	0.85	0.86	0.84	0.86	0.84	0.88	0.82	623.83							
LVA	0.74	0.75	0.71	0.76	0.69	0.71	0.75	0.74	0.69	0.62	0.63	0.68	0.73	0.66	0.64	0.76	0.79	0.79	0.73	0.73	0.71	0.72	508.07						
SVK	0.78	0.79	0.79	0.79	0.76	0.72	0.78	0.76	0.73	0.61	0.64	0.76	0.69	0.79	0.80	0.74	0.79	0.79	0.81	0.79	0.70	0.80	0.69	385.89					
LTU	0.74	0.73	0.71	0.75	0.66	0.68	0.70	0.70	0.66	0.60	0.63	0.70	0.65	0.73	0.69	0.77	0.63	0.79	0.68	0.69	0.63	0.74	0.68	0.72	398.17				
PRT	0.76	0.77	0.77	0.78	0.75	0.76	0.77	0.76	0.70	0.60	0.60	0.67	0.71	0.78	0.66	0.76	0.68	0.79	0.73	0.73	0.61	0.76	0.67	0.69	0.61	599.04			
KOR	0.85	0.79	0.80	0.80	0.78	0.77	0.85	0.77	0.71	0.70	0.74	0.82	0.73	0.84	0.80	0.76	0.78	0.80	0.75	0.76	0.79	0.85	0.72	0.69	0.68	480.71			
URY	0.71	0.70	0.67	0.75	0.69	0.69	0.71	0.71	0.65	0.76	0.73	0.70	0.71	0.71	0.68	0.64	0.66	0.79	0.69	0.70	0.74	0.68	0.70	0.63	0.67	0.61	167.51		
HRV	0.65	0.66	0.67	0.65	0.65	0.68	0.64	0.63	0.63	0.59	0.60	0.66	0.60	0.65	0.62	0.62	0.67	0.79	0.67	0.67	0.71	0.67	0.63	0.66	0.61	0.61	0.64	0.63	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	31.96																												
DEU	0.93	24.07																											
DFS	0.91	0.91	10.91																										
FRA	0.91	0.92	0.90	25.18																									
ITA	0.88	0.88	0.84	0.90	25.49																								
NLD	0.89	0.93	0.90	0.87	0.84	25.26																							
USA	0.92	0.92	0.87	0.91	0.90	0.87	26.52																						
CHE	0.87	0.90	0.87	0.91	0.84	0.88	0.85	22.98																					
GBR	0.86	0.88	0.83	0.87	0.83	0.86	0.85	0.88	9.48																				
NZL	0.67	0.68	0.69	0.75	0.65	0.67	0.72	0.74	0.71	15.63																			
AUS	0.73	0.72	0.67	0.75	0.70	0.69	0.74	0.70	0.71	0.79	14.78																		
BEL	0.85	0.86	0.80	0.84	0.79	0.83	0.81	0.80	0.79	0.69	0.75	20.21																	
IRL	0.81	0.80	0.82	0.85	0.73	0.82	0.79	0.84	0.78	0.80	0.78	0.81	6.70																
ESP	0.91	0.90	0.86	0.91	0.90	0.87	0.92	0.85	0.83	0.66	0.74	0.82	0.78	21.01															
CZE	0.83	0.85	0.81	0.79	0.80	0.78	0.84	0.72	0.74	0.57	0.66	0.80	0.67	0.83	22.34														
SVN	0.77	0.79	0.78	0.77	0.72	0.78	0.74	0.72	0.68	0.61	0.58	0.78	0.64	0.75	0.72	12.24													
EST	0.87	0.89	0.89	0.86	0.85	0.86	0.87	0.86	0.78	0.74	0.75	0.85	0.79	0.83	0.82	0.79	23.19												
ISR	0.77	0.81	0.74	0.76	0.79	0.76	0.85	0.76	0.71	0.62	0.61	0.64	0.61	0.78	0.73	0.62	0.77	14.87											
HUN	0.83	0.86	0.78	0.86	0.88	0.80	0.89	0.81	0.79	0.64	0.65	0.72	0.69	0.86	0.79	0.63	0.80	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	0.75	0.89	0.84	0.76	0.88	0.79	0.87	17.14									
ZAF	0.71	0.70	0.61	0.73	0.71	0.67	0.75	0.69	0.67	0.57	0.65	0.65	0.64	0.75	0.70	0.62	0.71	0.71	0.71	0.73	19.26								
JPN	0.92	0.91																											

NOR	0.82	12.06																		
USA	0.89	0.87	20.11																	
NZL	0.58	0.66	0.63	11.45																
AUS	0.63	0.65	0.66	0.78	12.17															
GBR	0.80	0.78	0.80	0.59	0.66	6.88														
DFS	0.87	0.88	0.85	0.64	0.62	0.76	10.61													
DEU	0.90	0.82	0.88	0.59	0.61	0.84	0.92	20.23												
ZAF	0.76	0.77	0.77	0.66	0.73	0.66	0.70	0.72	17.32											
EST	0.80	0.70	0.79	0.56	0.56	0.73	0.77	0.80	0.67	16.22										
LVA	0.71	0.68	0.73	0.57	0.55	0.68	0.65	0.72	0.69	0.70	9.76									
LTU	0.66	0.64	0.66	0.56	0.51	0.66	0.59	0.66	0.67	0.63	0.71	10.80								
IRL	0.74	0.75	0.76	0.79	0.77	0.74	0.74	0.75	0.68	0.63	0.65	0.62	5.32							
NLD	0.87	0.90	0.84	0.60	0.63	0.82	0.88	0.92	0.69	0.74	0.69	0.62	0.76	26.26						
CAM	0.79	0.78	0.89	0.66	0.68	0.78	0.79	0.78	0.79	0.76	0.77	0.75	0.74	0.78	10.34					

SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	564.19											
DEA	0.87	506.73										
FRM	0.95	0.87	615.75									
ITA	0.76	0.70	0.66	509.35								
SVN	0.75	0.74	0.75	0.71	9.27							
FRA	0.90	0.92	0.84	0.81	0.79	752.07						
NLD	0.88	0.92	0.88	0.76	0.75	0.88	759.74					
IRL	0.84	0.74	0.84	0.67	0.71	0.87	0.79	179.91				
GBR	0.86	0.85	0.85	0.77	0.68	0.85	0.84	0.77	227.86			
HRV	0.65	0.64	0.75	0.62	0.61	0.62	0.63	0.65	0.63	10.47		
USA	0.86	0.80	0.82	0.87	0.78	0.90	0.88	0.79	0.82	0.64	607.40	
HUN	0.84	0.75	0.77	0.82	0.71	0.85	0.83	0.76	0.80	0.66	0.89	417.09

SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	22.73											
DEA	0.87	19.06										
FRM	0.94	0.89	24.04									
ITA	0.77	0.76	0.69	19.81								
SVN	0.72	0.79	0.75	0.73	9.27							
FRA	0.89	0.94	0.84	0.81	0.77	30.27						
NLD	0.86	0.92	0.88	0.74	0.77	0.87	28.51					
IRL	0.79	0.73	0.79	0.64	0.70	0.83	0.77	7.63				
GBR	0.90	0.85	0.85	0.79	0.68	0.87	0.85	0.75	7.93			
HRV	0.64	0.61	0.75	0.61	0.61	0.62	0.65	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	20.21	
HUN	0.81	0.77	0.77	0.84	0.67	0.85	0.79	0.68	0.78	0.68	0.89	16.57

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	16.92											
DEA	0.86	15.47										
FRM	0.94	0.85	19.77									
ITA	0.70	0.67	0.63	15.94								
SVN	0.71	0.70	0.73	0.67	9.27							
FRA	0.88	0.91	0.78	0.77	0.73	24.40						
NLD	0.82	0.90	0.86	0.71	0.72	0.83	23.81					
IRL	0.77	0.74	0.78	0.58	0.66	0.80	0.73	6.26				
GBR	0.83	0.84	0.82	0.74	0.65	0.83	0.83	0.72	7.17			
HRV	0.63	0.60	0.75	0.59	0.59	0.60	0.60	0.58	0.61	10.57		
USA	0.82	0.75	0.74	0.83	0.75	0.87	0.84	0.71	0.81	0.63	17.00	
HUN	0.82	0.75	0.76	0.82	0.67	0.82	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	99	198	153	149	166	61	33	37	78	105
FRA	90	0	136	191	229	256	97	51	35	74	79
USA	194	101	0	336	263	357	95	40	48	110	136
CHE	130	154	315	0	519	652	116	78	44	89	127
ITA	132	195	190	461	0	821	147	96	50	97	135
DEA	146	213	326	544	719	0	168	104	59	96	142
NLD	56	83	87	107	122	159	0	47	35	47	69
SVN	30	50	32	74	92	95	47	0	14	22	28
NZL	36	26	40	34	42	54	28	12	0	31	42
GBR	76	61	103	67	71	65	38	17	26	0	68
AUS	108	63	128	87	100	104	52	20	34	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	99	198	153	149	166	61	33	37	78	105
FRA	90	0	136	191	229	256	97	51	35	74	79
USA	194	101	0	336	263	357	95	40	48	110	136
CHE	130	154	315	0	519	653	116	78	44	89	127
ITA	132	195	190	461	0	822	147	96	50	97	135
DEA	146	213	326	544	720	0	168	104	59	96	142
NLD	56	83	87	107	122	159	0	47	35	47	69
SVN	30	50	32	74	92	95	47	0	14	22	28
NZL	36	26	40	34	42	54	28	12	0	31	42
GBR	76	61	103	67	71	65	38	17	26	0	68
AUS	108	63	128	87	100	104	52	20	34	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	99	198	153	149	166	61	33	37	78	105
FRA	90	0	136	191	229	256	97	51	35	74	79
USA	194	101	0	336	263	357	95	40	48	110	136
CHE	130	154	315	0	519	653	116	78	44	89	127
ITA	132	195	190	461	0	822	147	96	50	97	135
DEA	146	213	326	544	720	0	168	104	59	96	142
NLD	56	83	87	107	122	159	0	47	35	47	69
SVN	30	50	32	74	92	95	47	0	14	22	28
NZL	36	26	40	34	42	54	28	12	0	31	42
GBR	76	61	103	67	71	65	38	17	26	0	68
AUS	108	63	128	87	100	104	52	20	34	62	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	78	56	39	14
USA	70	0	73	102	32
AUS	53	70	0	46	27
GBR	33	103	39	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	56	39	14
USA	70	0	73	102	32
AUS	53	70	0	46	27
GBR	33	103	39	0	16
NZL	11	29	27	14	0

GUE

common bulls below diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	78	56	39	14
USA	70	0	73	102	32
AUS	53	70	0	46	27
GBR	33	103	39	0	16
NZL	11	29	27	14	0

HOL

common bulls below 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	2683	1756	1722	1965	1833	4091	955	1946	881	1652	932	633	1484	1363	234	337	169	1111	1821	515	1489	591	474	300	1265	828	539	348
DEU	2153	0	2987	2755	2747	3724	3877	1223	2314	1109	1831	1368	934	1712	2140	381	531	195	1307	3087	560	1519	935	725	553	1449	728	515	722
DFS	1575	2303	0	1918	1689	2465	2465	794	1772	964	1462	996	800	1206	1505	277	402	178	991	2006	515	1077	578	444	359	1114	583	453	485
FRA	1284	1718	1214	0	1730	2312	2759	792	1743	917	1447	1109	799	1397	1503	234	320	147	1045	2099	514	1313	525	480	288	1141	633	454	385
ITA	1702	1965	1377	1084	0	1884	2861	764	1654	701	1224	837	591	1361	1362	278	341	161	1010	2031	394	1174	596	410	332	1113	652	419	411
NLD	1799	3549	2215	1645	1602	0	2879	990	2023	1234	1632	1438	958	1303	1805	295	466	190	1054	2327	522	1183	645	581	367	1258	590	466	516
USA	4688	2978	2016	1640	2271	2596	0	1086	2581	1252	2204	1098	885	1763	1993	269	446	259	1431	2713	647	2127	798	592	403	1596	1006	738	444
CHE	880	1158	754	738	702	989	1022	0	782	465	693	667	436	618	580	147	199	71	453	779	259	505	328	251	145	566	309	227	221
GBR	2205	1809	1393	1198	1308	1809	2395	751	0	1067	1601	977	1061	1213	1268	225	329	175	941	1681	519	1143	513	407	327	1102	583	493	382
NZL	875	861	701	602	530	1124	1205	392	930	0	1337	585	797	613	747	137	172	133	550	804	376	625	295	279	194	666	363	409	252
AUS	1693	1416	1099	1037	947	1445	2276	617	1408	1345	0	830	784	1003	1000	183	267	136	793	1262	487	984	457	335	265	944	537	480	331
BEL	931	1417	940	1140	830	1649	986	683	968	478	738	0	554	763	787	178	235	95	597	961	341	602	350	322	187	762	354	272	306
IRL	593	812	657	675	497	897	801	443	1085	690	678	543	0	546	600	115	156	118	467	690	331	471	244	222	156	534	272	296	204
ESP	1035	1143	943	1167	988	1172	1218	515	958	469	730	747	513	0	1024	210	248	124	843	1321	455	983	433	350	243	979	568	387	323
CZE	1063	1747	1054	1052	1024	1659	1658	451	929	562	690	647	471	767	0	237	337	159	1041	1659	439	969	520	554	306	970	569	435	428
SVN	182	373	225	177	238	258	220	105	165	93	127	139	86	151	174	0	100	52	162	311	74	172	138	81	72	179	116	65	127
EST	222	395	271	172	206	344	325	118	200	89	143	152	82	121	219	60	0	64	230	446	114	234	229	136	102	241	146	125	149
ISR	119	149	133	92	106	149	250	42	129	107	87	61	91	75	124	36	37	0	124	189	68	133	88	57	56	124	77	80	77
HUN	1048	1053	803	771	869	889	1409	379	817	427	602	517	405	681	972	120	138	85	0	1083	404	776	392	339	248	828	521	401	295
POL	1669	2909	1724	1575	1722	2231	2757	679	1495	625	1006	896	572	999	1436	277	332	149	982	0	427	1137	776	499	418	1254	681	467	558
ZAF	479	438	396	409	305	442	635	221	456	312	429	293	298	408	313	53	57	43	336	323	0	431	176	184	108	451	279	280	162
JPN	798	709	606	525	595	651	996	341	598	332	557	393	296	487	461	94	88	57	426	636	283	0	405	326	229	805	637	417	259
LVA	368	781	372	289	380	442	685	182	299	167	235	213	142	233	355	83	139	57	281	636	101	175	0	206	206	480	275	209	293
SVK	332	541	238	266	242	412	400	129	234	167	167	195	107	178	477	37	57	24	235	356	101	115	104	0	106	352	226	193	158
LTU	171	512	213	121	170	225	283	59	178	91	121	92	74	97	199	31	46	25	150	324	41	74	133	48	0	245	159	133	165
PRT	1328	1358	1029	1041	1060	1271	1707	517	1017	541	792	775	477	949	820	142	165	81	822	1290	405	492	372	235	153	0	552	429	360
KOR	812	511	433	396	537	431	1160	221	430	268	397	265	189	413	414	73	71	41	422	578	208	389	167	136	71	472	0	325	168
URY	535	388	330	310	318	371	920	179	417	331	379	209	241	313	340	37	72	44	340	402	240	257	122	123	76	381	262	0	154
HRV	214	748	391	280	300	471	343	148	274	151	211	249	142	242	330	103	108	54	218	510	109	120	228	79	114	298	82	98	0

HOL

common bulls below 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	2683	1754	1722	1967	1833	4089	955	1946	881	1652	932	633	1483	1363	235	337	169	1111	1821	514	1484	591	474	300	1265	828	539	347
DEU	2153	0	2986	2755	2747	3724	3874	1223	2314	1109	1831	1368	934	1712	2140	381	531	195	1307	3087	559	1513	935	725	553	1449	728	515	721
DFS	1575	2303	0	1918	1690	2465	2462	794	1772	964	1462	996	799	1205	1503	278	402	178	990	2004	514	1074	578	444	359	1114	583	453	484
FRA	1284	1718	1214	0	1731	2312	2758	792	1743	917	1447	1109	800	1397	1503	235	320	147	1045	2099	513	1310	525	480	288	1141	633	454	384
ITA	1705	1968	1379	1085	0	1885	2862	765	1655	702	1225	838	592	1361	1364	279	341	161	1012	2031	395	1170	596	410	332	1115	653	419	410
NLD	1799	3549	2215	1645	1604	0	2877	990	2023	1234	1632	1438	960	1303	1805	296	466	190	1054	2327	521	1177	645	581	367	1258	590	466	515

USA	4685	2974	2012	1639	2272	2595	0	1086	2580	1251	2204	1097	884	1761	1992	270	445	259	1430	2712	646	2120	797	592	403	1594	1006	738	442
CHE	880	1158	754	738	703	989	1022	0	782	465	693	667	436	618	580	148	199	71	453	779	258	502	328	251	145	566	309	227	220
GBR	2205	1809	1393	1198	1309	1809	2394	751	0	1067	1601	977	1062	1213	1268	226	329	175	941	1681	518	1138	513	407	327	1102	583	493	382
NZL	875	861	701	602	530	1124	1204	392	930	0	1337	585	797	613	747	138	172	133	550	804	375	624	295	279	194	666	363	409	251
AUS	1693	1416	1099	1037	947	1445	2276	617	1408	1345	0	830	784	1003	1000	184	267	136	793	1262	486	980	457	335	265	944	537	480	331
BEL	931	1417	940	1140	831	1649	985	683	968	478	738	0	554	763	787	179	235	95	597	961	340	600	350	322	187	762	354	272	305
IRL	593	812	657	675	498	899	801	443	1086	690	678	543	0	545	600	116	156	118	467	691	331	469	244	222	156	534	272	296	203
ESP	1035	1143	942	1167	990	1172	1216	515	958	469	730	747	513	0	1023	211	248	124	842	1320	454	981	433	350	243	979	568	387	323
CZE	1063	1747	1054	1052	1026	1659	1657	451	929	562	690	647	471	767	0	238	337	159	1041	1659	438	966	520	554	306	970	569	435	427
SVN	182	373	225	177	238	258	220	105	165	93	127	139	86	151	174	0	100	52	162	312	74	172	139	82	73	180	116	66	128
EST	222	395	271	172	206	344	324	118	200	89	143	152	82	121	219	60	0	64	230	446	114	231	229	136	102	241	146	125	149
ISR	119	149	133	92	106	149	250	42	129	107	87	61	91	75	124	36	37	0	124	189	67	132	88	57	56	124	77	80	77
HUN	1048	1053	803	771	871	889	1408	379	817	427	602	517	405	681	972	120	138	85	0	1083	403	774	392	339	248	828	521	401	295
POL	1669	2909	1724	1575	1722	2231	2755	679	1495	625	1006	896	572	999	1436	277	332	149	982	0	426	1131	776	499	418	1254	681	467	557
ZAF	478	437	395	408	306	441	634	220	455	312	428	293	298	407	312	52	57	43	335	322	0	429	175	183	107	450	278	279	161
JPN	793	703	603	521	591	645	986	338	593	330	552	391	294	484	458	94	85	56	424	630	282	0	404	325	229	801	636	416	259
LVA	368	781	372	289	381	442	684	182	299	167	235	213	142	233	355	83	139	57	281	636	101	174	0	206	206	480	275	209	293
SVK	332	541	238	266	242	412	400	129	234	167	167	195	107	178	477	37	57	24	235	356	101	114	104	0	106	352	226	193	158
LTU	171	512	213	121	170	225	283	59	178	91	121	92	74	97	199	31	46	25	150	324	40	74	133	48	0	245	159	133	165
PRT	1327	1357	1028	1039	1063	1270	1705	517	1016	541	791	774	477	948	820	142	165	81	822	1290	404	487	372	235	153	0	552	429	359
KOR	812	511	433	396	538	431	1159	221	430	268	397	265	189	413	414	73	71	41	422	578	208	387	167	136	71	472	0	325	168
URY	535	388	330	310	318	371	920	179	417	331	379	209	241	313	340	37	72	44	340	402	240	254	122	123	76	381	262	0	154
HRV	212	746	389	278	299	469	340	146	273	150	210	248	140	242	328	102	108	53	217	508	109	120	228	79	113	296	81	98	0

HOL

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV
CAN	0	2683	1754	1722	1965	1833	4083	955	1946	881	1652	932	633	1483	1363	234	337	169	1111	1821	514	1483	591	474	300	1265	828	539	348
DEU	2153	0	2986	2755	2746	3724	3872	1223	2315	1109	1831	1368	934	1712	2140	380	531	195	1307	3087	559	1513	935	725	553	1449	728	515	722
DFS	1575	2303	0	1918	1688	2465	2460	794	1773	964	1462	996	799	1205	1503	277	402	178	990	2004	514	1074	578	444	359	1114	583	453	485
FRA	1284	1718	1214	0	1730	2312	2757	792	1744	917	1447	1109	800	1397	1503	234	320	147	1045	2099	513	1310	525	480	288	1141	633	454	385
ITA	1702	1965	1377	1084	0	1884	2860	764	1655	701	1224	837	591	1360	1362	278	341	161	1010	2031	393	1169	596	410	332	1113	652	419	411
NLD	1799	3548	2215	1645	1601	0	2876	990	2024	1234	1632	1438	960	1303	1805	295	466	190	1054	2372	521	1176	645	581	367	1258	590	466	516
USA	4682	2974	2012	1639	2270	2595	0	1086	2579	1251	2201	1096	884	1760	1992	269	445	259	1430	2712	646	2117	797	591	403	1594	1007	738	443
CHE	880	1158	754	738	702	989	1021	0	782	465	693	667	436	618	580	147	199	71	453	779	258	501	328	251	145	566	309	227	221
GBR	2205	1811	1395	1200	1309	1810	2394	751	0	1068	1601	978	1063	1214	1268	225	329	175	941	1682	518	1138	513	407	327	1103	583	493	383
NZL	875	861	701	602	530	1124	1204	392	930	0	1337	585	797	613	747	137	172	133	550	804	375	624	295	279	194	666	363	409	252
AUS	1693	1416	1099	1037	947	1444	2275	617	1408	1345	0	830	784	1003	1000	183	267	136	793	1262	486	980	457	335	265	944	537	480	331
BEL	931	1417	940	1140	830	1649	984	683	969	478	738	0	554	763	787	178	235	95	597	961	340	600	350	322	187	762	354	272	306
IRL	593	812	657	675	497	899	801	443	1088	690	678	543	0	545	600	115	156	118	467	691	331	469	244	222	156	534	272	296	204
ESP	1035	1143	942	1167	988	1172	1216	515	959	469	730	747	513	0	1023	210	248	124	842	1320	454	981	433	350	243	979	568	387	323
CZE	1063	1747	1054	1052	1024	1659	1657	451	930	562	690	647	471	767	0	237	337	159	1041	1659	438	966	520	554	306	970	569	435	428
SVN	182	373	225	177	238	258	220	105	165	93	127	139	86	151	174	0	100	52	162	311	73	172	138	81	72	179	116	65	127
EST	222	395	271	172	206	344	324	118	200	89	143	152	82	121	219	60	0	64	230	446	114	230	229	136	102	241	146	125	149
ISR	119	149	133	92	106	149	250	42	129	107	87	61	91	75	124	36	37	0	124	189	67	132	88	57	56	124	77	80	77
HUN	1048	1053	803	771	869	889	1408	379	817	427	602	517	405	681	972	120	138	85	0	1083	403	774	392	339	248	828	521	401	295
POL	1669	2909	1724	1575	1722	2230	2755	679	1495	625	1006	896	572	999	1436	277	332	149	982	0	426	1131	776	499	418	1254	681	467	558
ZAF	478	437	395	408	304	441	634	220	455	312	428	293	298	407	312	52	57	43	335	322	0	429	175	183	107	450	278	279	161
JPN	792	703	603	521	590	644	985	338	594	330	552	391	294	484	458	94	84	56	424	630	282	0	404	325	229	801	636	416	259
LVA	368	781	372	289	380	442	684	182	300	167	235	213	142	233	355	83	139	57	281	636	101	174	0	206	206	480	275	209	293
SVK	332	541	238	266	242	412	399	129	234	167	167	195	107	178	477	37	57	24	235	356	101	114	104	0	106	352	226	193	158
LTU	171	512	213	121	170	225	283	59	179	91	121	92	74	97	199	31	46	25	150	324	40	74	133	48	0	245	159	133	165
PRT	1328	1358	1029	1040	1060	1271	1705	517	1019	541	791	775	477	949	820	142	165	81	822	1290	404	488	371	235	153	0	552	429	360
KOR	812	511</																											

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
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CAN   0   8  232  99 108  98 194  14  75   3  10  22  3   7   0
NOR   7   0   86  53  79  76 141  16   0  32  20  25 49 52   0
USA  216  87   0 144 154 137 224  26  64  28  25 41 25 50 31
NZL  100  53 144   0 174  98 210  23  39  23  19 25 11 26 13
AUS  109  68 156 174   0 103 217  48  38  49  40 46 15 44 14
GBR   96  80 129  94 101   0 132  16  43  15  17 29 19 46  0
DFS  200 116 221 206 192 126   0  66  53 144 132 108 15 59  0
DEU   13  15  24  23  47  16  57   0   1  33  36  28  5 19  0
ZAF   77   0  58  34  39  37  50   1   0   0  2  5  2  2  0
EST   2  32  27  21  44  13 131  33  0  0  56  22  0 24  0
LVA  10  18  22  16  36  16  91  30  2  48  0 48  3 17  0
LTU  21  22  36  24  43  27  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   7  51  49  26  42  45  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   8  232  99 108  98 194  14  75   3  10  22  3   7   0
NOR   7   0   86  53  79  76 141  16   0  32  20  25 49 52   0
USA  216  87   0 144 154 138 224  26  64  28  25 41 25 50 31
NZL  100  53 144   0 174  98 210  23  39  23  19 25 11 26 13
AUS  109  68 156 174   0 103 217  48  38  49  40 46 15 44 14
GBR   96  80 130  94 101   0 132  16  43  15  17 29 19 46  0
DFS  200 116 221 206 192 126   0  66  53 144 132 108 15 59  0
DEU   13  15  24  23  47  16  57   0   1  33  36  28  5 19  0
ZAF   77   0  58  34  39  37  50   1   0   0  2  5  2  2  0
EST   2  32  27  21  44  13 131  33  0  0  56  22  0 24  0
LVA  10  18  22  16  36  16  91  30  2  48  0 48  3 17  0
LTU  21  22  36  24  43  27  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   7  51  49  26  42  45  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  384 243 103   2  15  94  57  56   2  34   2
DEA  353   0 291 1093 268 259 400  67  55 728  40  52
FRM  295 335   0 193  11   2 133  72  73   2  92   3
ITA  105 1002 218   0 153 146 260  65  48 339  38  24
SVN   2  252  10 145   0  51  85   5  0 132  2  10
FRA  12  217   1 130  49   0  80   5  0 103  3  11
NLD  96  419 156 254  79  76   0  58  53 166  32  8
IRL  54  60  77  61   5   5  52   0  40  9  18  2
GBR  64  58  94  52   0   0  54  34  0  0  20  0
HRV   2  762   1 323 122  93 162  8  0  0  5  23
USA  33  43 107  45   2   3  33  17  28  5  0  1
HUN   1  36   1  20  9   8  8  2  0  21  1  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	243	103	2	15	94	57	56	2	34	2
DEA	353	0	291	1094	268	259	400	67	55	726	40	52
FRM	295	335	0	193	11	2	133	72	73	2	92	3
ITA	105	1003	218	0	153	146	260	65	48	338	38	24
SVN	2	252	10	145	0	51	85	5	0	132	2	10
FRA	12	217	1	130	49	0	80	5	0	103	3	11
NLD	96	419	156	254	79	76	0	58	53	166	32	8
IRL	54	60	77	61	5	5	52	0	40	9	18	2
GBR	64	58	94	52	0	0	54	34	0	0	20	0
HRV	2	760	1	322	122	93	162	8	0	0	5	23
USA	33	43	107	45	2	3	33	17	28	5	0	1
HUN	1	36	1	20	9	8	8	2	0	21	1	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	243	103	2	15	94	57	56	2	34	2
DEA	353	0	291	1093	268	259	400	67	55	727	40	52
FRM	295	335	0	193	11	2	133	72	73	2	92	3
ITA	105	1002	218	0	153	146	260	65	48	338	38	24
SVN	2	252	10	145	0	51	85	5	0	132	2	10
FRA	12	217	1	130	49	0	80	5	0	103	3	11
NLD	96	419	156	254	79	76	0	58	53	166	32	8
IRL	54	60	77	61	5	5	52	0	40	9	18	2
GBR	64	58	94	52	0	0	54	34	0	0	20	0
HRV	2	761	1	322	122	93	162	8	0	0	5	23
USA	33	43	107	45	2	3	33	17	28	5	0	1
HUN	1	36	1	20	9	8	8	2	0	21	1	0