

## Introduction

The latest international evaluation for dairy production traits took place as scheduled at the Interbull Centre. Data from thirty-four (34) 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, Uruguay and Mexico 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:

NOR RDC        The rolling definition of hys is causing the daughters to distribute somewhat differently over hys-classes at each evaluation. Therefore some bulls occasionally may lose EDC although the number of daughters stay the same. Reliability changes is a function of the EDC changes.

AUS ALL        A small cohort of animals changed proof type from 12 previous (second crop daughters) back to 11 (only first crop daughters). The determination of a first and second crop proof type is based on the proportion of daughters born within 5 years of the bulls birth date (first crop) and those born after 5 years (second crop). The pedigree has been recently updated and completed so that a number of older daughters have been entering proofs and this has tripped the threshold from proof type causing the reversion from second to first crop daughter proof.

JPN HOL        Some changes in proofs caused by additional records and in EDCs caused by modification of pedigree.

CHE ALL        Base change  
Decrease in information due to the continuous work on the raw data by herd-book organizations and in the fact that data have been merged from two data bases (for HOL-CHE and SIM-CHE).

ESP HOL        Base change

ITA SIM        Some decrease in information due to pedigree checks by the herd book.

## INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

### Subsetting:

As decided by the ITC in Orlando, new subsetting was introduced in the september test run. Sub-setting is necessary for operational purposes and restrictions of time scales. To minimize the effect of subsetting, larger subsets with 10-12 countries and with 4 link providing countries have been applied.

### Window:

According to the decision taken by ITC in Orlando, the following changes have been introduced in regards to the windows used for post processing:

The upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations. The lower values have been set to about the 25% percentile value. The largest changes are for the lower values for conformation traits, with the lowest window being 40% for OFL otherwise it is about 50% for all other confirmation traits. It is anticipated that these low values may not have large impact on evaluations since there were very few countries combinations whose estimated correlations fell between the old limit of 0.30 and these new limits.

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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

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

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

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 PUBLICATION OF INTERBULL TEST RUN  
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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 2018).  
 Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	194	132	7457	1640	696	
BEL			1961			
CAN	220	99	11949	708	792	
CHE	2878		3274	86		3150
CZE			4206			
DEA	5855					23378
DEU			27273	192	425	
DFS			12885	2106	7641	
ESP			3686			
EST			1094		423	
FRA	382		16789			456
FRM						4548
GBR	147	327	6967	873	608	93
HUN			3184			214
IRL			2639	165	52	93
ISR			1380			
ITA	2067		9116	170		1629
JPN			5780			
KOR			1313			
LTU			785		437	
LVA			1098		700	
NLD	187		15103	143	70	374
NOR					4086	
NZL	51	60	7377	4718	1343	
POL			10077			
PRT			2333			
SVK			1100			573
SVN	361		511			596
URY			1011			
USA	1076	775	37643	4490	700	45
ZAF			1273	690	141	
HRV			721			801
MEX			607			
CAM					38	
=====						
No. Records	13418	1393	200592	15981	18152	35950
Pub. Proofs	10917	1110	151999	12977	16240	32416
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

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 BSW mil

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	633.81										
FRA	0.89	634.95									
USA	0.92	0.88	632.14								
CHE	0.91	0.89	0.87	539.84							
ITA	0.88	0.83	0.88	0.87	595.82						
DEA	0.88	0.83	0.86	0.93	0.90	460.89					
NLD	0.88	0.87	0.87	0.85	0.84	0.86	629.00				
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.68			
NZL	0.70	0.76	0.71	0.76	0.70	0.73	0.72	0.75	335.67		
GBR	0.86	0.88	0.85	0.87	0.82	0.82	0.86	0.83	0.71	251.21	
AUS	0.75	0.77	0.73	0.73	0.71	0.71	0.76	0.73	0.84	0.75	397.14

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	26.72										
FRA	0.89	26.97									
USA	0.90	0.89	23.74								
CHE	0.87	0.87	0.84	21.15							
ITA	0.89	0.83	0.86	0.87	22.83						
DEA	0.87	0.84	0.83	0.93	0.88	17.31					
NLD	0.87	0.86	0.86	0.85	0.84	0.86	25.80				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	10.04			
NZL	0.71	0.74	0.71	0.74	0.70	0.82	0.70	0.75	14.69		
GBR	0.86	0.89	0.86	0.87	0.82	0.83	0.87	0.83	0.71	8.90	
AUS	0.74	0.75	0.73	0.71	0.70	0.71	0.72	0.73	0.83	0.73	15.96

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	22.83										
FRA	0.84	20.34									
USA	0.90	0.86	18.94								
CHE	0.86	0.85	0.83	17.55							
ITA	0.85	0.82	0.83	0.85	20.94						
DEA	0.86	0.81	0.82	0.92	0.89	14.34					
NLD	0.86	0.84	0.84	0.83	0.82	0.84	21.07				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	9.50			
NZL	0.70	0.70	0.70	0.71	0.70	0.74	0.70	0.75	10.44		
GBR	0.85	0.86	0.83	0.85	0.81	0.82	0.85	0.83	0.70	7.39	
AUS	0.70	0.71	0.69	0.70	0.69	0.71	0.71	0.73	0.81	0.72	12.05

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	743.60				
USA	0.94	700.66			
AUS	0.82	0.77	478.93		
GBR	0.86	0.83	0.77	240.96	
NZL	0.71	0.70	0.84	0.71	326.25

GUE fat

	CAN	USA	AUS	GBR	NZL
CAN	29.98				
USA	0.93	25.24			
AUS	0.79	0.76	17.83		
GBR	0.86	0.84	0.75	10.79	
NZL	0.72	0.71	0.84	0.70	16.39





JER fat												
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	26.14											
DFS	0.90	11.40										
USA	0.91	0.90	24.43									
NZL	0.69	0.70	0.74	12.08								
AUS	0.79	0.71	0.76	0.84	13.56							
GBR	0.83	0.84	0.82	0.69	0.71	10.65						
NLD	0.88	0.87	0.86	0.70	0.72	0.85	24.55					
ZAF	0.81	0.81	0.80	0.69	0.71	0.81	0.81	14.29				
ITA	0.88	0.84	0.86	0.70	0.73	0.83	0.84	0.82	24.88			
DEU	0.89	0.89	0.86	0.70	0.74	0.84	0.89	0.82	0.86	23.18		
IRL	0.80	0.79	0.76	0.81	0.81	0.76	0.80	0.72	0.74	0.79	6.50	
CHE	0.87	0.86	0.85	0.72	0.78	0.85	0.86	0.81	0.84	0.89	0.80	15.89

JER pro												
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	18.46											
DFS	0.91	10.40										
USA	0.89	0.92	18.51									
NZL	0.69	0.70	0.69	8.49								
AUS	0.73	0.70	0.69	0.81	10.40							
GBR	0.84	0.85	0.81	0.69	0.71	6.61						
NLD	0.88	0.89	0.85	0.70	0.71	0.85	19.58					
ZAF	0.83	0.82	0.80	0.69	0.72	0.81	0.82	11.42				
ITA	0.85	0.84	0.85	0.70	0.70	0.82	0.83	0.85	18.81			
DEU	0.86	0.91	0.86	0.70	0.71	0.83	0.88	0.82	0.84	17.26		
IRL	0.75	0.76	0.73	0.85	0.81	0.74	0.77	0.71	0.72	0.75	5.76	
CHE	0.84	0.85	0.83	0.70	0.71	0.83	0.84	0.81	0.83	0.85	0.78	10.61

RDC mil															
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	591.26														
NOR	0.89	12.46													
USA	0.91	0.89	664.08												
NZL	0.69	0.72	0.69	318.32											
AUS	0.76	0.77	0.76	0.84	417.08										
GBR	0.84	0.83	0.83	0.70	0.78	262.87									
DFS	0.91	0.92	0.90	0.69	0.79	0.84	10.22								
DEU	0.91	0.91	0.89	0.70	0.77	0.83	0.92	604.34							
ZAF	0.82	0.88	0.84	0.70	0.77	0.81	0.81	0.81	546.02						
EST	0.88	0.85	0.88	0.75	0.76	0.83	0.87	0.84	0.83	482.64					
LVA	0.82	0.83	0.81	0.73	0.72	0.82	0.83	0.82	0.82	0.83	314.69				
LTU	0.83	0.83	0.82	0.72	0.72	0.82	0.81	0.82	0.84	0.83	0.82	315.92			
IRL	0.83	0.73	0.82	0.85	0.83	0.81	0.83	0.82	0.79	0.80	0.75	0.75	156.96		
NLD	0.92	0.90	0.89	0.72	0.79	0.86	0.93	0.92	0.81	0.85	0.83	0.83	0.86	776.30	
CAM	0.89	0.89	0.95	0.76	0.77	0.88	0.89	0.89	0.88	0.90	0.89	0.89	0.84	0.88	440.53

RDC fat															
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	22.55														
NOR	0.88	11.59													
USA	0.91	0.84	24.53												
NZL	0.69	0.75	0.69	13.45											
AUS	0.74	0.75	0.78	0.86	15.71										
GBR	0.84	0.82	0.84	0.69	0.75	9.13									
DFS	0.90	0.89	0.89	0.70	0.78	0.85	10.30								
DEU	0.90	0.90	0.89	0.70	0.75	0.86	0.90	24.28							

ZAF	0.81	0.87	0.85	0.70	0.70	0.81	0.81	0.81	19.24						
EST	0.87	0.85	0.86	0.79	0.75	0.83	0.86	0.85	0.83	18.52					
LVA	0.82	0.83	0.82	0.73	0.72	0.82	0.82	0.83	0.83	0.84	13.68				
LTU	0.83	0.83	0.82	0.73	0.72	0.83	0.81	0.82	0.85	0.83	0.82	15.10			
IRL	0.81	0.72	0.79	0.83	0.82	0.79	0.82	0.79	0.71	0.83	0.74	0.76	6.97		
NLD	0.90	0.89	0.88	0.70	0.75	0.87	0.91	0.91	0.81	0.85	0.83	0.83	0.82	27.96	
CAM	0.90	0.88	0.95	0.76	0.80	0.89	0.89	0.89	0.90	0.89	0.89	0.89	0.83	0.89	22.33

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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	17.75														
NOR	0.88	11.60													
USA	0.89	0.86	18.85												
NZL	0.69	0.72	0.69	9.52											
AUS	0.69	0.77	0.71	0.80	12.26										
GBR	0.83	0.83	0.83	0.69	0.73	7.23									
DFS	0.89	0.89	0.89	0.69	0.72	0.84	10.39								
DEU	0.87	0.93	0.86	0.70	0.72	0.83	0.90	18.52							
ZAF	0.81	0.89	0.81	0.70	0.73	0.81	0.81	0.81	15.79						
EST	0.83	0.83	0.85	0.75	0.73	0.83	0.82	0.84	0.83	14.56					
LVA	0.82	0.83	0.82	0.73	0.72	0.82	0.82	0.82	0.83	0.82	9.16				
LTU	0.83	0.83	0.82	0.73	0.72	0.83	0.81	0.82	0.85	0.83	0.82	9.52			
IRL	0.74	0.73	0.76	0.82	0.82	0.78	0.77	0.73	0.72	0.74	0.74	0.76	5.04		
NLD	0.88	0.90	0.86	0.70	0.73	0.86	0.89	0.89	0.81	0.84	0.83	0.83	0.79	26.10	
CAM	0.89	0.89	0.91	0.76	0.78	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.83	0.89	10.32

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SIM mil

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	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	628.88												
DEA	0.87	511.08											
FRM	0.96	0.88	625.12										
ITA	0.84	0.81	0.81	493.62									
SVN	0.84	0.81	0.84	0.81	8.85								
FRA	0.93	0.89	0.89	0.85	0.82	680.02							
HUN	0.85	0.82	0.89	0.87	0.84	0.87	399.80						
NLD	0.89	0.94	0.90	0.83	0.82	0.89	0.85	735.99					
IRL	0.83	0.73	0.84	0.74	0.73	0.89	0.79	0.80	170.81				
SVK	0.83	0.81	0.82	0.81	0.82	0.82	0.85	0.82	0.76	321.26			
GBR	0.88	0.88	0.88	0.82	0.82	0.87	0.83	0.86	0.80	0.83	211.46		
HRV	0.82	0.81	0.89	0.81	0.82	0.82	0.83	0.82	0.73	0.82	0.81	10.55	
USA	0.89	0.84	0.88	0.89	0.81	0.91	0.89	0.90	0.83	0.81	0.85	0.81	579.32

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SIM fat

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	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	24.88												
DEA	0.88	19.35											
FRM	0.94	0.90	24.58										
ITA	0.83	0.82	0.81	19.50									
SVN	0.83	0.81	0.84	0.81	9.09								
FRA	0.90	0.91	0.89	0.85	0.82	27.46							
HUN	0.81	0.82	0.88	0.88	0.84	0.87	15.37						
NLD	0.88	0.93	0.90	0.83	0.82	0.88	0.83	28.05					
IRL	0.75	0.71	0.78	0.72	0.73	0.85	0.70	0.79	7.27				
SVK	0.83	0.81	0.82	0.81	0.82	0.82	0.84	0.82	0.74	12.78			
GBR	0.91	0.87	0.87	0.83	0.82	0.89	0.82	0.87	0.77	0.82	8.10		
HRV	0.82	0.81	0.88	0.81	0.82	0.82	0.83	0.82	0.75	0.82	0.81	10.56	
USA	0.86	0.84	0.84	0.90	0.81	0.91	0.90	0.89	0.78	0.81	0.86	0.81	18.36

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SIM pro



	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	19.09												
DEA	0.85	15.53											
FRM	0.93	0.88	19.38										
ITA	0.82	0.81	0.81	15.63									
SVN	0.83	0.81	0.84	0.81	9.04								
FRA	0.90	0.86	0.89	0.82	0.82	21.49							
HUN	0.82	0.82	0.89	0.85	0.84	0.85	12.85						
NLD	0.85	0.93	0.87	0.82	0.82	0.85	0.82	23.19					
IRL	0.77	0.71	0.81	0.71	0.73	0.81	0.69	0.75	6.09				
SVK	0.83	0.81	0.82	0.81	0.82	0.82	0.85	0.82	0.73	9.82			
GBR	0.85	0.89	0.88	0.81	0.82	0.86	0.81	0.86	0.76	0.83	6.63		
HRV	0.82	0.81	0.89	0.81	0.82	0.82	0.83	0.82	0.73	0.82	0.81	10.52	
USA	0.85	0.83	0.84	0.87	0.81	0.88	0.87	0.86	0.75	0.81	0.84	0.81	15.02

^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	77	162	120	113	128	49	29	23	66	84
FRA	65	0	117	153	177	203	80	51	21	58	58
USA	146	79	0	308	229	310	76	39	28	90	121
CHE	95	114	289	0	420	551	90	71	24	73	107
ITA	93	141	160	364	0	664	118	90	26	79	111
DEA	101	150	272	447	562	0	138	96	32	78	122
NLD	46	66	67	84	98	133	0	40	23	42	52
SVN	25	50	32	68	89	88	41	0	8	25	24
NZL	21	17	24	19	19	27	16	7	0	19	25
GBR	58	45	80	53	54	52	32	18	17	0	55
AUS	83	43	112	66	79	83	38	20	20	45	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	77	162	120	113	128	49	29	23	66	84
FRA	65	0	117	153	177	203	80	51	21	58	58
USA	146	79	0	308	229	310	76	39	28	90	121
CHE	95	114	289	0	420	551	90	71	24	73	107
ITA	93	141	160	364	0	664	118	90	26	79	111
DEA	101	150	272	447	562	0	138	96	32	78	122
NLD	46	66	67	84	98	133	0	40	23	42	52
SVN	25	50	32	68	89	88	41	0	8	25	24
NZL	21	17	24	19	19	27	16	7	0	19	25
GBR	58	45	80	53	54	52	32	18	17	0	55
AUS	83	43	112	66	79	83	38	20	20	45	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	77	162	120	113	128	49	29	23	66	84
FRA	65	0	117	153	177	203	80	51	21	58	58
USA	146	79	0	308	229	310	76	39	28	90	121
CHE	95	114	289	0	420	551	90	71	24	73	107
ITA	93	141	160	364	0	664	118	90	26	79	111

DEA	101	150	272	447	562	0	138	96	32	78	122
NLD	46	66	67	84	98	133	0	40	23	42	52
SVN	25	50	32	68	89	88	41	0	8	25	24
NZL	21	17	24	19	19	27	16	7	0	19	25
GBR	58	45	80	53	54	52	32	18	17	0	55
AUS	83	43	112	66	79	83	38	20	20	45	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	68	46	31	14
USA	59	0	58	90	31
AUS	43	53	0	36	27
GBR	26	92	31	0	15
NZL	11	29	27	13	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	68	46	31	14
USA	59	0	58	90	31
AUS	43	53	0	36	27
GBR	26	92	31	0	15
NZL	11	29	27	13	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	67	46	31	13
USA	58	0	58	90	31
AUS	43	53	0	36	27
GBR	26	92	31	0	15
NZL	11	29	27	13	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	MEX
CAN	0	2236	1238	1311	1454	1265	2964	777	1466	657	1138	716	498	1172	978	177	216	102	881	1151	467	1190	405	399	215	928	607	442	246	360
DEU	1449	0	2638	2428	2354	3258	3485	1089	2011	928	1439	1206	867	1460	1820	279	376	150	1181	2176	577	1388	675	708	474	1194	578	475	563	352
DFS	961	1634	0	1526	1439	1898	1888	657	1428	770	1057	795	706	941	1177	223	260	132	840	1405	490	884	429	393	291	875	444	394	353	285
FRA	793	1167	737	0	1582	1827	2347	606	1431	752	1078	858	702	1052	1171	183	232	120	874	1477	462	1120	377	403	223	878	475	381	255	296
ITA	973	1358	959	740	0	1530	2360	647	1416	682	969	745	609	1154	1187	215	240	119	924	1394	459	1066	448	373	260	935	528	410	329	326
NLD	1131	2873	1556	1038	1121	0	2260	810	1603	961	1201	1204	845	1015	1393	227	323	142	894	1586	502	963	465	512	280	994	442	402	388	299
USA	3040	2241	1318	1161	1377	1883	0	917	2009	998	1574	911	735	1438	1555	213	309	157	1206	1811	620	1784	565	517	314	1229	784	640	332	447
CHE	621	928	574	523	562	782	806	0	636	369	493	565	375	515	502	130	147	57	413	603	259	427	253	220	112	480	237	197	182	174
GBR	1614	1406	1003	815	961	1335	1701	572	0	863	1141	812	887	1003	995	192	227	120	802	1181	497	952	379	357	247	906	457	417	296	319
NZL	643	705	526	419	466	865	932	308	732	0	992	483	679	498	578	121	124	103	469	607	358	517	225	246	152	537	294	330	192	194
AUS	1037	899	636	619	555	935	1394	396	843	925	0	618	596	730	699	140	174	89	586	791	412	730	284	264	181	635	356	360	212	240
BEL	693	1233	726	823	682	1374	789	573	788	395	490	0	495	621	620	163	176	76	507	743	323	500	273	285	149	635	270	232	240	198
IRL	459	759	578	546	505	796	653	377	909	588	458	492	0	479	504	116	131	91	425	573	325	416	205	204	137	482	229	255	170	174
ESP	676	898	671	732	784	887	884	419	771	376	445	603	461	0	809	174	183	103	709	952	435	832	330	304	199	787	430	346	252	279
CZE	652	1362	724	685	777	1197	1150	350	643	397	375	484	375	544	0	199	238	118	860	1225	383	774	401	452	239	764	442	356	321	272
SVN	124	265	185	126	176	196	161	97	138	83	86	134	90	132	148	0	83	42	145	225	95	150	106	77	54	155	90	70	95	64
EST	114	264	153	105	130	232	201	83	124	62	66	111	70	86	150	50	0	46	177	280	102	182	168	108	74	177	97	94	110	69



NZL	643	705	526	419	466	865	932	308	732	0	992	483	679	498	578	121	124	103	469	607	358	517	225	246	152	537	294	330	192	99
AUS	1037	899	636	619	555	935	1393	396	843	925	0	618	596	730	699	140	174	89	586	791	412	727	284	264	181	635	356	360	212	112
BEL	693	1233	726	823	682	1374	788	573	788	395	490	0	495	621	620	163	176	76	507	743	323	499	273	285	149	635	270	232	240	101
IRL	459	759	578	546	505	796	653	377	909	588	458	492	0	479	504	116	131	91	425	573	325	415	205	204	137	482	229	255	170	89
ESP	676	898	671	732	784	887	884	419	771	376	445	603	461	0	809	174	183	103	709	952	435	831	330	304	199	787	430	346	252	118
CZE	652	1361	723	685	777	1196	1150	350	643	397	375	483	375	543	0	199	238	118	860	1225	383	773	401	452	239	764	442	356	321	93
SVN	124	265	185	126	176	196	161	97	138	83	86	134	90	132	148	0	83	42	145	225	95	149	106	77	54	155	90	70	95	33
EST	114	264	153	105	130	232	201	83	124	62	66	111	70	86	150	50	0	46	177	280	102	179	168	108	74	177	97	94	110	26
ISR	66	123	102	62	74	114	142	37	82	84	50	50	71	61	88	31	28	0	101	126	58	94	63	47	43	97	53	63	59	15
HUN	774	909	636	560	757	720	1150	329	691	371	376	439	380	554	759	112	108	76	0	860	381	655	293	304	186	674	417	347	231	108
POL	859	1830	1062	877	983	1389	1630	483	920	451	457	673	473	651	969	201	200	98	736	0	401	881	535	419	319	946	512	389	407	99
ZAF	401	441	368	316	340	419	594	209	428	292	329	274	290	384	254	65	51	39	313	294	0	408	160	176	100	418	257	265	141	101
JPN	513	507	427	354	436	451	697	260	441	254	332	303	254	365	310	82	58	39	349	425	267	0	307	289	178	650	493	361	188	125
LVA	227	541	267	173	281	314	460	129	224	128	123	173	126	181	277	71	108	44	225	432	92	129	0	169	153	371	198	170	223	43
SVK	270	529	200	206	211	347	333	112	199	145	118	174	106	152	366	45	49	19	214	285	95	100	83	0	90	308	196	173	121	56
LTU	97	446	150	56	122	150	198	43	113	66	58	65	61	82	144	27	34	19	112	237	37	48	110	41	0	191	125	102	130	24
PRT	927	1086	757	726	841	993	1272	424	821	435	437	641	439	742	623	124	122	72	666	953	372	374	289	210	114	0	433	374	290	123
KOR	551	376	300	259	414	300	893	164	328	210	218	196	162	300	310	55	49	32	345	427	194	279	113	119	55	363	0	282	119	96
URY	413	334	280	220	301	317	797	147	349	262	255	181	205	278	263	41	59	34	296	327	223	211	105	114	58	336	232	0	121	99
HRV	123	577	269	152	236	347	247	121	208	111	114	199	122	193	237	77	79	43	178	357	93	85	180	61	88	234	53	73	0	44
MEX	161	141	121	122	123	131	183	92	148	94	104	112	98	131	72	26	15	10	112	97	110	119	27	42	7	141	97	104	29	0

JER

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common bulls below diagonal

common three quarter sib group above diagonal

CAN DFS USA NZL AUS GBR NLD ZAF ITA DEU IRL CHE

CAN	0	74	381	159	213	145	33	137	67	68	11	35
DFS	59	0	148	118	110	141	87	123	96	115	35	53
USA	393	118	0	331	424	215	74	276	99	118	41	61
NZL	169	92	405	0	381	195	65	186	84	84	104	48
AUS	211	74	444	417	0	179	60	206	77	75	43	44
GBR	143	124	231	197	173	0	74	155	103	97	57	64
NLD	26	84	78	58	45	67	0	66	55	60	27	37
ZAF	133	99	286	193	189	154	61	0	90	85	32	52
ITA	64	93	106	82	71	104	54	83	0	73	19	45
DEU	65	107	120	78	63	94	56	81	75	0	24	46
IRL	7	28	41	114	37	57	25	31	18	24	0	17
CHE	28	49	61	40	35	62	32	47	42	43	14	0

JER

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common bulls below diagonal

common three quarter sib group above diagonal

CAN DFS USA NZL AUS GBR NLD ZAF ITA DEU IRL CHE

CAN	0	74	381	159	213	144	33	137	67	68	11	35
DFS	59	0	148	118	110	140	87	123	96	115	35	53
USA	393	118	0	331	424	214	74	276	99	118	41	61
NZL	169	92	405	0	381	194	65	186	84	84	104	49
AUS	211	74	444	417	0	178	60	206	77	75	43	44
GBR	143	124	231	197	173	0	74	155	102	97	57	64
NLD	26	84	78	58	45	67	0	66	55	60	27	37
ZAF	133	99	286	193	189	154	61	0	90	85	32	52
ITA	64	93	106	82	71	104	54	83	0	73	19	45
DEU	65	107	120	78	63	94	56	81	75	0	24	46
IRL	7	28	41	114	37	57	25	31	18	24	0	17
CHE	28	49	61	40	35	62	32	47	42	43	14	0

JER

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common bulls below diagonal

common three quarter sib group above diagonal

CAN DFS USA NZL AUS GBR NLD ZAF ITA DEU IRL CHE

CAN	0	74	381	159	213	144	33	137	67	68	11	35		
DFS	59	0	148	118	110	140	87	123	96	115	35	53		
USA	393	118	0	331	424	214	74	276	99	118	41	61		
NZL	169	92	405	0	381	194	65	186	84	84	104	48		
AUS	211	74	444	417	0	178	60	206	77	75	43	44		
GBR	143	124	231	197	173	0	74	155	102	97	57	64		
NLD	26	84	78	58	45	67	0	66	55	60	27	37		
ZAF	133	99	286	193	189	154	61	0	90	85	32	52		
ITA	64	93	106	82	71	104	54	83	0	73	19	45		
DEU	65	107	120	78	63	94	56	81	75	0	24	46		
IRL	7	28	41	114	37	57	25	31	18	24	0	17		
CHE	28	49	61	40	35	62	32	47	42	43	14	0		

RDC

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common bulls below diagonal  
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	5	191	78	92	77	143	15	74	2	10	17	2	5	0
NOR	5	0	66	40	58	42	116	19	0	17	20	28	47	35	0
USA	176	67	0	110	114	101	172	29	63	19	24	37	23	34	20
NZL	77	39	109	0	128	70	160	22	37	7	17	27	8	16	9
AUS	92	49	114	130	0	73	162	41	37	27	35	45	11	25	10
GBR	75	44	93	66	72	0	93	18	38	7	17	26	16	28	0
DFS	143	89	165	156	137	87	0	67	51	95	121	116	13	40	0
DEU	14	19	28	21	40	17	57	0	2	26	35	39	5	16	0
ZAF	76	0	57	32	36	33	48	2	0	0	2	5	2	2	0
EST	2	17	18	6	24	6	84	25	0	0	48	26	0	14	0
LVA	10	18	21	14	32	16	81	30	2	42	0	54	2	11	0
LTU	16	23	30	23	41	24	99	35	5	25	48	0	4	16	0
IRL	2	46	23	8	10	15	10	5	2	0	2	4	0	9	0
NLD	5	35	33	15	23	27	38	16	2	13	10	13	9	0	0
CAM	0	0	20	9	10	0	0	0	0	0	0	0	0	0	0

RDC

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common bulls below diagonal  
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	5	191	78	92	77	143	15	74	2	10	17	2	5	0
NOR	5	0	66	40	58	42	117	20	0	18	21	28	47	35	0
USA	176	68	0	110	114	100	172	29	63	19	24	37	23	34	20
NZL	77	39	109	0	128	70	160	22	37	7	17	27	8	16	9
AUS	92	49	114	130	0	73	162	41	37	27	35	45	11	25	10
GBR	75	44	93	66	72	0	93	18	38	7	17	26	16	28	0
DFS	143	90	166	156	137	87	0	67	51	95	121	116	13	40	0
DEU	14	20	29	21	40	17	57	0	2	26	35	39	5	16	0
ZAF	76	0	57	32	36	33	48	2	0	0	2	5	2	2	0
EST	2	18	18	6	24	6	84	25	0	0	48	26	0	14	0
LVA	10	19	21	14	32	16	81	30	2	42	0	54	2	11	0
LTU	16	23	30	23	41	24	99	35	5	25	48	0	4	16	0
IRL	2	46	23	8	10	15	10	5	2	0	2	4	0	9	0
NLD	5	35	34	15	23	27	38	16	2	13	10	13	9	0	0
CAM	0	0	20	9	10	0	0	0	0	0	0	0	0	0	0

RDC

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common bulls below diagonal  
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	0	5	191	78	92	77	143	15	74	2	10	17	2	5	0
NOR	5	0	66	40	58	42	117	20	0	18	21	28	47	35	0
USA	176	68	0	110	114	100	172	29	63	19	24	37	23	34	20

NZL	77	39	109	0	128	70	160	22	37	7	17	27	8	16	9
AUS	92	49	114	130	0	73	162	41	37	27	35	45	11	25	10
GBR	75	44	93	66	72	0	93	18	38	7	17	26	16	28	0
DFS	143	90	166	156	137	87	0	67	51	95	121	115	13	40	0
DEU	14	20	29	21	40	17	57	0	2	26	35	39	5	16	0
ZAF	76	0	57	32	36	33	48	2	0	0	2	5	2	2	0
EST	2	18	18	6	24	6	84	25	0	0	48	26	0	14	0
LVA	10	19	21	14	32	16	81	30	2	42	0	54	2	11	0
LTU	16	23	30	23	41	24	98	35	5	25	48	0	4	16	0
IRL	2	46	23	8	10	15	10	5	2	0	2	4	0	9	0
NLD	5	35	34	15	23	27	38	16	2	13	10	13	9	0	0
CAM	0	0	20	9	10	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	SVK	GBR	HRV	USA
CHE	0	312	184	84	6	12	2	84	56	32	55	1	18
DEA	275	0	243	834	175	252	46	274	58	366	52	504	17
FRM	235	288	0	157	17	3	3	113	69	58	72	2	30
ITA	86	735	191	0	103	140	21	173	57	138	47	214	20
SVN	6	161	17	96	0	55	12	46	1	46	0	69	0
FRA	9	212	1	125	52	0	12	59	1	53	0	84	0
HUN	1	32	1	17	10	9	0	6	1	13	0	20	0
NLD	85	286	135	169	44	57	6	0	51	64	52	89	15
IRL	53	51	74	55	1	1	1	46	0	12	39	3	15
SVK	26	373	57	116	45	45	11	54	4	0	11	88	4
GBR	63	55	93	53	0	0	0	53	34	6	0	0	18
HRV	1	527	1	202	59	78	18	86	2	70	0	0	0
USA	19	24	45	27	0	0	0	18	15	4	26	0	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	0	313	184	84	6	12	2	84	56	32	55	1	18
DEA	276	0	243	835	175	252	46	274	58	366	52	502	17
FRM	235	288	0	157	17	3	3	113	69	58	72	2	30
ITA	86	736	191	0	103	140	21	173	57	138	47	212	20
SVN	6	161	17	96	0	55	12	46	1	46	0	69	0
FRA	9	212	1	125	52	0	12	59	1	53	0	84	0
HUN	1	32	1	17	10	9	0	6	1	13	0	20	0
NLD	85	286	135	169	44	57	6	0	51	64	52	89	15
IRL	53	51	74	55	1	1	1	46	0	12	39	3	15
SVK	26	373	57	116	45	45	11	54	4	0	11	86	4
GBR	63	55	93	53	0	0	0	53	34	6	0	0	18
HRV	1	525	1	200	59	78	18	86	2	68	0	0	0
USA	19	24	45	27	0	0	0	18	15	4	26	0	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	0	312	184	84	6	12	2	84	56	32	55	1	18
DEA	275	0	243	834	175	252	46	274	58	366	52	503	17
FRM	235	288	0	157	17	3	3	113	69	58	72	2	30
ITA	86	735	191	0	103	140	21	173	57	138	47	213	20
SVN	6	161	17	96	0	55	12	46	1	46	0	69	0
FRA	9	212	1	125	52	0	12	59	1	53	0	84	0
HUN	1	32	1	17	10	9	0	6	1	13	0	20	0

NLD	85	286	135	169	44	57	6	0	51	64	52	89	15
IRL	53	51	74	55	1	1	1	46	0	12	39	3	15
SVK	26	373	57	116	45	45	11	54	4	0	11	87	4
GBR	63	55	93	53	0	0	0	53	34	6	0	0	18
HRV	1	526	1	201	59	78	18	86	2	69	0	0	0
USA	19	24	45	27	0	0	0	18	15	4	26	0	0

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