

Introduction

The latest routine international evaluation for udder traits took place as scheduled at the Interbull Centre. Data from thirty-three (33) countries were included in this evaluation.

International genetic evaluations for udder health traits of bulls from Australia, Austria-Germany, Belgium, Canada, Croatia, 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, Croatia, Slovenia, Portugal and Uruguay were computed. Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed data were included in this evaluation.

Countries sending real MAS data (other countries participate to the MAS evaluation using SCS data as predictor):

HOL : DFS, NLD, FRA, CAN, ITA, CHE, USA
RDC : DFS, NLD, CAN
BSW : NLD, FRA, CHE
JER : DFS, NLD, CAN
SIM : NLD, CHE
GUE : No evaluation for MAS yet

Changes in national procedures

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

DFS (ALL) Decrease in information for Swedish bulls. Sweden has stated to check if the herds participate in disease recording or not
ITA (SIM) Base change
ITA (HOL) Base change, editing and pedigree checks
ITA (BSW) Base change
BEL (HOL) Up to 21 bulls missing in current data most of them are Montbeliard bulls erroneously added before due to a bug in one of the programs preparing the file to be submitted. which has now been fixed.
FRA (ALL) Base change
CAN (ALL) Base change
SVN (ALL) Base change
EST (ALL) Correction in type of proof
AUS (ALL) New database and procedures for data extraction. Mix99 software will be used for all traits. EBV expression is on the observable scale for a trait into consideration, (kg, days, log(scc), type scores, etc). Drop in reliabilities. The genetic parameters for all traits remain the same.
CHE (HOL, BSW, SIM) Participating with real MAS data coming from a new genetic evaluation based on producer recorder diagnosis data and milk recording data.
USA (HOL) First time with real MAS data
NZL (ALL) NZL has continuous DNA parentage testing so daughters, herds, EDC will always change. Small decrease in Reliability as consequence.

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.

DATA AND METHOD OF ANALYSIS

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

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

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

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

SCIENTIFIC LITERATURE

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

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

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

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

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

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

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

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

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

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.

^aLTable 1. National evaluation data considered in the Interbull evaluation for udder health (April Routine Evaluation 2019).

Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		133	7981	1600	721	
BEL			1988			
CAN	227	99	12457	738	806	
CHE	2933		3377	85		3227
CZE			3906			
DEA	5576				22285	
DEU		27627		429		
DFS		13135		2131	7804	
ESP			3791			
EST			1129		425	
FRA	385		17054			458
FRM						4296
GBR	113	279	6641	688	505	83
HUN			2803			173
IRL			2473			
ISR			1421			
ITA	1905		9651			1493
JPN			6024			
KOR			1278			
LTU			807		435	
LVA			527		564	
NLD	194		15596	159	85	
NOR					4158	
NZL	50	57	7676	4523	1307	
POL			10440			
PRT			2412			
SVK			1101		563	
SVN	368		542			607
URY			1736			
USA	1067	697	38142	4526	674	58
ZAF			1183	577	123	
HRV			774			852
MEX						
CAM				38		
<hr/>						
No. Records	12818	1265	203672	15027	18074	34496
Pub. Proofs	10415	983	154669	12366	17290	30897

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

BSW scs

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.08									
FRA	0.91	1.02								
NLD	0.89	0.92	3.69							
USA	0.89	0.91	0.88	0.21						
CHE	0.92	0.94	0.94	0.88	10.59					
DEA	0.92	0.96	0.92	0.88	0.97	11.92				
NZL	0.87	0.87	0.87	0.86	0.87	0.88	0.37			
ITA	0.89	0.90	0.89	0.89	0.95	0.91	0.87	16.77		
GBR	0.90	0.96	0.95	0.91	0.94	0.95	0.89	0.89	12.70	
SVN	0.89	0.89	0.89	0.89	0.89	0.89	0.88	0.89	0.89	10.48

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.07									
FRA	0.92	1.07								
NLD	0.89	0.88	3.80							
USA	0.88	0.88	0.88	0.21						
CHE	0.92	0.90	0.91	0.90	12.45					
DEA	0.93	0.87	0.89	0.88	0.91	11.92				
NZL	0.90	0.89	0.89	0.87	0.91	0.87	0.37			
ITA	0.89	0.88	0.89	0.88	0.90	0.91	0.87	16.77		
GBR	0.89	0.89	0.88	0.89	0.92	0.90	0.89	0.89	2.86	
SVN	0.89	0.89	0.89	0.89	0.90	0.89	0.88	0.89	0.89	10.48

GUE SCS

	CAN	GBR	USA	AUS	NZL
CAN	5.96				
GBR	0.89	13.63			
USA	0.89	0.90	0.25		
AUS	0.88	0.92	0.86	0.27	
NZL	0.87	0.89	0.86	0.95	0.6

HOL SCS

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	5.78																												
CHE	0.89	10.98																											
DEU	0.93	0.94	12.67																										
DFS	0.92	0.93	0.96	11.85																									
EST	0.88	0.89	0.94	0.92	13.45																								
FRA	0.94	0.93	0.95	0.97	0.91	1.19																							
GBR	0.94	0.94	0.95	0.94	0.90	0.96	12.77																						
NLD	0.91	0.94	0.95	0.94	0.91	0.94	0.96	4.20																					
USA	0.94	0.88	0.89	0.88	0.90	0.90	0.90	0.88	0.21																				
ISR	0.85	0.85	0.85	0.84	0.86	0.85	0.84	0.83	0.88	0.24																			
ITA	0.90	0.89	0.94	0.92	0.93	0.93	0.90	0.88	0.89	0.85	5.81																		
AUS	0.86	0.91	0.88	0.88	0.86	0.89	0.93	0.91	0.86	0.84	0.86	0.29																	
HUN	0.88	0.90	0.92	0.90	0.91	0.91	0.89	0.88	0.92	0.88	0.93	0.86	1.43																
BEL	0.91	0.93	0.96	0.96	0.95	0.95	0.94	0.94	0.89	0.84	0.94	0.86	0.92	0.52															
JPN	0.88	0.88	0.88	0.89	0.87	0.90	0.88	0.88	0.88	0.83	0.88	0.86	0.88	0.88	0.88	0.88	0.88	0.42											
ESP	0.92	0.91	0.95	0.94	0.94	0.96	0.93	0.91	0.91	0.88	0.95	0.86	0.93	0.96	0.88	11.54													
ZAF	0.90	0.89	0.92	0.90	0.89	0.93	0.92	0.89	0.89	0.87	0.92	0.88	0.91	0.91	0.88	0.95	26.47												
NZL	0.86	0.86	0.86	0.86	0.86	0.86	0.89	0.86	0.86	0.83	0.85	0.96	0.86	0.86	0.86	0.86	0.86	0.40											
IRL	0.88	0.93	0.93	0.93	0.90	0.93	0.95	0.93	0.86	0.83	0.88	0.95	0.86	0.93	0.86	0.92	0.91	0.92	0.11										
CZE	0.88	0.88	0.90	0.88	0.88	0.89	0.88	0.88	0.88	0.84	0.90	0.86	0.89	0.88	0.91	0.88	0.86	17.38											
SVK	0.88	0.89	0.91	0.89	0.88	0.90	0.88	0.88	0.88	0.84	0.90	0.86	0.91	0.88	0.86	0.86	0.88	0.42											
POL	0.89	0.92	0.95	0.95	0.94	0.93	0.91	0.91	0.88	0.85	0.94	0.86	0.94	0.96	0.88	0.95	0.90	0.86	0.89	0.90	0.91	10.02							
LTU	0.88	0.88	0.90	0.88	0.92	0.88	0.88	0.88	0.88	0.85	0.88	0.86	0.88	0.92	0.88	0.90	0.88	0.86	0.86	0.88	0.89	0.90	0.36						
LVA	0.88	0.89	0.94	0.92	0.94	0.90	0.90	0.89	0.88	0.82	0.92	0.87	0.88	0.94	0.88	0.89	0.88	0.86	0.90	0.88	0.87	0.93	0.92	0.48					
PRT	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.88	0.86	0.88	0.88	0.88	0.86	0.88	0.88	0.86	0.88	0.88	0.88	0.88	0.46					

KOR	0.88	0.88	0.88	0.90	0.88	0.88	0.88	0.88	0.83	0.89	0.86	0.88	0.90	0.88	0.91	0.88	0.86	0.86	0.88	0.88	0.92	0.88	0.90	0.88	0.34
SVN	0.88	0.88	0.88	0.88	0.87	0.88	0.88	0.88	0.84	0.88	0.86	0.88	0.88	0.88	0.88	0.88	0.86	0.87	0.88	0.87	0.88	0.88	0.89	0.88	10.68
HRV	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.88	0.86	0.88	0.88	0.88	0.88	0.88	0.86	0.87	0.88	0.87	0.88	0.88	0.88	0.87	11.73
URY	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.85	0.88	0.86	0.88	0.88	0.88	0.88	0.88	0.86	0.86	0.88	0.88	0.88	0.88	0.88	0.88	0.20

HOL mas

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	7.63																												
CHE	0.91	11.42																											
DEU	0.87	0.94	12.67																										
DFS	0.94	0.90	0.87	12.61																									
EST	0.86	0.90	0.93	0.86	13.44																								
FRA	0.96	0.92	0.87	0.94	0.86	1.20																							
GBR	0.88	0.91	0.89	0.88	0.88	0.88	2.49																						
NLD	0.88	0.93	0.93	0.88	0.91	0.88	0.88	4.80																					
USA	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	2.27																				
ISR	0.82	0.83	0.84	0.82	0.85	0.82	0.84	0.83	0.84	0.24																			
ITA	0.87	0.90	0.89	0.88	0.88	0.88	0.88	0.88	0.88	0.83	6.02																		
AUS	0.89	0.89	0.89	0.89	0.86	0.89	0.89	0.89	0.89	0.83	0.86	0.29																	
HUN	0.87	0.91	0.92	0.87	0.90	0.87	0.88	0.91	0.88	0.87	0.90	0.86	1.43																
BEL	0.87	0.94	0.97	0.88	0.94	0.88	0.88	0.94	0.88	0.83	0.89	0.88	0.93	0.52															
JPN	0.87	0.88	0.88	0.87	0.86	0.87	0.88	0.87	0.88	0.82	0.88	0.86	0.88	0.88	0.42														
ESP	0.87	0.94	0.96	0.88	0.92	0.88	0.88	0.92	0.88	0.87	0.89	0.86	0.93	0.96	0.88	11.54													
ZAF	0.87	0.90	0.92	0.87	0.88	0.87	0.88	0.89	0.88	0.86	0.89	0.89	0.91	0.92	0.88	0.95	26.18												
NZL	0.87	0.87	0.86	0.87	0.84	0.87	0.89	0.88	0.89	0.82	0.85	0.96	0.85	0.86	0.86	0.85	0.86	0.40											
IRL	0.88	0.92	0.93	0.88	0.88	0.88	0.89	0.89	0.89	0.82	0.86	0.95	0.86	0.93	0.86	0.92	0.91	0.92	0.11										
CZE	0.87	0.89	0.91	0.87	0.88	0.87	0.88	0.88	0.88	0.83	0.88	0.86	0.90	0.89	0.88	0.91	0.88	0.85	0.86	17.30									
SVK	0.86	0.88	0.91	0.86	0.88	0.86	0.88	0.88	0.88	0.83	0.89	0.86	0.95	0.90	0.87	0.90	0.88	0.85	0.86	0.41									
POL	0.88	0.93	0.96	0.88	0.93	0.88	0.88	0.92	0.88	0.84	0.89	0.86	0.94	0.96	0.88	0.95	0.90	0.86	0.89	0.90	10.01								
LTU	0.88	0.89	0.90	0.88	0.91	0.88	0.88	0.88	0.88	0.85	0.88	0.86	0.91	0.88	0.89	0.90	0.87	0.86	0.88	0.89	0.90	0.35							
LVA	0.87	0.88	0.93	0.87	0.93	0.87	0.88	0.89	0.88	0.82	0.88	0.87	0.88	0.94	0.87	0.88	0.87	0.85	0.89	0.87	0.93	0.92	0.48						
PRT	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.88	0.86	0.88	0.88	0.88	0.88	0.86	0.86	0.88	0.88	0.88	0.88	0.45						
KOR	0.87	0.90	0.88	0.87	0.86	0.87	0.87	0.88	0.87	0.88	0.81	0.88	0.86	0.87	0.90	0.88	0.87	0.85	0.86	0.87	0.92	0.88	0.89	0.88	0.86	0.34			
SVN	0.86	0.87	0.87	0.87	0.86	0.86	0.88	0.87	0.88	0.82	0.87	0.86	0.87	0.89	0.87	0.87	0.85	0.87	0.86	0.88	0.88	0.88	0.88	0.86	10.68				
HRV	0.86	0.86	0.88	0.86	0.87	0.86	0.88	0.88	0.87	0.88	0.83	0.88	0.86	0.87	0.87	0.88	0.87	0.85	0.88	0.88	0.88	0.88	0.88	0.87	0.87	11.74			
URY	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.88	0.86	0.88	0.88	0.88	0.88	0.86	0.86	0.88	0.88	0.88	0.88	0.88	0.88	0.20				

JER SCS

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE

<tbl_r cells="10" ix="2" maxcspan="1" maxrspan="1"

RDC	SCS	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN		5.60													
DFS		0.94	12.85												
GBR		0.93	0.92	11.38											
NOR		0.92	0.91	0.89	13.69										
USA		0.92	0.88	0.89	0.89	0.23									
DEU		0.93	0.95	0.95	0.90	0.89	13.62								
AUS		0.88	0.91	0.92	0.92	0.86	0.90	0.30							
EST		0.89	0.94	0.91	0.90	0.91	0.95	0.90	12.02						
ZAF		0.89	0.90	0.90	0.93	0.89	0.92	0.88	0.90	25.13					
NZL		0.88	0.88	0.89	0.90	0.86	0.87	0.95	0.88	0.87	0.41				
LTU		0.90	0.90	0.89	0.90	0.89	0.89	0.87	0.91	0.91	0.87	0.34			
LVA		0.90	0.89	0.90	0.90	0.89	0.93	0.89	0.96	0.89	0.88	0.90	0.44		
NLD		0.91	0.95	0.96	0.90	0.88	0.95	0.92	0.92	0.89	0.87	0.89	0.90	3.84	
CAM		0.94	0.94	0.94	0.93	0.90	0.94	0.93	0.94	0.93	0.91	0.93	0.94	0.94	5.63

RDC	mas	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN		7.66													
DFS		0.91	13.82												
GBR		0.88	0.88	1.96											
NOR		0.92	0.88	0.89	13.69										
USA		0.88	0.88	0.88	0.89	0.23									
DEU		0.88	0.87	0.89	0.90	0.88	13.62								
AUS		0.90	0.89	0.89	0.92	0.87	0.90	0.30							
EST		0.87	0.87	0.89	0.90	0.89	0.93	0.87	12.02						
ZAF		0.89	0.88	0.89	0.93	0.89	0.92	0.88	0.90	25.26					
NZL		0.88	0.88	0.89	0.90	0.86	0.87	0.95	0.87	0.87	0.41				
LTU		0.88	0.87	0.89	0.90	0.89	0.90	0.87	0.92	0.90	0.87	0.34			
LVA		0.88	0.86	0.89	0.90	0.89	0.94	0.89	0.95	0.88	0.88	0.91	0.44		
NLD		0.88	0.88	0.88	0.89	0.89	0.93	0.90	0.91	0.90	0.89	0.89	0.90	4.19	
CAM		0.93	0.93	0.93	0.93	0.90	0.94	0.93	0.94	0.93	0.92	0.93	0.94	0.94	5.63

SIM	SCS	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM		1.09											
FRA		0.93	1.02										
ITA		0.94	0.90	13.54									
NLD		0.91	0.93	0.88	3.84								
CHE		0.93	0.93	0.90	0.93	10.47							
DEA		0.91	0.93	0.88	0.90	0.89	12.16						
HUN		0.93	0.91	0.93	0.88	0.90	0.94	16.24					
SVK		0.89	0.89	0.91	0.90	0.88	0.94	0.38					
SVN		0.90	0.89	0.89	0.89	0.90	0.88	0.90	0.89	8.89			
GBR		0.91	0.96	0.89	0.95	0.91	0.93	0.89	0.89	0.88	11.75		
HRV		0.93	0.88	0.88	0.88	0.89	0.88	0.89	0.89	0.89	0.88	9.87	
USA		0.89	0.90	0.89	0.88	0.89	0.90	0.92	0.89	0.89	0.90	0.88	0.22

SIM	mas	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM		1.08											
FRA		0.92	1.00										
ITA		0.95	0.88	13.54									
NLD		0.88	0.88	0.88	3.80								
CHE		0.93	0.92	0.91	0.93	11.61							
DEA		0.91	0.92	0.88	0.88	0.89	0.89	12.16					

^aLAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal

common three quarter sib group above diagonal

CAN FRA NLD USA CHE DEA NZL ITA GBR SVN

	1	2	3	4	5	6	7	8	9	10
CAN	0	79	51	163	124	129	22	116	57	32
FRA	70	0	82	119	158	206	21	182	50	54
NLD	48	67	0	77	94	146	23	123	38	43
USA	151	80	67	0	312	308	28	218	77	41
CHE	99	116	87	291	0	569	24	426	63	77
DEA	108	154	140	272	471	0	32	606	65	101
NZL	20	17	16	25	19	27	0	26	17	9
ITA	97	144	103	151	369	508	19	0	65	95
GBR	54	41	30	72	49	45	15	47	0	20
SVN	28	53	44	33	73	94	8	94	16	0

BSW

common bulls below diagonal

common three quarter sib group above diagonal

CAN FRA NLD USA CHE DEA NZL ITA GBR SVN

CAN	0	73	49	163	32	129	22	116	28	32
FRA	65	0	66	103	40	190	18	169	26	52
NLD	44	56	0	70	23	129	23	110	19	39
USA	151	71	60	0	36	307	28	216	35	41
CHE	26	32	22	25	0	106	6	88	9	33
DEA	108	143	121	272	101	0	32	602	31	101
NZL	20	15	16	25	6	27	0	26	10	9
ITA	97	137	91	151	82	506	19	0	32	95
GBR	26	21	15	33	5	23	8	25	0	12
SVN	28	51	40	33	32	94	8	94	10	0

GUE

common bulls below diagonal

common three quarter sib group above diagonal

CAN GBR USA AUS NZL

CAN	0	29	69	46	14
GBR	24	0	86	37	13
USA	60	88	0	61	29
AUS	44	31	57	0	26
NZL	11	11	29	26	0

GUE

HOL

common bulls below diagonal

common three quarter sib group above diagonal

CAN CHE DEU DFS EST FRA GBR NLD USA ISR ITA AUS HUN BEL JPN ESP ZAF NZL IRL CZE SVK POL LTU LVA PRT KOR SVN HRV URY

CAN	0	840	2386	1359	234	1423	1490	1442	3187	116	1640	1337	972	765	1308	1234	492	714	461	1008	418	1293	238	207	1014	627	193	294	732
CHE	700	0	1133	686	151	643	650	861	956	58	694	582	424	571	452	540	260	383	333	485	225	642	117	138	496	239	132	199	299

DEU	1648	979	0	2705	388	2515	1996	3434	3571	153	2509	1644	1209	1221	1454	1503	570	953	742	1710	716	2313	490	306	1229	576	294	603	756
DFS	1120	598	1742	0	268	1584	1450	1996	1965	136	1555	1222	860	816	932	971	488	793	623	1132	400	1500	308	206	915	441	235	387	614
EST	134	84	268	156	0	237	225	331	315	46	252	198	185	177	195	186	104	125	111	233	109	286	75	87	181	98	86	119	131
FRA	919	555	1261	792	106	0	1458	1916	2417	122	1680	1223	908	894	1175	1102	462	772	610	1133	413	1568	239	186	913	466	192	285	574
GBR	1689	586	1431	1051	126	866	0	1630	1996	123	1466	1290	814	816	984	1005	494	846	759	927	359	1220	255	180	919	444	194	318	631
NLD	1348	832	3105	1699	236	1136	1376	0	2379	145	1679	1405	927	1223	1025	1064	501	988	738	1342	522	1707	299	227	1032	429	243	426	638
USA	3431	841	2345	1412	205	1234	1701	2035	0	165	2519	1790	1237	920	1884	1472	618	1019	646	1488	523	1919	326	260	1275	777	223	366	1049
ISR	84	36	125	105	28	64	83	115	150	0	132	100	103	79	98	105	60	103	82	111	47	132	45	28	99	53	43	65	83
ITA	1274	616	1602	1123	139	854	1076	1353	1641	94	0	1162	985	788	1152	1226	474	732	540	1179	386	1512	282	223	999	548	223	375	660
AUS	1323	507	1168	844	98	797	1082	1210	1745	66	834	0	695	720	856	846	468	1158	605	772	302	966	214	168	769	392	165	285	626
HUN	906	339	946	673	111	596	711	767	1183	75	827	519	0	522	695	739	382	483	365	838	306	910	203	139	699	417	151	250	489
BEL	751	580	1256	747	109	863	796	1406	802	52	754	620	449	0	525	644	323	490	429	586	288	769	161	143	645	264	166	259	336
JPN	657	292	587	492	67	414	500	529	841	45	520	470	398	333	0	868	414	542	373	763	303	945	188	149	697	504	156	215	554
ESP	763	435	939	704	89	777	792	937	920	63	892	595	579	624	407	0	434	515	419	773	307	995	209	167	815	430	179	276	500
ZAF	446	212	439	372	53	322	426	422	597	41	371	403	305	273	288	381	0	358	281	353	177	401	103	99	419	249	94	147	319
NZL	719	321	731	549	64	446	713	904	959	86	531	1155	374	401	291	391	290	0	604	545	245	622	159	114	552	286	121	211	481
IRL	401	306	584	469	54	431	710	637	528	58	424	490	295	403	222	379	228	483	0	401	180	500	129	94	400	172	100	157	306
CZE	704	323	1239	703	145	648	584	1150	1090	80	788	477	735	436	331	501	223	368	251	0	430	1211	240	182	732	427	198	341	500
SVK	290	115	539	204	50	218	202	357	339	19	230	150	216	176	113	153	95	147	88	335	0	431	93	96	314	192	77	139	229
POL	1058	518	2004	1179	201	961	980	1542	1768	102	1131	709	795	698	495	682	296	469	376	960	296	0	331	251	993	522	234	444	611
LTU	120	43	462	166	34	66	123	166	207	21	144	86	123	71	54	87	38	68	55	148	42	245	0	75	202	126	55	140	149
LVA	131	78	206	126	62	86	103	149	208	20	152	79	99	91	66	95	58	55	52	118	47	186	52	0	190	99	43	115	120
PRT	1057	432	1128	808	126	767	849	1034	1327	74	931	608	691	651	428	776	376	450	337	592	215	991	122	143	0	437	157	309	535
KOR	596	165	377	306	49	265	326	299	875	31	445	286	344	194	305	298	188	205	111	294	116	439	55	59	370	0	90	132	359
SVN	140	96	281	194	51	133	142	209	169	32	187	118	117	138	88	135	66	87	73	147	45	212	27	26	125	55	0	106	98
HRV	169	127	616	295	86	168	223	381	274	45	282	174	184	213	102	209	98	123	103	240	69	391	95	90	247	57	82	0	180
URY	715	230	546	436	80	340	525	516	1318	46	481	495	407	275	323	398	279	390	237	336	144	514	83	80	474	286	57	108	0

HOL

common bulls below diagonal

common three quarter sib group above diagonal

CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	0	79	1280	655	134	7																						

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NLD USA AUS ZAF NZL CHE

CAN	0	78	143	35	403	246	145	163	36
DFS	62	0	137	95	151	122	124	118	53
GBR	146	124	0	74	214	194	154	196	65
NLD	30	92	68	0	79	65	68	70	38
USA	420	120	233	84	0	468	270	339	61
AUS	253	86	201	57	506	0	216	413	50
ZAF	140	100	154	63	283	206	0	187	53
NZL	171	89	201	62	408	456	196	0	49
CHE	29	48	62	32	61	41	47	40	0

JER

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NLD USA AUS ZAF NZL CHE

CAN	0	32	64	14	148	102	63	69	22
DFS	26	0	88	80	137	108	113	109	52
GBR	61	80	0	53	157	138	114	133	61
NLD	8	73	48	0	73	64	67	65	36
USA	137	97	167	78	0	468	270	339	61
AUS	92	70	139	56	506	0	216	412	50
ZAF	55	87	115	62	283	206	0	187	53
NZL	65	77	136	57	408	455	196	0	49
CHE	18	47	55	30	61	41	47	40	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NOR USA DEU AUS EST ZAF NZL LTU LVA NLD CAM

CAN	0	149	76	5	190	15	99	2	69	80	17	7	6	0
DFS	150	0	95	122	174	69	175	92	50	158	103	91	52	0
GBR	76	88	0	44	100	19	77	7	36	71	25	11	30	0
NOR	5	95	46	0	68	20	63	17	0	39	25	17	40	0
USA	177	170	95	70	0	29	125	18	58	109	35	15	39	21
DEU	14	58	18	19	29	0	43	25	2	22	38	29	17	0
AUS	99	149	74	53	127	42	0	25	33	135	43	28	28	10
EST	2	81	6	17	17	24	23	0	0	7	25	36	13	0
ZAF	71	47	32	0	52	2	33	0	0	32	5	1	3	0
NZL	77	153	67	38	109	21	136	6	28	0	26	13	19	10
LTU	16	98	24	22	30	35	42	25	5	24	0	36	16	0
LVA	7	59	11	15	11	23	25	28	1	10	32	0	9	0
NLD	6	51	29	40	38	17	26	12	3	18	14	8	0	0
CAM	0	0	0	0	21	0	10	0	0	10	0	0	0	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NOR USA DEU AUS EST ZAF NZL LTU LVA NLD CAM

CAN	0	67	24	3	68	8	32	0	35	30	13	4	3	0
DFS	67	0	67	124	167	69	194	92	45	156	102	92	46	0
GBR	24	62	0	41	68	16	49	5	23	50	20	9	22	0
NOR	3	96	43	0	68	20	63	17	0	39	25	17	33	0
USA	67	162	67	70	0	29	123	18	53	106	35	15	35	21
DEU	8	58	16	19	29	0	43	25	2	22	38	29	16	0
AUS	33	169	47	53	126	42	0	25	30	134	43	28	26	10
EST	0	81	5	17	17	24	23	0	0	7	25	36	12	0
ZAF	36	45	22	0	51	2	33	0	0	30	5	1	2	0

NZL	30	148	48	38	109	21	135	6	28	0	26	13	16	10
LTU	12	97	19	22	30	35	42	25	5	24	0	36	15	0
LVA	4	59	9	15	11	23	25	28	1	10	32	0	8	0
NLD	3	44	22	33	35	16	24	11	2	15	13	7	0	0
CAM	0	0	0	0	21	0	10	0	0	10	0	0	0	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

FRM	0	3	159	115	188	232	2	57	17	65	2	41
FRA	1	0	139	63	12	254	5	54	53	0	90	1
ITA	192	124	0	191	85	801	15	137	102	44	229	23
NLD	141	61	186	0	84	292	7	63	49	48	106	18
CHE	239	9	87	88	0	303	2	31	5	51	2	21
DEA	270	213	705	305	268	0	32	367	180	47	548	22
HUN	0	4	12	7	1	21	0	9	8	0	16	0
SVK	57	45	115	54	26	374	8	0	44	11	94	5
SVN	17	50	96	47	5	166	7	43	0	0	75	0
GBR	83	0	48	48	58	50	0	6	0	0	0	19
HRV	1	82	214	100	2	571	14	74	63	0	0	2
USA	56	1	29	20	20	27	0	5	0	27	2	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

FRM	0	2	154	104	0	212	2	57	17	24	2	34
FRA	1	0	86	31	1	159	3	39	34	0	58	1
ITA	188	75	0	179	0	800	15	137	102	18	229	23
NLD	126	30	174	0	0	262	7	62	46	17	96	18
CHE	0	1	0	0	0	32	0	0	0	0	0	0
DEA	257	122	705	275	28	0	32	367	180	18	548	22
HUN	0	2	12	7	0	21	0	9	8	0	16	0
SVK	57	31	115	53	0	374	8	0	44	5	94	5
SVN	17	29	96	44	0	166	7	43	0	0	75	0
GBR	32	0	22	20	0	24	0	5	0	0	0	16
HRV	1	51	214	91	0	571	14	74	63	0	0	2
USA	49	1	29	20	0	27	0	5	0	21	2	0