

## 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 production traits are as follows:

IRL (HOL, JER, RDC, SIM)	Few bulls dropping small number of daughters - due to ongoing genotyping picking up incorrect sires.
BEL (HOL)	Few bulls missing due to drop in daughters, changes in type of proofs caused by the program assigning them.
DEA (BSW)	Drops in info causing changes in rel.
ISR (HOL)	Some bulls had slight reductions in the numbers of records, due to editing and parentage corrections.
JPN (HOL)	Changes in information caused by additional records and modification of pedigree.
NZL (ALL)	Changes in information caused by continuous DNA parentage testing.
DFS (HOL, JER, RDC)	Changes in type of proofs, Type of proof is based information from production. When production information for foreign bulls comes, they might change type of proof for other traits from unknown to XX, drops in information.
DEA (BSW, SIM)	Pedigree corrections leading to expected decreasing reliabilities in few bulls. Some bulls changed to TOP 21 because of updated registration data
SVN (ALL)	Small changes in information due changes in data base related to the pedigree completeness as well as phenotypic data improvement.
ITA (SIM)	Some drops in information due to edits on very old test day records used to estimate the ebvs and some pedigree's correction.
ESP (HOL)	Base change.
ZAF (HOL, JER)	Reliabilities estimated with Jamrozik et al. method.
LTU (HOL)	Decrease in information due to pedigree correction for old animals.

## 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](https://interbull.org/ib/rg_procedure)

#### DATA AND METHOD OF ANALYSIS

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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

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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

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

#### NEXT TEST INTERNATIONAL EVALUATION

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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 2021).  
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	216	143	8569	1834	766	
BEL			2177			
CAN	270	104	13268	825	849	
CHE	3089		3632	96		3433
CZE			4911			
DEA	6212					25213
DEU			23206	205	283	
DFS			13723	2272	7909	
ESP			4239			
EST			1255		470	
FRA	425		17595			497
FRM						4910
GBR	175	359	7731	945	666	94
HUN			3582			237
IRL			2988	162	62	100
ISR			1587			
ITA	2252		9242	171		1822
JPN			6458			
KOR			1584			
LTU			1274		438	
LVA			1372		726	
NLD	207		16262	203	89	450
NOR					4237	
NZL	64	61	8333	5176	1453	
POL			11569			
PRT			2465			
SVK			1160			
SVN	407		649			709
URY			1121			
USA	1160	801	40696	5081	759	80
ZAF			1323	732	143	
HRV			881			985
CAM					45	
=====						
No. Records	14477	1468	212852	17702	18895	38530
Pub. Proofs	11657	1164	156074	14150	16817	34787
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^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	653.80										
FRA	0.89	626.57									
USA	0.92	0.88	638.50								
CHE	0.91	0.88	0.87	493.38							
ITA	0.88	0.81	0.88	0.86	607.28						
DEA	0.87	0.82	0.86	0.94	0.89	464.30					
NLD	0.88	0.86	0.87	0.85	0.86	0.87	664.43				
SVN	0.78	0.77	0.77	0.76	0.72	0.75	0.76	9.14			
NZL	0.67	0.73	0.68	0.70	0.65	0.66	0.70	0.66	381.89		
GBR	0.86	0.88	0.86	0.87	0.82	0.81	0.85	0.77	0.69	275.39	
AUS	0.74	0.76	0.71	0.70	0.67	0.67	0.73	0.70	0.83	0.73	388.85

BSW fat											
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.91										
FRA	0.88	26.59									
USA	0.90	0.89	23.71								
CHE	0.86	0.87	0.84	19.44							
ITA	0.88	0.83	0.86	0.86	23.24						
DEA	0.84	0.84	0.84	0.94	0.87	17.34					
NLD	0.86	0.85	0.86	0.83	0.85	0.86	26.45				
SVN	0.77	0.77	0.78	0.76	0.71	0.76	0.76	9.51			
NZL	0.67	0.71	0.71	0.72	0.62	0.78	0.67	0.71	17.51		
GBR	0.86	0.89	0.86	0.88	0.82	0.81	0.86	0.77	0.70	10.52	
AUS	0.73	0.72	0.73	0.67	0.67	0.68	0.69	0.68	0.79	0.71	15.38

BSW pro											
	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.43										
FRA	0.84	20.14									
USA	0.89	0.86	18.89								
CHE	0.84	0.83	0.83	15.73							
ITA	0.85	0.80	0.83	0.84	21.25						
DEA	0.83	0.79	0.82	0.92	0.88	14.48					
NLD	0.85	0.82	0.84	0.82	0.82	0.84	21.80				
SVN	0.76	0.75	0.76	0.74	0.74	0.74	0.75	8.93			
NZL	0.57	0.62	0.60	0.63	0.54	0.69	0.60	0.59	12.79		
GBR	0.84	0.84	0.83	0.84	0.80	0.79	0.84	0.76	0.62	8.11	
AUS	0.70	0.68	0.67	0.65	0.64	0.65	0.67	0.66	0.77	0.68	11.93

GUE mil					
	CAN	USA	AUS	GBR	NZL
CAN	757.30				
USA	0.94	784.03			
AUS	0.79	0.75	466.00		
GBR	0.86	0.82	0.74	247.05	
NZL	0.70	0.68	0.83	0.70	299.47

GUE fat					
	CAN	USA	AUS	GBR	NZL
CAN	30.04				
USA	0.93	27.84			
AUS	0.78	0.75	17.53		
GBR	0.86	0.83	0.73	10.27	
NZL	0.70	0.71	0.80	0.71	14.70





AUS	0.77	0.70	0.76	0.79	13.69										
GBR	0.82	0.81	0.82	0.66	0.70	9.59									
NLD	0.87	0.85	0.84	0.66	0.69	0.83	25.71								
ZAF	0.79	0.78	0.78	0.66	0.69	0.74	0.75	13.62							
ITA	0.88	0.84	0.87	0.65	0.71	0.79	0.82	0.79	25.94						
DEU	0.92	0.91	0.90	0.68	0.73	0.85	0.90	0.79	0.87	23.00					
IRL	0.79	0.78	0.74	0.82	0.80	0.75	0.79	0.67	0.73	0.77	6.22				
CHE	0.86	0.85	0.83	0.69	0.74	0.83	0.84	0.78	0.82	0.89	0.79	17.16			

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JER pro  
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	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE			
CAN	19.48														
DFS	0.90	10.54													
USA	0.89	0.90	20.31												
NZL	0.62	0.65	0.65	8.47											
AUS	0.70	0.67	0.67	0.75	10.39										
GBR	0.82	0.83	0.80	0.62	0.68	7.01									
NLD	0.87	0.87	0.84	0.63	0.68	0.82	19.96								
ZAF	0.82	0.79	0.79	0.68	0.70	0.76	0.76	10.88							
ITA	0.86	0.85	0.86	0.60	0.68	0.79	0.82	0.86	19.82						
DEU	0.89	0.93	0.90	0.60	0.66	0.83	0.91	0.78	0.85	18.90					
IRL	0.74	0.74	0.73	0.83	0.80	0.72	0.76	0.68	0.72	0.75	5.60				
CHE	0.82	0.83	0.80	0.61	0.66	0.81	0.83	0.76	0.80	0.87	0.77	11.96			

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RDC mil  
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	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	599.60														
NOR	0.88	12.03													
USA	0.92	0.91	703.06												
NZL	0.66	0.72	0.68	315.91											
AUS	0.73	0.74	0.74	0.82	411.92										
GBR	0.83	0.83	0.83	0.70	0.76	256.17									
DFS	0.90	0.91	0.88	0.66	0.73	0.82	10.36								
DEU	0.93	0.84	0.90	0.67	0.72	0.85	0.93	661.41							
ZAF	0.83	0.86	0.84	0.71	0.74	0.78	0.80	0.80	610.48						
EST	0.88	0.88	0.90	0.70	0.74	0.81	0.85	0.83	0.80	509.29					
LVA	0.79	0.81	0.80	0.65	0.70	0.78	0.79	0.78	0.79	0.82	318.86				
LTU	0.78	0.79	0.76	0.63	0.68	0.76	0.75	0.77	0.79	0.77	0.79	316.24			
IRL	0.83	0.75	0.80	0.82	0.81	0.79	0.81	0.83	0.77	0.76	0.74	0.74	177.97		
NLD	0.91	0.92	0.89	0.71	0.76	0.86	0.92	0.93	0.79	0.84	0.78	0.77	0.84	795.64	
CAM	0.86	0.88	0.93	0.73	0.77	0.85	0.85	0.85	0.86	0.86	0.85	0.84	0.82	0.85	443.71

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RDC fat  
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	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.44														
NOR	0.87	11.51													
USA	0.90	0.83	26.58												
NZL	0.65	0.77	0.69	12.84											
AUS	0.72	0.73	0.76	0.81	15.05										
GBR	0.83	0.81	0.84	0.69	0.73	8.58									
DFS	0.90	0.89	0.87	0.69	0.73	0.83	10.37								
DEU	0.92	0.88	0.91	0.67	0.72	0.87	0.91	25.39							
ZAF	0.80	0.85	0.83	0.63	0.68	0.76	0.77	0.77	19.59						
EST	0.86	0.82	0.88	0.70	0.71	0.81	0.83	0.85	0.80	19.88					
LVA	0.79	0.80	0.80	0.63	0.68	0.78	0.78	0.80	0.79	0.84	13.86				
LTU	0.77	0.79	0.77	0.66	0.71	0.76	0.75	0.76	0.79	0.78	0.78	15.05			
IRL	0.81	0.74	0.80	0.80	0.80	0.78	0.78	0.80	0.68	0.81	0.70	0.74	7.45		
NLD	0.89	0.87	0.88	0.66	0.71	0.86	0.91	0.93	0.76	0.83	0.79	0.77	0.81	28.88	
CAM	0.86	0.86	0.94	0.68	0.76	0.85	0.86	0.85	0.86	0.86	0.85	0.85	0.82	0.86	22.32

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RDC pro  
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	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.16														
NOR	0.86	11.48													
USA	0.89	0.89	20.03												
NZL	0.56	0.71	0.63	9.36											
AUS	0.67	0.72	0.69	0.76	11.97										
GBR	0.82	0.82	0.82	0.59	0.70	6.85									
DFS	0.89	0.88	0.86	0.61	0.67	0.81	10.54								
DEU	0.90	0.85	0.89	0.56	0.67	0.84	0.92	19.87							
ZAF	0.80	0.85	0.80	0.65	0.70	0.75	0.77	0.77	16.47						
EST	0.83	0.82	0.87	0.60	0.69	0.80	0.80	0.83	0.78	15.59					
LVA	0.78	0.80	0.78	0.55	0.65	0.77	0.76	0.77	0.78	0.78	9.33				
LTU	0.76	0.78	0.75	0.53	0.64	0.75	0.74	0.75	0.78	0.76	0.76	9.51			
IRL	0.75	0.76	0.76	0.78	0.79	0.75	0.75	0.75	0.68	0.71	0.69	0.68	5.50		
NLD	0.87	0.92	0.85	0.60	0.68	0.84	0.90	0.92	0.77	0.81	0.77	0.76	0.77	26.74	
CAM	0.85	0.86	0.91	0.72	0.77	0.85	0.85	0.85	0.86	0.86	0.85	0.85	0.80	0.85	11.06

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SIM mil

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	562.76											
DEA	0.87	508.81										
FRM	0.95	0.85	613.49									
ITA	0.81	0.77	0.78	506.43								
SVN	0.79	0.77	0.80	0.76	8.72							
FRA	0.92	0.88	0.85	0.85	0.80	677.14						
HUN	0.85	0.79	0.85	0.85	0.78	0.85	416.68					
NLD	0.88	0.93	0.89	0.81	0.76	0.88	0.85	760.70				
IRL	0.82	0.73	0.85	0.71	0.73	0.87	0.78	0.80	180.45			
GBR	0.88	0.87	0.87	0.81	0.75	0.86	0.82	0.86	0.78	228.62		
HRV	0.76	0.74	0.85	0.74	0.75	0.75	0.77	0.75	0.71	0.75	10.83	
USA	0.88	0.82	0.83	0.88	0.79	0.91	0.90	0.89	0.80	0.84	0.76	563.14

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SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	22.26											
DEA	0.87	19.19										
FRM	0.93	0.89	24.09									
ITA	0.81	0.81	0.79	19.91								
SVN	0.79	0.77	0.78	0.76	8.82							
FRA	0.90	0.90	0.86	0.85	0.78	27.71						
HUN	0.81	0.80	0.85	0.86	0.78	0.85	16.56					
NLD	0.87	0.93	0.89	0.80	0.76	0.87	0.81	28.11				
IRL	0.76	0.73	0.82	0.69	0.72	0.84	0.70	0.78	7.74			
GBR	0.91	0.86	0.86	0.81	0.74	0.88	0.81	0.86	0.76	8.24		
HRV	0.73	0.70	0.83	0.70	0.71	0.73	0.74	0.71	0.69	0.73	10.70	
USA	0.86	0.86	0.83	0.89	0.78	0.91	0.89	0.88	0.76	0.86	0.74	21.69

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SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	16.59											
DEA	0.86	15.51										
FRM	0.93	0.85	19.00									
ITA	0.78	0.76	0.77	16.01								
SVN	0.77	0.75	0.77	0.74	8.78							
FRA	0.89	0.85	0.85	0.81	0.78	21.61						
HUN	0.83	0.80	0.85	0.84	0.76	0.83	13.45					
NLD	0.84	0.91	0.87	0.78	0.75	0.84	0.81	23.61				
IRL	0.75	0.73	0.80	0.66	0.70	0.80	0.68	0.74	6.30			
GBR	0.85	0.85	0.86	0.79	0.74	0.85	0.80	0.85	0.74	7.06		
HRV	0.75	0.73	0.84	0.73	0.74	0.74	0.76	0.74	0.68	0.74	10.86	
USA	0.83	0.80	0.80	0.85	0.77	0.88	0.86	0.85	0.73	0.83	0.74	16.67

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^LAPPENDIX II. Number of common bulls

BSW

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common bulls below diagonal

common three quarter	sib	group	above diagonal								
CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS	
CAN	0	88	186	142	138	155	55	36	29	69	97
FRA	78	0	120	163	195	221	85	62	24	58	65
USA	181	81	0	321	251	339	83	44	33	95	127
CHE	122	120	298	0	483	608	100	88	31	74	118
ITA	123	153	177	420	0	757	133	108	35	81	123
DEA	137	162	302	503	655	0	153	117	43	79	131
NLD	51	70	75	94	112	147	0	52	28	43	58
SVN	33	60	36	84	106	108	53	0	14	24	30
NZL	29	19	29	24	27	37	21	13	0	21	31
GBR	65	45	79	53	54	52	32	17	18	0	59
AUS	100	49	119	79	90	94	42	23	24	50	0

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BSW

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common bulls below diagonal

common three quarter	sib	group	above diagonal								
CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS	
CAN	0	88	186	142	138	155	55	36	29	69	97
FRA	78	0	120	163	195	221	85	62	24	58	65
USA	181	81	0	321	251	339	83	44	33	95	127
CHE	122	120	298	0	483	609	100	88	31	74	118
ITA	123	153	177	420	0	758	133	108	35	81	123
DEA	137	162	302	503	656	0	153	117	43	79	131
NLD	51	70	75	94	112	147	0	52	28	43	58
SVN	33	60	36	84	106	108	53	0	14	24	30
NZL	29	19	29	24	27	37	21	13	0	21	31
GBR	65	45	79	53	54	52	32	17	18	0	59
AUS	100	49	119	79	90	94	42	23	24	50	0

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BSW

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common bulls below diagonal

common three quarter	sib	group	above diagonal								
CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS	
CAN	0	88	186	142	138	155	55	36	29	69	97
FRA	78	0	120	163	195	221	85	62	24	58	65
USA	181	81	0	321	251	339	83	44	33	95	127
CHE	122	120	298	0	483	608	100	88	31	74	118
ITA	123	153	177	420	0	757	133	108	35	81	123
DEA	137	162	302	503	655	0	153	117	43	79	131
NLD	51	70	75	94	112	147	0	52	28	43	58
SVN	33	60	36	84	106	108	53	0	14	24	30
NZL	29	19	29	24	27	37	21	13	0	21	31
GBR	65	45	79	53	54	52	32	17	18	0	59
AUS	100	49	119	79	90	94	42	23	24	50	0

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GUE

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common bulls below diagonal

common three quarter	sib	group	above diagonal		
CAN	USA	AUS	GBR	NZL	
CAN	0	73	51	35	14
USA	64	0	67	97	32
AUS	48	63	0	41	27
GBR	28	98	34	0	16
NZL	11	29	27	14	0

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GUE





DFS	108	0	204	158	161	180	133	157	108	125	37	59
USA	491	185	0	378	508	246	94	305	100	133	39	70
NZL	191	135	452	0	459	227	78	209	84	84	105	53
AUS	277	130	552	510	0	235	77	247	84	90	51	57
GBR	165	167	264	226	227	0	92	175	104	100	64	72
NLD	37	135	101	72	68	83	0	77	56	80	27	40
ZAF	155	138	319	215	232	172	73	0	90	85	34	57
ITA	67	109	107	82	79	106	55	83	0	60	19	44
DEU	72	124	133	78	81	94	76	82	61	0	21	49
IRL	6	33	40	116	48	67	25	34	18	21	0	18
CHE	33	58	70	43	47	67	34	49	42	44	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	115	464	185	270	169	41	159	70	75	9	40
DFS	108	0	204	158	161	180	133	157	108	125	37	59
USA	491	185	0	378	507	246	94	305	100	133	39	70
NZL	191	135	452	0	459	226	78	209	84	84	105	54
AUS	276	130	551	510	0	233	76	247	84	89	51	57
GBR	165	167	264	226	226	0	92	175	104	100	64	72
NLD	37	135	101	72	67	83	0	77	56	80	27	40
ZAF	155	138	319	215	232	172	73	0	90	85	34	57
ITA	67	109	107	82	79	106	55	83	0	60	19	44
DEU	72	124	133	78	80	94	76	82	61	0	21	49
IRL	6	33	40	116	48	67	25	34	18	21	0	18
CHE	33	58	70	43	47	67	34	49	42	44	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	115	464	185	271	169	41	159	70	75	9	40
DFS	108	0	204	158	161	180	133	157	108	125	37	59
USA	491	185	0	378	508	246	94	305	100	133	39	70
NZL	191	135	452	0	459	227	78	209	84	84	105	53
AUS	277	130	552	510	0	235	77	247	84	90	51	57
GBR	165	167	264	226	227	0	92	175	104	100	64	72
NLD	37	135	101	72	68	83	0	77	56	80	27	40
ZAF	155	138	319	215	232	172	73	0	90	85	34	57
ITA	67	109	107	82	79	106	55	83	0	60	19	44
DEU	72	124	133	78	81	94	76	82	61	0	21	49
IRL	6	33	40	116	48	67	25	34	18	21	0	18
CHE	33	58	70	43	47	67	34	49	42	44	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	216	91	101	84	178	14	74	3	10	17	2	6	0
NOR	6	0	78	42	70	58	132	14	0	26	19	26	48	44	0
USA	199	79	0	127	135	115	200	23	63	22	24	35	24	43	25
NZL	90	42	128	0	146	85	176	17	38	12	17	28	9	21	12
AUS	102	59	136	146	0	86	189	40	37	35	38	45	14	33	12
GBR	82	61	106	80	86	0	108	14	40	10	17	27	18	39	0
DFS	183	106	195	174	163	102	0	54	51	121	126	113	14	51	0
DEU	13	13	22	17	39	14	45	0	1	24	35	30	4	15	0
ZAF	76	0	57	33	37	35	48	1	0	0	2	5	2	2	0
EST	2	26	21	11	32	9	109	24	0	0	52	26	0	18	0
LVA	10	17	21	14	35	16	84	29	2	45	0	55	2	13	0
LTU	16	22	29	25	42	24	99	28	5	25	49	0	4	15	0
IRL	2	47	24	9	13	17	11	4	2	0	2	4	0	9	0

NLD	6	43	42	21	31	38	48	14	2	17	12	13	9	0	0
CAM	0	0	25	12	12	0	0	0	0	0	0	0	0	0	0

RDC

common bulls below diagonal															
common	three	quarter	sib	group	above	diagonal									
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	7	216	91	101	84	178	14	74	3	10	17	2	6	0
NOR	6	0	78	42	70	58	132	14	0	26	19	26	48	44	0
USA	199	79	0	127	135	115	200	23	63	22	24	35	24	43	25
NZL	90	42	128	0	146	85	176	17	38	12	17	28	9	21	12
AUS	102	59	136	146	0	86	189	40	37	35	38	45	14	33	12
GBR	82	61	106	80	86	0	108	14	40	10	17	27	18	39	0
DFS	183	106	195	174	163	102	0	54	51	121	126	113	14	51	0
DEU	13	13	22	17	39	14	45	0	1	24	35	30	4	15	0
ZAF	76	0	57	33	37	35	48	1	0	0	2	5	2	2	0
EST	2	26	21	11	32	9	109	24	0	0	52	26	0	18	0
LVA	10	17	21	14	35	16	84	29	2	45	0	55	2	13	0
LTU	16	22	29	25	42	24	99	28	5	25	49	0	4	15	0
IRL	2	47	24	9	13	17	11	4	2	0	2	4	0	9	0
NLD	6	43	42	21	31	38	48	14	2	17	12	13	9	0	0
CAM	0	0	25	12	12	0	0	0	0	0	0	0	0	0	0

RDC

common bulls below diagonal															
common	three	quarter	sib	group	above	diagonal									
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	7	216	91	101	84	178	14	74	3	10	17	2	6	0
NOR	6	0	78	42	70	58	132	14	0	26	19	26	48	44	0
USA	199	79	0	127	135	115	200	23	63	22	24	35	24	43	25
NZL	90	42	128	0	146	85	176	17	38	12	17	28	9	21	12
AUS	102	59	136	146	0	86	189	40	37	35	38	45	14	33	12
GBR	82	61	106	80	86	0	108	14	40	10	17	27	18	39	0
DFS	183	106	195	174	163	102	0	54	51	121	126	112	14	51	0
DEU	13	13	22	17	39	14	45	0	1	24	35	30	4	15	0
ZAF	76	0	57	33	37	35	48	1	0	0	2	5	2	2	0
EST	2	26	21	11	32	9	109	24	0	0	52	26	0	18	0
LVA	10	17	21	14	35	16	84	29	2	45	0	55	2	13	0
LTU	16	22	29	25	42	24	98	28	5	25	49	0	4	15	0
IRL	2	47	24	9	13	17	11	4	2	0	2	4	0	9	0
NLD	6	43	42	21	31	38	48	14	2	17	12	13	9	0	0
CAM	0	0	25	12	12	0	0	0	0	0	0	0	0	0	0

SIM

common bulls below diagonal												
common	three	quarter	sib	group	above	diagonal						
	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	0	364	217	96	6	12	2	91	56	55	2	30
DEA	333	0	284	979	236	276	52	346	64	54	662	34
FRM	269	335	0	175	17	3	3	124	71	72	2	60
ITA	99	886	200	0	137	156	24	228	63	47	304	33
SVN	6	219	17	130	0	61	15	67	4	0	115	1
FRA	9	235	1	139	58	0	12	77	4	0	108	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	365	147	224	64	74	8	0	55	52	149	25
IRL	53	58	76	61	4	4	2	50	0	39	7	17
GBR	63	57	93	52	0	0	0	53	34	0	0	19
HRV	2	695	1	293	104	98	21	147	6	0	0	4
USA	29	40	75	38	1	3	0	27	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	363	217	96	6	12	2	91	56	55	2	30
DEA	333	0	284	980	236	276	52	346	64	54	660	34
FRM	269	335	0	175	17	3	3	124	71	72	2	60
ITA	99	887	200	0	137	156	24	228	63	47	303	33
SVN	6	219	17	130	0	61	15	67	4	0	115	1
FRA	9	235	1	139	58	0	12	77	4	0	108	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	365	147	224	64	74	8	0	55	52	149	25
IRL	53	58	76	61	4	4	2	50	0	39	7	17
GBR	63	57	93	52	0	0	0	53	34	0	0	19
HRV	2	693	1	292	104	98	21	147	6	0	0	4
USA	29	40	75	38	1	3	0	27	16	27	4	0

SIM

	common bulls			below diagonal		above diagonal						
	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
CHE	0	363	217	96	6	12	2	91	56	55	2	30
DEA	333	0	284	979	236	276	52	346	64	54	661	34
FRM	269	335	0	175	17	3	3	124	71	72	2	60
ITA	99	886	200	0	137	156	24	228	63	47	303	33
SVN	6	219	17	130	0	61	15	67	4	0	115	1
FRA	9	235	1	139	58	0	12	77	4	0	108	3
HUN	1	36	1	20	13	9	0	8	2	0	23	0
NLD	93	365	147	224	64	74	8	0	55	52	149	25
IRL	53	58	76	61	4	4	2	50	0	39	7	17
GBR	63	57	93	52	0	0	0	53	34	0	0	19
HRV	2	694	1	292	104	98	21	147	6	0	0	4
USA	29	40	75	38	1	3	0	27	16	27	4	0