Introduction

The latest routine international evaluation for udder traits took place as scheduled at the Interbull Centre. Data from twentysix (26) countries were included in this evaluation.

International genetic evaluations for udder health traits of bulls from Australia, Austria-Germany, Belgium, Canada, Czech Republic, Denmark-Finland-Sweden, Estonia, France, Hungary, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, South Africa, Slovak Republic, Spain, Switzerland, the United Kingdom, the United States of America, Poland, Lithuania, Latvia and Portugal were computed.
Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed data were included in this evaluation.

Changes in national procedures

Changes in the national genetic evaluation of udder health traits are as follows:

BEL (HOL) Definition of genetic groups were updated/improved. Genetic groups are always based on selection path, type of breed, degree of Holsteinisation, origin (North-America vs Europe) and time. Periods of time were updated and improved. Genetic reference base was changed on cows born in 2010

CAN (ALL) Modified version of TD model (including a Herd-Year curve) and newly estimated parameters for scs.

CHE (HOL,SIM) The formerly separate genetic evaluations of HOL-CHR/SIM-CHE and HOL-CHE have been joined to one single evaluation. The main differences are: Use of pooled data, Various changes in data edits, New genetic parameters,inclusion of Red Holstein (CHR) into B&W (CHE)

DEA (BSW,SIM) Base change shifting 4 months ahead

DEU (HOL,RDC) Relative breeding values on published scale, with a mean of 100 and standard deviation of 12, were submitted for MACE evaluation, instead of the original natural EBV.

EST (HOL,RDC) Changed the definition of a HERD, more precisely the location of a cow.

NLD (ALL) Base change, cow base is now 2010 and bull base is 2008

GBR (ALL) The major changes are mostly data clean up and correction, so few bulls have become unofficial as herds/daughters have dropped.

ITA (HOL) Base change plus deleted records with birth year=1999.

NLD (ALL) Base change

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

1) Data submission for pedigree, EBV/PTA, and parameters is possible only through uploading of the data to the Interbull Data Exchange Area (IDEA);
2) Interbull Centre has moved to a completely new MACE evaluation software called "Dairy System for International Evaluation (DAISIE)", partly because of the extended use of IDEA for EBV/PTA, and partly because of our continuous efforts to make the system more effective than before;
3) All trait groups (including conformation traits) are now evaluated in-house.
4) The file containing heritability values now contain more decimal places for heritability, and one extra field for the definition of reference base population;
5) The file containing genetic correlations has changed name from rG_columns_all to cor{RUNID}.csv, and also contains one extra field for the number of common bulls;
6) The file containing sire genetic standard deviations has changed name from sire_std_columns_all to std{RUNID}.csv;
7) Sire-MGS based pedigree files are not distributed anymore;
8) Parent averages in the "ipa" format are not distributed anymore;
9) An import AI bull (type of proof = 21) with official publication status 'Y' from a given country is included in the distribution file if the bull has a first country proof included from a different country OR a second country proof is included with minimum required

number of daughters or EDC (20, 10, 150, 20, 20, and 80) and herds (20, 10, 150, 20, 20, and 80) for different breeds (BSW, GUE, HOL, JER, RDC and SIM), respectively;

10) Bulls with some missing pedigree information (sires and/or dam and/or birthdate) are excluded from evaluations;

11) Standardization factors are not used anymore;

12) Post-processing of genetic correlation are now applied to all trait groups.

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 in the 01x-proof file.

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 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 udder health (April Routine Evaluation 2015).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
ARG						
AUS		121	6839	1372	602	
BEL			968			
CAN	198	91	10446	571	714	
CHE	2779		2717			2804
CZE			3321			
DEA	5083					20141
DEU			25115		391	
DFS			11923	1913	7163	
ESP			2869			
EST			895		370	
FRA	325		15571			355
FRM						3788
FRR			218			
GBR	92	252	5732	611	407	78
HUN			2328			150
IRL			1956			
ISR			1170			
ITA	1631		9079			1214
JPN			5098			
KOR			937			
LTU			592		375	
LVA			527		562	
NLD	153		13821	113	58	267
NOR					3693	
NZL	41	57	6486	3848	1135	
POL			7267			
PRT			2207			
SVK			949			499
SVN	301		375			494
URY						
USA	944	644	32873	3656	570	
ZAF		16	1076	506	119	
HRV			561			688
No.Records	11547	1181	173916	12590	16159	30478
Pub. Proofs	9479	926	137942	10480	15673	27748

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

BSW scs

	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
CAN	0.25									
CHE	0.93	10.44								
DEA	0.92	0.97	11.87							
FRA	0.92	0.96	0.96	1.03						
GBR	0.92	0.94	0.95	0.96	13.45					
ITA	0.92	0.96	0.93	0.91	0.89	13.05				
NLD	0.89	0.92	0.91	0.93	0.96	0.87	4.09			
NZL	0.77	0.82	0.78	0.82	0.86	0.76	0.86	0.39		
SVN	0.87	0.86	0.86	0.86	0.87	0.86	0.86	0.77	10.68	
USA	0.90	0.85	0.85	0.91	0.90	0.87	0.86	0.75	0.87	0.22

BSW mas

	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
CAN	0.25									
CHE	0.92	10.44								
DEA	0.91	0.98	11.87							
FRA	0.66	0.53	0.49	1.09						
GBR	0.86	0.94	0.94	0.62	13.45					
ITA	0.91	0.96	0.93	0.63	0.89	13.05				
NLD	0.81	0.85	0.88	0.73	0.89	0.86	3.75			
NZL	0.72	0.81	0.77	0.53	0.85	0.76	0.73	0.39		
SVN	0.84	0.86	0.86	0.52	0.86	0.86	0.72	0.76	10.68	
USA	0.84	0.85	0.85	0.61	0.90	0.87	0.86	0.75	0.86	0.22

GUE scs

	AUS	CAN	GBR	NZL	USA	ZAF
AUS	29.64					
CAN	0.84	0.25				
GBR	0.92	0.92	13.30			
NZL	0.95	0.78	0.86	0.62		
USA	0.81	0.93	0.90	0.76	0.25	
ZAF	0.88	0.89	0.90	0.85	0.88	24.10

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HOL     SCS
--------------------------------------------------------------------------------
            AUS     BEL     CAN     CHE     CZE     DEU     DFS     ESP     EST     FRA     FRR
GBR     HRV     HUN     IRL     ISR     ITA     JPN     KOR     LTU     LVA     NLD     NZL     POL
PRT     SVK     SVN     USA     ZAF
AUS      30.11
BEL       0.87    0.50
CAN       0.83    0.91    0.27
CHE       0.91    0.92    0.87   10.85
CZE       0.76    0.89    0.86    0.85   16.35
DEU       0.88    0.96    0.92    0.93    0.89   12.79
DFS       0.89    0.95    0.91    0.91    0.88    0.96   11.92
ESP       0.84    0.96    0.92    0.90    0.90    0.95    0.94   11.24
EST       0.81    0.94    0.86    0.85    0.89    0.93    0.92    0.93   13.15
FRA       0.90    0.96    0.93    0.92    0.88    0.95    0.97    0.95    0.89    1.20
FRR       0.83    0.92    0.88    0.88    0.88    0.92    0.91    0.88    0.87    0.94    1.10
GBR       0.93    0.94    0.93    0.93    0.85    0.94    0.94    0.93    0.91    0.96    0.91
12.85
HRV       0.76    0.85    0.84    0.84    0.85    0.85    0.85    0.85    0.83    0.84    0.81
0.84   11.96
HUN       0.79    0.92    0.88    0.87    0.90    0.91    0.90    0.93    0.90    0.91    0.83
0.89    0.85    1.28
IRL       0.96    0.94    0.88    0.93    0.84    0.93    0.93    0.90    0.88    0.93    0.88
0.96    0.78    0.86    0.11
ISR       0.72    0.78    0.82    0.76    0.80    0.81    0.80    0.83    0.81    0.82    0.73
0.77    0.72    0.84    0.74    0.24
ITA       0.80    0.94    0.90    0.88    0.91    0.94    0.93    0.95    0.92    0.92    0.87
0.90    0.85    0.93    0.88    0.84    5.85
JPN       0.82    0.85    0.88    0.85    0.85    0.85    0.88    0.85    0.84    0.90    0.84
0.86    0.84    0.85    0.85    0.74    0.85    0.42
KOR       0.79    0.86    0.87    0.84    0.85    0.86    0.89    0.90    0.86    0.88    0.82
0.87    0.83    0.85    0.83    0.72    0.88    0.85    0.34
LTU       0.77    0.84    0.84    0.83    0.84    0.87    0.85    0.87    0.82    0.84    0.80
0.85    0.84    0.84    0.82    0.72    0.85    0.84    0.84    0.36
LVA       0.84    0.93    0.86    0.86    0.86    0.93    0.91    0.89    0.92    0.89    0.84
0.88    0.86    0.87    0.89    0.73    0.91    0.85    0.88    0.86    0.48
NLD       0.92    0.94    0.91    0.92    0.85    0.95    0.95    0.91    0.90    0.94    0.94
0.97    0.85    0.87    0.94    0.76    0.87    0.87    0.85    0.84    0.87    4.69
NZL       0.97    0.81    0.77    0.86    0.75    0.82    0.85    0.78    0.80    0.84    0.76
0.87    0.74    0.76    0.92    0.73    0.75    0.82    0.77    0.76    0.82    0.88    0.40
POL       0.82    0.93    0.89    0.87    0.88    0.93    0.92    0.93    0.90    0.92    0.90
0.88    0.85    0.90    0.89    0.78    0.93    0.85    0.90    0.85    0.93    0.87    0.78
10.29
PRT       0.75    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.83
0.85    0.85    0.85    0.81    0.79    0.85    0.85    0.85    0.84    0.84    0.85    0.75
0.85    0.50
SVK       0.77    0.88    0.84    0.85    0.88    0.89    0.88    0.91    0.85    0.89    0.84
0.86    0.83    0.94    0.84    0.76    0.88    0.85    0.85    0.84    0.84    0.85    0.75
0.86    0.85    0.42
SVN       0.75    0.84    0.84    0.83    0.84    0.85    0.84    0.84    0.83    0.84    0.79
0.84    0.83    0.84    0.81    0.71    0.84    0.84    0.82    0.79    0.82    0.84    0.73
0.84    0.84    0.82   10.34
USA       0.77    0.90    0.94    0.85    0.85    0.88    0.87    0.91    0.90    0.89    0.82
0.89    0.85    0.92    0.84    0.84    0.89    0.87    0.85    0.84    0.84    0.86    0.75
0.87    0.85    0.86    0.84    0.21
ZAF       0.87    0.91    0.90    0.88    0.87    0.90    0.90    0.94    0.88    0.91    0.81
0.92    0.84    0.91    0.90    0.83    0.91    0.85    0.85    0.82    0.85    0.88    0.83
0.88    0.85    0.87    0.83    0.89   26.35
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HOL     mas
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            AUS     BEL     CAN     CHE     CZE     DEU     DFS     ESP     EST     FRA     FRR
GBR     HRV     HUN     IRL     ISR     ITA     JPN     KOR     LTU     LVA     NLD     NZL     POL
PRT     SVK     SVN     USA     ZAF
AUS      30.11
BEL       0.86    0.50
CAN       0.61    0.82    9.38
CHE       0.91    0.91    0.72   10.84
CZE       0.76    0.90    0.76    0.85   16.35
DEU       0.87    0.96    0.79    0.93    0.89   12.79
DFS       0.64    0.84    0.92    0.70    0.77    0.81   12.30
ESP       0.83    0.96    0.83    0.90    0.90    0.95    0.85   11.22
EST       0.82    0.94    0.77    0.84    0.89    0.93    0.82    0.93   13.16
FRA       0.60    0.84    0.95    0.71    0.78    0.80    0.93    0.87    0.79    1.22
FRR       0.43    0.65    0.72    0.57    0.70    0.60    0.77    0.64    0.62    0.78    1.02
GBR       0.93    0.94    0.74    0.93    0.85    0.94    0.78    0.93    0.90    0.76    0.56
12.85
HRV       0.75    0.85    0.63    0.83    0.84    0.85    0.67    0.85    0.83    0.67    0.48
0.84   11.96
HUN       0.79    0.92    0.76    0.87    0.89    0.91    0.82    0.93    0.89    0.80    0.61
0.89    0.85    1.28
IRL       0.95    0.94    0.73    0.93    0.84    0.93    0.77    0.90    0.87    0.75    0.59
0.96    0.76    0.86    0.11
ISR       0.71    0.76    0.63    0.75    0.79    0.80    0.66    0.82    0.80    0.70    0.54
0.76    0.70    0.83    0.74    0.24
ITA       0.80    0.94    0.79    0.88    0.90    0.94    0.81    0.95    0.92    0.83    0.65
0.90    0.84    0.93    0.88    0.83    5.85
JPN       0.82    0.85    0.69    0.85    0.85    0.85    0.71    0.85    0.83    0.71    0.54
0.86    0.83    0.85    0.84    0.73    0.85    0.42
KOR       0.79    0.86    0.78    0.84    0.84    0.86    0.80    0.90    0.85    0.84    0.63
0.87    0.82    0.85    0.83    0.72    0.88    0.85    0.33
LTU       0.77    0.83    0.68    0.83    0.84    0.87    0.73    0.86    0.81    0.72    0.55
0.84    0.83    0.83    0.81    0.70    0.84    0.83    0.82    0.36
LVA       0.81    0.92    0.70    0.84    0.85    0.93    0.77    0.88    0.91    0.75    0.59
0.87    0.85    0.85    0.87    0.71    0.90    0.84    0.85    0.85    0.48
NLD       0.80    0.94    0.85    0.86    0.87    0.94    0.85    0.92    0.90    0.85    0.71
0.90    0.78    0.89    0.89    0.77    0.90    0.80    0.82    0.79    0.88    5.01
NZL       0.97    0.80    0.54    0.85    0.75    0.82    0.62    0.78    0.79    0.55    0.44
0.87    0.73    0.76    0.92    0.71    0.75    0.82    0.76    0.75    0.80    0.76    0.40
POL       0.82    0.94    0.80    0.88    0.88    0.93    0.80    0.92    0.90    0.84    0.68
0.89    0.84    0.90    0.90    0.78    0.93    0.85    0.90    0.84    0.92    0.89    0.78
10.29
PRT       0.75    0.85    0.66    0.85    0.85    0.85    0.72    0.85    0.84    0.76    0.65
0.85    0.84    0.85    0.81    0.78    0.85    0.85    0.85    0.84    0.84    0.79    0.75
0.85    0.50
SVK       0.76    0.88    0.73    0.85    0.88    0.89    0.78    0.91    0.85    0.78    0.62
0.85    0.82    0.94    0.84    0.73    0.88    0.84    0.85    0.84    0.83    0.86    0.74
0.87    0.84    0.41
SVN       0.74    0.84    0.69    0.83    0.84    0.84    0.76    0.84    0.82    0.72    0.57
0.84    0.83    0.83    0.81    0.69    0.84    0.83    0.80    0.76    0.81    0.77    0.73
0.84    0.84    0.81   10.34
USA       0.77    0.90    0.79    0.85    0.85    0.88    0.83    0.91    0.90    0.81    0.59
0.89    0.84    0.92    0.83    0.82    0.89    0.87    0.85    0.83    0.84    0.88    0.75
0.86    0.85    0.87    0.84    0.21
ZAF       0.87    0.90    0.78    0.88    0.87    0.89    0.77    0.94    0.87    0.80    0.55
0.91    0.82    0.90    0.89    0.83    0.91    0.85    0.85    0.81    0.83    0.87    0.83
0.88    0.84    0.87    0.81    0.89   26.24
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JER scs

	AUS	CAN	DFS	GBR	NLD	NZL	USA	ZAF
AUS	28.96							
CAN	0.79	0.23						
DFS	0.87	0.88	12.50					
GBR	0.88	0.91	0.91	11.38				
NLD	0.91	0.92	0.93	0.96	4.24			
NZL	0.96	0.76	0.78	0.83	0.85	0.38		
USA	0.77	0.91	0.83	0.87	0.86	0.75	0.19	
ZAF	0.89	0.87	0.83	0.87	0.91	0.85	0.86	20.83

JER mas

	AUS	CAN	DFS	GBR	NLD	NZL	USA	ZAF
AUS	28.98							
CAN	0.50	8.75						
DFS	0.57	0.88	12.45					
GBR	0.89	0.61	0.70	11.39				
NLD	0.81	0.84	0.82	0.88	4.17			
NZL	0.95	0.45	0.46	0.83	0.75	0.38		
USA	0.78	0.69	0.75	0.88	0.86	0.75	0.19	
ZAF	0.88	0.57	0.66	0.88	0.87	0.84	0.86	20.83

RDC scs

	AUS	CAN	DEU	DFS	EST	GBR	LTU	LVA	NLD	NOR	NZL
USA	ZAF										
AUS	31.27										
CAN	0.86	0.26									
DEU	0.89	0.92	13.65								
DFS	0.92	0.92	0.93	12.70							
EST	0.88	0.87	0.94	0.93	11.95						
GBR	0.91	0.93	0.94	0.92	0.91	11.62					
LTU	0.83	0.87	0.87	0.86	0.92	0.88	0.34				
LVA	0.89	0.87	0.93	0.86	0.95	0.89	0.89	0.43			
NLD	0.91	0.91	0.95	0.93	0.91	0.96	0.87	0.88	4.08		
NOR	0.88	0.90	0.88	0.90	0.90	0.87	0.87	0.87	0.91	11.61	
NZL	0.96	0.78	0.83	0.86	0.83	0.83	0.80	0.85	0.87	0.85	0.41
USA	0.78	0.93	0.88	0.88	0.89	0.88	0.86	0.86	0.86	0.86	0.75
0.24											
ZAF	0.81	0.87	0.90	0.82	0.89	0.89	0.88	0.87	0.89	0.89	0.79
0.87	25.63										

RDC mas

	AUS	CAN	DEU	DFS	EST	GBR	LTU	LVA	NLD	NOR	NZL
USA	ZAF										
AUS	31.34										
CAN	0.56	8.83									
DEU	0.88	0.76	13.65								
DFS	0.58	0.83	0.73	13.32							
EST	0.87	0.76	0.93	0.70	11.95						
GBR	0.90	0.71	0.93	0.73	0.90	11.65					
LTU	0.85	0.60	0.87	0.65	0.92	0.87	0.34				
LVA	0.88	0.65	0.94	0.63	0.95	0.87	0.90	0.43			
NLD	0.79	0.85	0.92	0.84	0.84	0.88	0.73	0.80	3.89		
NOR	0.86	0.61	0.88	0.54	0.87	0.86	0.87	0.87	0.75	11.61	
NZL	0.96	0.49	0.83	0.62	0.81	0.83	0.82	0.84	0.75	0.82	0.40
USA	0.76	0.73	0.88	0.76	0.89	0.88	0.86	0.85	0.86	0.85	0.75
0.24											
ZAF	0.81	0.71	0.90	0.77	0.88	0.89	0.87	0.86	0.87	0.85	0.79
0.87	25.82										

SIM scs

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	ITA	NLD	SVK	SVN
CHE	10.28										
DEA	0.90	12.11									
FRA	0.91	0.92	1.00								
FRM	0.93	0.94	0.92	1.08							
GBR	0.89	0.91	0.95	0.91	11.07						
HRV	0.85	0.85	0.86	0.91	0.85	10.26					
HUN	0.88	0.93	0.91	0.92	0.89	0.87	16.27				
ITA	0.90	0.90	0.90	0.96	0.88	0.85	0.92	14.78			
NLD	0.91	0.91	0.94	0.92	0.95	0.86	0.87	0.86	4.29		
SVK	0.87	0.85	0.88	0.88	0.86	0.86	0.92	0.90	0.87	0.38	
SVN	0.87	0.86	0.86	0.88	0.85	0.86	0.87	0.86	0.86	0.86	8.98

SIM mas

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	ITA	NLD	SVK	SVN
CHE	10.28										
DEA	0.89	12.11									
FRA	0.76	0.91	1.00								
FRM	0.92	0.93	0.88	1.08							
GBR	0.89	0.89	0.76	0.91	11.07						
HRV	0.82	0.85	0.83	0.87	0.82	10.26					
HUN	0.87	0.89	0.83	0.88	0.89	0.85	16.27				
ITA	0.91	0.90	0.87	0.96	0.88	0.85	0.92	14.78			
NLD	0.82	0.87	0.84	0.86	0.88	0.64	0.87	0.86	3.93		
SVK	0.86	0.85	0.85	0.86	0.84	0.85	0.90	0.90	0.82	0.38	
SVN	0.84	0.85	0.84	0.86	0.82	0.86	0.84	0.85	0.73	0.85	8.98

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
CAN	0	103	108	72	53	94	44	19	22	138
CHE	85	0	493	133	55	355	73	17	52	281
DEA	93	392	0	175	57	492	118	26	72	278
FRA	65	95	131	0	43	149	72	17	41	114
GBR	55	45	40	37	0	52	29	13	15	69
ITA	82	306	395	117	39	0	99	17	67	188
NLD	40	66	111	59	25	80	0	18	32	66
NZL	19	14	21	13	11	13	11	0	4	23
SVN	20	52	68	41	12	68	33	3	0	29
USA	136	264	246	75	68	128	57	21	23	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
CAN	0	103	108	63	53	94	40	19	22	138
CHE	85	0	493	129	55	355	64	17	52	281
DEA	93	392	0	156	57	492	98	26	72	278
FRA	57	94	118	0	39	137	53	13	37	98
GBR	55	45	40	37	0	52	27	13	15	69
ITA	82	306	395	110	39	0	82	17	67	188
NLD	34	57	87	44	22	62	0	17	29	58
NZL	19	14	21	10	11	13	10	0	4	23
SVN	20	52	68	37	12	68	29	3	0	29
USA	136	264	246	66	68	128	46	21	23	0

GUE
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 common bulls below diagonal
 common three quarter sib group above diagonal
       AUS CAN GBR NZL USA ZAF

  AUS   0   43   33   26   54   3
  CAN   40   0   26   13   60   1
  GBR   26   21   0   13   72   3
  NZL   26   11   11   0   29   2
  USA   51   51   75   29   0   6
  ZAF   2   0   2   0   3   0

HOL

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common bulls below diagonal
common three quarter sib group above diagonal

	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	FRR	GBR	HRV	HUN	IRL	ISR	ITA	JPN	KOR	LTU	LVA	NLD	NZL	POL	PRT	SVK	SVN	USA	ZAF
AUS	0	412	1005	415	646	1366	1017	667	154	1027	24	1076	199	561	499	77	1003	702	306	141	161	1173	978	739	671	243	121	1450	407
BEL	312	0	368	303	312	634	446	347	81	495	34	450	135	283	257	41	441	282	136	72	96	664	285	373	374	148	87	475	203
CAN	871	312	0	572	762	1879	1015	956	159	1096	13	1171	185	704	344	73	1273	1056	458	141	191	1032	560	864	800	331	123	2370	404
CHE	341	264	404	0	360	858	485	384	99	437	37	473	133	316	247	43	510	324	155	66	127	633	282	420	379	159	86	680	195
CZE	349	200	447	223	0	1472	952	630	181	952	35	771	238	699	320	84	1007	641	343	149	182	1113	468	944	621	349	139	1233	302
DEU	862	535	993	681	990	0	2349	1224	300	2090	126	1692	441	1004	618	117	2253	1263	448	346	307	2865	812	1693	1092	618	199	2979	507
DFS	623	349	661	390	519	1247	0	790	200	1367	46	1218	268	719	525	105	1344	797	353	208	210	1641	679	1120	820	343	165	1641	428
ESP	446	309	486	293	388	735	542	0	133	877	15	824	200	583	345	82	1005	712	322	145	164	852	431	735	701	247	123	1179	376
EST	65	47	80	52	109	201	113	64	0	174	20	167	78	138	87	40	193	142	70	48	88	267	101	211	147	90	56	245	78
FRA	607	436	596	369	491	892	580	592	69	0	25	1250	190	738	520	96	1560	1014	366	154	177	1603	666	1141	799	326	127	2110	402
FRR	17	28	7	25	27	99	30	8	17	20	0	22	17	9	9	4	27	7	2	1	23	87	10	78	21	25	13	29	11
GBR	839	371	1235	416	447	1086	784	637	91	671	16	0	233	673	637	94	1258	829	356	166	176	1359	735	925	817	298	142	1652	435
HRV	126	114	92	89	176	457	205	159	58	107	17	167	0	176	115	44	267	148	86	92	107	313	150	308	233	93	66	251	113
HUN	405	217	578	248	596	772	538	464	83	471	8	579	132	0	301	76	814	571	331	133	139	765	413	702	605	258	112	997	330
IRL	377	219	262	221	180	448	361	307	40	343	7	566	77	241	0	61	464	302	130	87	93	612	492	379	365	143	71	532	245
ISR	54	24	42	28	59	96	83	56	26	51	3	65	34	60	44	0	104	73	41	29	28	111	80	94	89	35	31	115	52
ITA	614	341	723	419	589	1271	839	695	104	683	22	833	207	653	332	76	0	1019	443	194	225	1474	653	1167	894	340	167	2208	441
JPN	356	163	453	204	250	454	390	315	48	324	5	385	75	325	166	34	407	0	395	130	149	855	459	720	592	255	114	1623	360
KOR	207	71	399	98	235	273	227	214	35	187	0	251	38	267	77	24	338	226	0	83	98	342	221	384	357	148	64	614	208
LTU	46	21	56	18	86	324	103	62	16	33	0	67	67	69	33	13	95	29	39	0	73	195	115	203	145	62	31	215	73
LVA	77	53	109	73	118	208	130	91	62	78	19	101	89	99	51	20	152	66	59	51	0	225	111	241	197	95	44	259	94
NLD	944	692	811	585	882	2338	1217	728	189	842	51	1055	280	620	490	91	1031	411	213	97	147	0	847	1241	937	440	168	1978	441
NZL	949	210	548	234	289	588	435	314	53	352	7	601	87	324	370	68	450	235	151	48	54	753	0	497	499	204	90	887	317
POL	478	290	565	320	679	1285	793	489	144	588	70	658	266	588	253	72	806	341	297	140	182	1007	340	0	788	332	155	1402	329
PRT	530	356	805	344	499	1027	722	727	98	704	19	779	197	597	333	74	842	360	299	92	154	980	429	788	0	266	119	1089	385
SVK	116	77	212	77	254	454	167	120	42	163	13	158	47	183	72	14	179	87	86	30	45	282	124	205	193	0	51	437	150
SVN	87	71	87	61	104	175	137	91	35	86	12	102	56	89	49	24	138	65	33	14	27	141	64	136	100	32	0	154	72
USA	1270	355	2126	570	819	1676	1016	691	152	968	15	1272	186	915	399	95	1141	647	674	120	207	1539	806	1106	1134	274	121	0	551
ZAF	340	157	335	166	190	381	313	332	39	268	7	373	80	271	199	38	326	249	157	23	55	369	253	236	367	84	53	516	0

HOL

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common bulls below diagonal
common three quarter sib group above diagonal

	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	FRR	GBR	HRV	HUN	IRL	ISR	ITA	JPN	KOR	LTU	LVA	NLD	NZL	POL	PRT	SVK	SVN	USA	ZAF
AUS	0	412	478	415	646	1362	948	659	154	774	16	1076	199	560	499	77	1002	702	302	140	160	1119	976	739	648	234	121	1447	406
BEL	312	0	225	303	312	634	424	344	81	416	22	450	135	283	257	41	440	282	136	72	95	643	285	373	368	143	87	475	203
CAN	452	202	0	351	467	1011	453	561	78	503	0	579	122	419	167	40	771	558	285	86	109	482	251	576	397	164	84	1206	177
CHE	341	264	254	0	360	856	445	380	99	370	22	473	133	316	247	43	509	324	155	66	126	595	282	420	367	156	86	679	195
CZE	349	200	296	223	0	1472	890	618	181	821	26	771	238	699	320	84	1007	641	340	149	182	1061	467	944	600	347	139	1233	302
DEU	862	535	602	680	990	0	2211	1206	300	1544	67	1689	441	1004	618	117	2250	1261	443	345	305	2687	809	1692	1048	608	199	2970	504
DFS	539	325	361	350	462	1072	0	750	188	1002	24	1149	257	675	511	101	1259	747	324	202	201	1434	646	1044	754	311	159	1518	414
ESP	436	305	274	288	380	719	497	0	132	709	9	819	199	576	342	81	989	704	319	143	163	798	428	719	681	241	122	1165	376
EST	65	47	44	52	109	201	104	62	0	135	14	167	78	138	87	40	193	141	70	48	88	256	100	211	143	89	56	244	77
FRA	475	355	309	309	383	600	426	500	58	0	11	954	164	625	421	80	1228	752	297	129	145	1147	504	983	637	248	113	1426	318
FRR	11	20	0	20	20	49	21	7	13	8	0	14	15	5	5	3	17	2	1	0	17	53	5	65	15	17	11	19	8
GBR	839	371	500	416	447	1086	704	630	91	522	11	0	233	673	637	94	1258	829	353	165	174	1294	733	925	791	290	142	1650	432
HRV	126	114	73	89	176	457	187	157	58	96	15	167	0	176	115	44	266	148	86	92	107	295	150	308	232	92	66	251	112
HUN	405	217	376	248	596	772	495	455	83	403	5	579	132	0	301	76	814	571	330	133	138	726	412	702	589	255	112	996	329
IRL	377	219	158	221	180	448	341	305	40	298	5	566	77	241	0	61	464	302	130	87	92	598	491	378	363	140	71	532	245
ISR	54	24	29	28	59	96	75	55	26	45	3	65	34	60	44	0	104	73	41	29	28	110	80	94	89	33	31	115	52
ITA	614	341	460	419	589	1270	742	683	104	511	16	833	207	653	332	76	0	1019	441	194	224	1381	653	1165	856	334	167	2206	439
JPN	356	163	329	204	250	454	347	306	48	279	2	385	75	325	166	34	407	0	392	130	147	813	456	720	564	248	114	1621	359
KOR	207	71	254	98	235	273	202	210	35	157	0	251	38	267	77	24	338	226	0	82	98	330	219	384	346	147	64	608	206
LTU	46	21	38	18	86	324	94	62	16	27	0	67	67	69	33	13	95	29	39	0	72	187	115	203	143	61	31	214	73
LVA	77	53	66	73	118	208	121	91	62	68	15	101	89	99	51	20	152	66	59	51	0	211	110	241	193	93	44	258	93
NLD	872	654	402	535	811	2095	953	650	180	564	35	964	259	562	466	89	902	377	193	87	128	0	825	1181	857	414	164	1857	423
NZL	949	210	225	234	289	587	401	312	52	278	4	601	87	324	370	68	450	235	151	48	54	720	0	497	486	200	90	882	317
POL	478	290	434	320	679	1285	707	476	144	499	61	658	266	588	253	72	806	341	297	140	182	933	340	0	759	329	155	1401	327
PRT	513	351	377	337	491	1000	653	710	97	582	15	766	197	586	331	74	821	345	293	90	153	897	423	765	0	258	113	1032	381
SVK	115	77	107	77	254	453	148	119	42	119	10	158	47	183	72	14	178	87	86	30	45	263	124	205	190	0	51	429	147
SVN	87	71	64	61	104	175	128	90	35	79	10	102	56	89	49	24	138	65	33	14	27	136	64	136	94	32	0	154	72
USA	1270	355	1072	570	819	1674	844	675	152	560	11	1272	186	915	399	95	1140	647	674	120	207	1354	806	1106	1087	274	121	0	547
ZAF	340	157	161	166	190	381	299	332	39	228	6	373	80	271	199	38	326	249	157	23	55	342	253	236	365	84	53	516	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DFS	GBR	NLD	NZL	USA	ZAF
AUS	0	182	103	162	53	334	378	176
CAN	185	0	65	119	28	135	295	106
DFS	68	49	0	121	63	105	137	110
GBR	167	121	109	0	61	164	183	132
NLD	46	22	61	56	0	56	65	56
NZL	376	148	78	167	47	0	291	160
USA	411	305	109	199	69	364	0	220
ZAF	169	103	86	130	51	165	232	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DFS	GBR	NLD	NZL	USA	ZAF
AUS	0	63	94	162	46	333	378	176
CAN	55	0	23	46	8	44	101	37
DFS	57	18	0	116	45	96	126	101
GBR	167	45	104	0	46	163	181	131
NLD	42	3	38	42	0	47	51	48
NZL	375	41	66	167	39	0	291	160
USA	411	89	88	199	55	364	0	220
ZAF	169	31	75	130	44	165	232	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	EST	GBR	LTU	LVA	NLD	NOR	NZL	USA	ZAF
AUS	0	82	33	139	16	44	39	26	18	46	110	94	29
CAN	82	0	11	107	1	58	14	7	5	4	68	158	66
DEU	32	10	0	57	21	5	30	28	13	17	14	20	1
DFS	115	103	48	0	74	47	100	89	33	91	134	130	47
EST	16	1	20	64	0	1	21	34	8	11	3	10	0
GBR	42	59	5	46	1	0	11	5	13	12	44	65	33
LTU	35	13	28	83	20	10	0	35	12	22	23	27	5
LVA	25	7	23	59	28	5	31	0	9	16	12	11	1
NLD	16	5	13	33	7	13	11	8	0	27	9	25	3
NOR	38	4	17	71	11	13	17	14	26	0	31	47	0
NZL	112	67	14	132	2	41	19	10	9	30	0	83	29
USA	95	145	20	130	9	61	20	9	23	47	83	0	54
ZAF	29	68	1	44	0	29	5	1	3	0	25	49	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	EST	GBR	LTU	LVA	NLD	NOR	NZL	USA	ZAF
AUS	0	25	33	157	16	42	39	26	17	46	109	92	27
CAN	24	0	5	59	0	27	10	4	3	3	24	61	33
DEU	32	5	0	57	21	5	30	28	13	17	14	20	1
DFS	136	54	48	0	74	44	99	90	29	92	131	122	43
EST	16	0	20	64	0	1	21	34	8	11	3	10	0
GBR	41	27	5	43	1	0	11	5	10	12	42	63	30
LTU	35	9	28	82	20	10	0	35	11	22	23	27	5
LVA	25	4	23	59	28	5	31	0	7	16	12	11	1
NLD	15	3	13	29	7	10	10	6	0	23	7	22	1
NOR	38	3	17	71	11	13	17	14	22	0	31	47	0
NZL	111	24	14	127	2	41	19	10	7	30	0	81	27
USA	94	62	20	121	9	61	20	9	20	47	83	0	50
ZAF	29	35	1	42	0	28	5	1	1	0	25	49	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	ITA	NLD	SVK	SVN
CHE	0	239	8	141	48	0	1	70	68	27	4
DEA	205	0	170	194	45	408	26	623	175	316	140
FRA	5	129	0	2	0	63	3	92	37	39	37
FRM	181	220	1	0	62	2	2	142	100	52	17
GBR	54	43	0	78	0	0	0	42	46	8	0
HRV	0	427	58	1	0	0	8	174	67	71	59
HUN	0	14	2	0	0	8	0	7	2	6	5
ITA	74	522	82	171	46	167	7	0	129	114	74
NLD	73	180	36	123	45	65	2	125	0	45	35
SVK	19	322	33	52	3	55	5	97	38	0	37
SVN	4	126	34	17	0	49	4	70	33	37	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	ITA	NLD	SVK	SVN
CHE	0	239	8	141	48	0	1	70	62	27	4
DEA	205	0	158	194	45	408	26	623	146	316	140
FRA	5	121	0	2	0	58	3	85	29	38	34
FRM	181	219	1	0	62	2	2	142	89	52	17
GBR	54	43	0	78	0	0	0	42	41	8	0
HRV	0	427	51	1	0	0	8	174	60	71	59
HUN	0	14	2	0	0	8	0	7	2	6	5
ITA	74	522	75	171	46	167	7	0	112	114	74
NLD	65	150	27	108	41	58	2	109	0	40	29
SVK	19	322	30	52	3	55	5	97	34	0	37
SVN	4	126	29	17	0	49	4	70	29	37	0