

Introduction

The latest international evaluation for dairy production traits took place as scheduled at the Interbull Centre. Data from thirty one (31) countries were included in this evaluation.

International genetic evaluations for milk, fat and protein yields of bulls from Australia, Austria-Germany, Belgium, Canada, 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, Argentina 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:

- 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 and have been .02 or lower.
- ZAF JER For this run we included data for ARC herds since 2012 that were previously not available. This caused some changes in averages and sds for certain birth years, especially 2004 and 2005.
- ZAF HOL Corrected error in reliability calculation
- ZAF RDC Inclusion of heterosis and recombination in the model + new calculation of reliability based on PEVs
- ISR HOL Correction of a bug in computation of production records, with respect to handling missing test day records. The correction caused decrease in information
- KOR HOL Some of the sires used for test run had been corrected afterwards using interbull pedigree info (from CAN bulls to USA bulls). And the outcomes of daughter records had been updated accordingly
- DEA BSW/SIM Base change
- POL HOL Base change
- EST HOL/RDC Decrease in number of daughters of some bulls is due to the pedigree check of cows
- SVN HOL/BSW Changes in number of information are mostly consequences of changes in data
SIM base related to the pedigree completeness as well as phenotypic data improvement.
- HRV HOL/SIM Decreasing reliability for many bulls came from changed pedigree for many animals in data base
- DEU HOL/JER Introduced new editings from test run: all cows must have data in prod+uder
RDC and all cows must have at least 2 test day records per lactation
- IRL JER MILK: change in sire std of 8% due to addition of new information, small population and previous run being april 2015
- ESP HOL Base change
- CHE BSW Introduced changes in pedigree: Each animal with unverified pedigree got a missing dam, sire or both.
- ITA SIM Base change

HUN HOL New genetic base
HUN SIM Base change
CHE HOL Change in type of proofs and publication rules
CHE SIM Change in type of proofs and publication rules
USA SIM First time in routine run.
USA BSW/GUE Changed unknown parent group definitions
HOL/JER
RDC
URY HOL Change in model from ST to MT-TD-RRM
LVA HOL/RDC Base change
PRT HOL New variance components and new heritabilities. There are minimal changes and some corrections in the pedigree and base change+ Did a major review of the data and updated our definitions of official and unofficial bulls.
SVK HOL/SIM Base change
NZL (HOL, JER) Change in parentage verification cause decrease in information

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 in the 0lx-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 dairy production traits (December Routine Evaluation 2015).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	142	118	6836	1538	601	
BEL			1061			
CAN	205	93	10767	595	733	
CHE	2878		2922			2885
CZE			3822			
DEA	5556					21966
DEU			25391	120	391	
DFS			12057	1956	7170	
ESP			3111			
EST			935		385	
FRA	343		15702			383
FRM						4202
FRR			206			
GBR	129	311	6270	822	525	88
HUN			2868			195
IRL			2077	114	34	88
ISR			1229			
ITA	1932		9145	164		1435
JPN			5081			
KOR			1073			
LTU			639		391	
LVA			890		665	
NLD	159		13972	114	55	276
NOR					3751	
NZL	45	58	6735	4354	1239	
POL			8628			
PRT			2031			
SVK			999			536
SVN	316		402			519
URY			894			
USA	992	742	33899	3908	626	35
ZAF		37	1207	647	140	
HRV			598			705
No. Records	12697	1359	181447	14332	16706	33313
Pub. Proofs	10403	1094	142110	11815	15074	30319

^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	598.59										
FRA	0.89	643.68									
USA	0.92	0.89	622.55								
CHE	0.90	0.90	0.87	480.76							
ITA	0.88	0.85	0.87	0.87	581.16						
DEA	0.87	0.85	0.86	0.93	0.90	461.81					
NLD	0.89	0.89	0.87	0.85	0.86	0.86	558.26				
SVN	0.86	0.85	0.82	0.81	0.85	0.85	0.85	10.47			
NZL	0.73	0.76	0.73	0.76	0.73	0.75	0.74	0.76	344.96		
GBR	0.86	0.87	0.85	0.86	0.85	0.85	0.87	0.86	0.73	249.27	
AUS	0.77	0.79	0.75	0.75	0.75	0.75	0.78	0.76	0.86	0.76	406.04

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	25.61										
FRA	0.90	27.59									
USA	0.91	0.90	23.37								
CHE	0.85	0.88	0.83	19.15							
ITA	0.88	0.85	0.84	0.87	22.16						
DEA	0.87	0.85	0.83	0.92	0.88	17.46					
NLD	0.89	0.88	0.87	0.84	0.85	0.87	24.51				
SVN	0.86	0.85	0.82	0.81	0.85	0.85	0.85	10.51			
NZL	0.74	0.75	0.73	0.76	0.73	0.83	0.73	0.76	15.00		
GBR	0.86	0.88	0.85	0.88	0.85	0.85	0.88	0.86	0.73	9.43	
AUS	0.76	0.78	0.74	0.73	0.75	0.75	0.76	0.77	0.85	0.75	14.94

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	21.85										
FRA	0.86	20.94									
USA	0.89	0.87	18.74								
CHE	0.86	0.86	0.82	15.10							
ITA	0.86	0.85	0.83	0.87	20.38						
DEA	0.85	0.84	0.81	0.91	0.89	14.42					
NLD	0.87	0.85	0.84	0.83	0.84	0.85	18.36				
SVN	0.86	0.85	0.82	0.81	0.85	0.85	0.85	10.37			
NZL	0.73	0.73	0.73	0.74	0.73	0.75	0.73	0.76	10.62		
GBR	0.85	0.86	0.83	0.85	0.84	0.85	0.87	0.86	0.73	7.19	
AUS	0.75	0.75	0.71	0.72	0.74	0.75	0.75	0.77	0.84	0.75	11.91

GUE mil

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	731.62					
USA	0.94	707.90				
AUS	0.85	0.80	488.67			
GBR	0.86	0.83	0.78	234.96		
ZAF	0.86	0.85	0.82	0.85	345.98	
NZL	0.73	0.73	0.86	0.73	0.74	333.24

GUE fat

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	30.09					
USA	0.94	25.33				
AUS	0.83	0.79	18.02			
GBR	0.87	0.84	0.77	10.02		
ZAF	0.84	0.81	0.76	0.85	13.59	
NZL	0.75	0.74	0.87	0.73	0.74	16.65

GUE pro

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	22.23					
USA	0.92	19.45				
AUS	0.78	0.71	14.10			
GBR	0.86	0.83	0.76	6.42		
ZAF	0.84	0.81	0.77	0.85	10.55	
NZL	0.73	0.73	0.85	0.73	0.73	11.06

HOL mil

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	LVA
BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR	HUN	POL	ZAF	JPN	
SVK	LTU	PRT	KOR	URY	HRV							
CAN	758.65											
DEU	0.91	623.68										
DFS	0.94	0.93	11.10									
FRA	0.91	0.89	0.93	668.76								
ITA	0.89	0.87	0.90	0.88	573.80							
NLD	0.92	0.92	0.94	0.91	0.86	652.67						
USA	0.94	0.90	0.93	0.92	0.91	0.91	665.10					
CHE	0.89	0.89	0.93	0.94	0.88	0.91	0.89	583.98				
GBR	0.86	0.84	0.88	0.87	0.84	0.88	0.85	0.89	267.57			
NZL	0.72	0.72	0.73	0.76	0.75	0.74	0.72	0.76	0.72	314.14		
AUS	0.82	0.78	0.79	0.84	0.76	0.82	0.81	0.84	0.79	0.86	467.58	
BEL	0.86	0.87	0.85	0.85	0.83	0.88	0.82	0.84	0.84	0.72	0.81	
476.66												
IRL	0.81	0.80	0.83	0.88	0.77	0.84	0.81	0.84	0.81	0.85	0.86	
0.80	171.12											
ESP	0.93	0.91	0.92	0.92	0.89	0.92	0.93	0.90	0.85	0.72	0.81	
0.86	0.82	548.89										
CZE	0.86	0.87	0.85	0.84	0.83	0.85	0.84	0.84	0.84	0.72	0.75	
0.84	0.74	0.85	535.27									
SVN	0.85	0.83	0.84	0.84	0.83	0.84	0.81	0.84	0.84	0.73	0.74	
0.84	0.74	0.84	0.84	11.67								
EST	0.88	0.84	0.90	0.85	0.85	0.85	0.87	0.87	0.84	0.74	0.78	
0.85	0.75	0.86	0.85	0.85	611.32							
ISR	0.80	0.81	0.82	0.82	0.83	0.82	0.85	0.82	0.82	0.79	0.75	
0.80	0.72	0.84	0.79	0.80	0.80	377.93						
FRR	0.86	0.89	0.88	0.90	0.84	0.87	0.84	0.88	0.86	0.79	0.83	
0.92	0.81	0.88	0.91	0.86	0.87	0.81	665.99					
HUN	0.86	0.85	0.89	0.88	0.90	0.85	0.90	0.85	0.84	0.72	0.75	
0.83	0.77	0.87	0.84	0.83	0.85	0.81	0.86	662.42				
POL	0.85	0.85	0.84	0.83	0.83	0.84	0.83	0.83	0.83	0.72	0.76	
0.86	0.74	0.85	0.86	0.84	0.83	0.79	0.87	0.83	429.60			
ZAF	0.85	0.83	0.83	0.84	0.83	0.83	0.84	0.83	0.83	0.72	0.83	
0.83	0.77	0.84	0.83	0.83	0.84	0.84	0.85	0.83	0.83	525.73		
JPN	0.94	0.91	0.94	0.91	0.89	0.92	0.93	0.90	0.85	0.75	0.82	
0.85	0.79	0.91	0.85	0.84	0.86	0.87	0.87	0.85	0.85	0.85	638.32	
LVA	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.83	0.83	0.72	0.72	
0.83	0.73	0.83	0.83	0.84	0.83	0.80	0.84	0.83	0.83	0.83	0.84	
447.09												
SVK	0.84	0.83	0.85	0.84	0.83	0.84	0.81	0.84	0.84	0.72	0.74	
0.84	0.76	0.84	0.84	0.85	0.85	0.81	0.86	0.85	0.83	0.83	0.84	
0.84	401.02											
LTU	0.84	0.83	0.84	0.84	0.83	0.84	0.81	0.85	0.84	0.73	0.75	
0.85	0.73	0.84	0.84	0.85	0.85	0.81	0.88	0.83	0.83	0.84	0.85	
0.83	0.85	350.27										
PRT	0.80	0.80	0.80	0.80	0.83	0.80	0.80	0.80	0.80	0.72	0.68	
0.80	0.72	0.80	0.80	0.81	0.81	0.83	0.83	0.80	0.80	0.80	0.83	
0.80	0.80	0.81	640.01									
KOR	0.85	0.83	0.84	0.84	0.83	0.84	0.83	0.84	0.84	0.72	0.77	
0.84	0.73	0.84	0.84	0.85	0.85	0.80	0.88	0.83	0.83	0.83	0.85	
0.83	0.84	0.85	0.80	467.01								
URY	0.80	0.80	0.80	0.80	0.83	0.80	0.80	0.81	0.80	0.76	0.79	
0.80	0.76	0.80	0.80	0.82	0.82	0.84	0.86	0.80	0.80	0.80	0.83	
0.81	0.81	0.82	0.80	0.80	181.51							
HRV	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.84	0.84	0.72	0.74	
0.84	0.72	0.84	0.84	0.85	0.85	0.80	0.85	0.83	0.83	0.83	0.84	
0.83	0.85	0.84	0.80	0.85	0.81	12.25						

HOL	fat											
	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	LVA
BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR	HUN	POL	ZAF	JPN	
SVK	LTU	PRT	KOR	URY	HRV							
CAN	30.59											
DEU	0.91	24.18										
DFS	0.93	0.91	11.17									
FRA	0.92	0.89	0.92	26.96								
ITA	0.90	0.86	0.86	0.88	23.49							
NLD	0.91	0.91	0.91	0.90	0.85	24.84						
USA	0.94	0.90	0.91	0.92	0.92	0.89	24.75					
CHE	0.89	0.88	0.91	0.91	0.85	0.90	0.87	23.24				
GBR	0.86	0.85	0.89	0.89	0.84	0.88	0.87	0.89	9.68			
NZL	0.72	0.72	0.72	0.74	0.75	0.72	0.72	0.74	0.72	12.68		
AUS	0.79	0.75	0.76	0.81	0.74	0.77	0.79	0.77	0.76	0.84	18.35	
BEL	0.85	0.87	0.84	0.85	0.83	0.85	0.82	0.84	0.84	0.73	0.79	
19.71												
IRL	0.79	0.77	0.82	0.85	0.75	0.82	0.79	0.82	0.79	0.85	0.84	
0.83	6.15											
ESP	0.91	0.89	0.88	0.91	0.89	0.89	0.93	0.87	0.85	0.72	0.78	
0.84	0.79	21.80										
CZE	0.87	0.87	0.85	0.84	0.84	0.84	0.85	0.84	0.84	0.72	0.74	
0.84	0.72	0.85	21.58									
SVN	0.84	0.83	0.84	0.84	0.83	0.84	0.81	0.84	0.84	0.73	0.74	
0.84	0.73	0.84	0.84	11.90								
EST	0.88	0.85	0.89	0.86	0.86	0.85	0.87	0.85	0.84	0.79	0.78	
0.87	0.83	0.85	0.85	0.85	23.23							
ISR	0.79	0.80	0.79	0.80	0.80	0.80	0.85	0.80	0.79	0.69	0.72	
0.79	0.70	0.82	0.79	0.80	0.80	14.22						
FRR	0.88	0.84	0.85	0.87	0.84	0.84	0.85	0.85	0.85	0.78	0.81	
0.90	0.80	0.88	0.90	0.86	0.88	0.81	24.88					
HUN	0.86	0.85	0.84	0.89	0.91	0.84	0.91	0.83	0.84	0.72	0.73	
0.83	0.72	0.89	0.85	0.83	0.84	0.82	0.85	24.53				
POL	0.87	0.88	0.84	0.86	0.86	0.84	0.87	0.83	0.83	0.72	0.74	
0.85	0.74	0.90	0.87	0.83	0.86	0.79	0.89	0.85	16.64			
ZAF	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.83	0.83	0.72	0.73	
0.83	0.72	0.83	0.83	0.84	0.84	0.80	0.85	0.83	0.83	17.29		
JPN	0.93	0.89	0.92	0.90	0.85	0.89	0.90	0.89	0.85	0.75	0.76	
0.85	0.78	0.86	0.85	0.84	0.88	0.78	0.85	0.84	0.85	0.84	24.29	
LVA	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.83	0.83	0.73	0.73	
0.83	0.72	0.83	0.83	0.84	0.85	0.80	0.84	0.83	0.83	0.83	0.84	
18.45												
SVK	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.85	0.84	0.72	0.74	
0.84	0.72	0.84	0.84	0.85	0.85	0.81	0.86	0.84	0.83	0.83	0.84	
0.83	15.08											
LTU	0.84	0.83	0.84	0.85	0.83	0.84	0.81	0.85	0.84	0.73	0.75	
0.85	0.73	0.84	0.84	0.86	0.85	0.81	0.89	0.83	0.83	0.84	0.85	
0.83	0.85	15.29										
PRT	0.80	0.80	0.80	0.80	0.83	0.80	0.80	0.80	0.80	0.72	0.68	
0.80	0.72	0.80	0.80	0.81	0.81	0.83	0.83	0.80	0.80	0.80	0.83	
0.80	0.80	0.81	27.90									
KOR	0.85	0.83	0.84	0.84	0.83	0.84	0.86	0.84	0.84	0.72	0.78	
0.84	0.72	0.85	0.84	0.85	0.85	0.81	0.89	0.83	0.84	0.83	0.84	
0.83	0.84	0.85	0.80	19.04								
URY	0.80	0.80	0.80	0.82	0.83	0.80	0.80	0.81	0.80	0.77	0.77	
0.81	0.78	0.80	0.80	0.82	0.86	0.84	0.88	0.80	0.80	0.80	0.83	
0.81	0.81	0.82	0.80	0.80	6.84							
HRV	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.84	0.84	0.73	0.74	
0.84	0.72	0.84	0.84	0.85	0.84	0.80	0.85	0.83	0.83	0.83	0.84	
0.83	0.85	0.84	0.80	0.85	0.81	12.85						

HOL pro

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	LVA
BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR	HUN	POL	ZAF	JPN	
SVK	LTU	PRT	KOR	URY	HRV							
CAN	20.97											
DEU	0.87	17.78										
DFS	0.92	0.92	10.77									
FRA	0.87	0.84	0.91	18.42								
ITA	0.86	0.84	0.88	0.85	17.73							
NLD	0.87	0.90	0.90	0.86	0.83	18.12						
USA	0.91	0.87	0.92	0.89	0.89	0.86	17.35					
CHE	0.85	0.85	0.90	0.91	0.85	0.85	0.85	16.99				
GBR	0.85	0.83	0.88	0.87	0.83	0.87	0.84	0.88	7.19			
NZL	0.72	0.72	0.72	0.72	0.75	0.72	0.72	0.72	0.72	9.11		
AUS	0.75	0.73	0.75	0.76	0.72	0.75	0.72	0.76	0.76	0.83	10.55	
BEL	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.84	0.84	0.72	0.74	
13.96												
IRL	0.75	0.74	0.77	0.81	0.75	0.78	0.76	0.79	0.78	0.85	0.84	
0.75	4.76											
ESP	0.89	0.86	0.90	0.88	0.86	0.87	0.90	0.86	0.85	0.72	0.75	
0.84	0.78	16.01										
CZE	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.84	0.84	0.72	0.73	
0.84	0.72	0.84	16.35									
SVN	0.84	0.83	0.84	0.84	0.83	0.84	0.81	0.85	0.84	0.73	0.74	
0.84	0.73	0.84	0.84	10.96								
EST	0.84	0.83	0.86	0.84	0.83	0.84	0.81	0.85	0.84	0.73	0.74	
0.84	0.73	0.84	0.84	0.85	18.29							
ISR	0.80	0.79	0.80	0.82	0.81	0.79	0.83	0.80	0.79	0.69	0.69	
0.80	0.69	0.82	0.79	0.81	0.81	9.85						
FRR	0.86	0.83	0.85	0.85	0.84	0.84	0.82	0.85	0.85	0.76	0.77	
0.86	0.76	0.85	0.87	0.87	0.89	0.83	18.98					
HUN	0.84	0.83	0.86	0.86	0.88	0.83	0.88	0.84	0.83	0.72	0.72	
0.83	0.72	0.84	0.83	0.83	0.83	0.81	0.85	20.42				
POL	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.83	0.83	0.72	0.72	
0.83	0.72	0.83	0.83	0.83	0.83	0.79	0.83	0.83	11.92			
ZAF	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.83	0.83	0.72	0.77	
0.83	0.72	0.83	0.83	0.84	0.84	0.83	0.87	0.83	0.83	13.64		
JPN	0.91	0.86	0.92	0.87	0.87	0.87	0.91	0.87	0.84	0.75	0.75	
0.84	0.75	0.88	0.84	0.85	0.85	0.81	0.86	0.84	0.84	0.84	17.32	
LVA	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.83	0.83	0.73	0.72	
0.83	0.73	0.83	0.83	0.84	0.83	0.80	0.85	0.83	0.83	0.83	0.84	
12.87												
SVK	0.84	0.83	0.85	0.84	0.83	0.84	0.80	0.84	0.84	0.72	0.74	
0.84	0.73	0.84	0.84	0.85	0.85	0.82	0.86	0.86	0.83	0.83	0.84	
0.84	11.24											
LTU	0.85	0.83	0.84	0.85	0.83	0.84	0.81	0.86	0.84	0.73	0.75	
0.85	0.73	0.84	0.84	0.86	0.86	0.82	0.90	0.83	0.83	0.84	0.85	
0.83	0.86	10.67										
PRT	0.80	0.80	0.80	0.80	0.83	0.80	0.80	0.80	0.80	0.72	0.68	
0.80	0.72	0.80	0.80	0.81	0.81	0.83	0.83	0.80	0.80	0.80	0.83	
0.80	0.80	0.81	20.43									
KOR	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.84	0.84	0.72	0.74	
0.84	0.72	0.84	0.84	0.85	0.85	0.81	0.90	0.83	0.83	0.83	0.84	
0.83	0.84	0.85	0.80	13.12								
URY	0.80	0.80	0.80	0.80	0.83	0.80	0.80	0.81	0.80	0.72	0.72	
0.80	0.72	0.80	0.80	0.82	0.84	0.88	0.80	0.80	0.80	0.80	0.83	
0.81	0.81	0.82	0.80	0.80	5.42							
HRV	0.84	0.83	0.84	0.84	0.83	0.84	0.80	0.84	0.84	0.73	0.74	
0.84	0.72	0.84	0.84	0.85	0.85	0.80	0.86	0.83	0.83	0.83	0.84	
0.83	0.85	0.85	0.80	0.85	0.82	11.90						

SIM		fat										
		CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR
HRV	USA											
CHE		22.41										
DEA		0.88	19.32									
FRM		0.94	0.92	24.99								
ITA		0.85	0.84	0.83	19.30							
SVN		0.85	0.84	0.86	0.83	9.16						
FRA		0.91	0.93	0.91	0.87	0.85	27.83					
HUN		0.84	0.84	0.89	0.89	0.86	0.88	14.38				
NLD		0.88	0.92	0.91	0.84	0.85	0.89	0.84	27.83			
IRL		0.76	0.74	0.77	0.74	0.75	0.85	0.72	0.79	5.43		
SVK		0.85	0.84	0.85	0.83	0.85	0.85	0.85	0.85	0.75	13.20	
GBR		0.90	0.89	0.87	0.84	0.85	0.89	0.84	0.87	0.77	0.85	11.17
HRV		0.84	0.84	0.90	0.83	0.85	0.85	0.85	0.85	0.76	0.85	0.84
10.43												
USA		0.87	0.83	0.84	0.89	0.81	0.92	0.91	0.89	0.79	0.81	0.86
0.81	23.31											

SIM		pro										
		CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR
HRV	USA											
CHE		16.57										
DEA		0.86	15.45									
FRM		0.93	0.89	19.72								
ITA		0.84	0.83	0.83	15.64							
SVN		0.86	0.84	0.87	0.83	9.21						
FRA		0.90	0.88	0.91	0.84	0.85	21.97					
HUN		0.84	0.84	0.90	0.87	0.86	0.86	11.94				
NLD		0.85	0.92	0.88	0.83	0.85	0.86	0.83	22.02			
IRL		0.77	0.73	0.77	0.73	0.75	0.81	0.72	0.76	4.76		
SVK		0.85	0.84	0.85	0.83	0.85	0.85	0.86	0.85	0.75	10.14	
GBR		0.87	0.91	0.89	0.83	0.85	0.87	0.83	0.87	0.76	0.85	8.79
HRV		0.84	0.84	0.91	0.83	0.85	0.85	0.85	0.85	0.75	0.85	0.84
10.63												
USA		0.86	0.83	0.84	0.87	0.81	0.89	0.88	0.86	0.76	0.81	0.84
0.81	15.30											

^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	75	145	106	104	113	46	22	20	64	68
FRA	67	0	114	141	163	185	75	45	17	52	46
USA	140	75	0	288	215	291	71	30	24	84	91
CHE	87	101	271	0	396	516	79	55	19	69	78
ITA	91	129	148	342	0	610	109	72	22	73	78
DEA	96	138	256	412	511	0	124	78	26	73	89
NLD	42	61	62	69	89	116	0	34	18	38	39
SVN	20	45	24	55	73	73	35	0	4	19	16
NZL	20	13	21	15	16	21	11	3	0	17	20
GBR	64	43	78	54	52	51	30	14	15	0	48
AUS	67	35	82	48	50	58	29	12	15	40	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	75	145	106	104	113	46	22	20	64	68
FRA	67	0	114	141	163	185	75	45	17	52	46
USA	140	75	0	288	215	291	71	30	24	84	91
CHE	87	101	271	0	396	516	79	55	19	69	78
ITA	91	129	148	342	0	610	109	72	22	73	78
DEA	96	138	256	412	511	0	124	78	26	73	89
NLD	42	61	62	69	89	116	0	34	18	38	39
SVN	20	45	24	55	73	73	35	0	4	19	16
NZL	20	13	21	15	16	21	11	3	0	17	20
GBR	64	43	78	54	52	51	30	14	15	0	48
AUS	67	35	82	48	50	58	29	12	15	40	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	75	145	106	104	113	46	22	20	64	68
FRA	67	0	114	141	163	185	75	45	17	52	46
USA	140	75	0	288	215	291	71	30	24	84	91
CHE	87	101	271	0	396	516	79	55	19	69	78
ITA	91	129	148	342	0	610	109	72	22	73	78
DEA	96	138	256	412	511	0	124	78	26	73	89
NLD	42	61	62	69	89	116	0	34	18	38	39
SVN	20	45	24	55	73	73	35	0	4	19	16
NZL	20	13	21	15	16	21	11	3	0	17	20
GBR	64	43	78	54	52	51	30	14	15	0	48
AUS	67	35	82	48	50	58	29	12	15	40	0

GUE

```

-----
common bulls below diagonal
common three quarter sib group above diagonal

```

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	0	61	41	28	5	14
USA	52	0	50	78	11	31
AUS	38	45	0	33	6	27
GBR	23	81	27	0	5	15
ZAF	2	8	5	4	0	5
NZL	11	29	27	13	3	0

GUE

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

CAN 0 60 41 28 4 13
USA 51 0 50 78 11 31
AUS 38 45 0 33 6 27
GBR 23 81 27 0 5 15
ZAF 2 8 5 4 0 5
NZL 11 29 27 13 3 0

GUE

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

CAN 0 60 41 28 4 13
USA 51 0 50 78 11 31
AUS 38 45 0 33 6 27
GBR 23 81 27 0 5 15
ZAF 2 8 5 4 0 5
NZL 11 29 27 13 3 0

HOL

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR
FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV							
CAN	0	1932	1053	1127	1288	1060	2471	651	1270	584	938	414	366	1016	856	136	174	78
7	737	932	424	1051	323	346	157	808	512	393	203							
DEU	1057	0	2394	2109	2221	2885	3045	951	1783	831	1245	691	641	1283	1651	218	316	121
112	1033	1803	532	1244	549	641	377	1045	492	415	468							
DFS	730	1316	0	1371	1340	1670	1676	559	1271	695	929	499	544	833	1060	178	217	111
35	736	1193	444	791	353	355	225	773	385	347	290							
FRA	628	904	592	0	1562	1607	2137	500	1285	680	953	542	537	916	1056	142	186	101
17	759	1190	417	1004	294	340	171	757	402	330	204							
ITA	741	1179	813	668	0	1445	2218	575	1293	655	898	475	477	1043	1083	176	204	102
15	824	1188	452	997	368	341	206	846	471	378	269							
NLD	858	2353	1254	842	963	0	2004	710	1415	869	1056	717	641	888	1233	179	279	115
72	785	1310	456	842	375	452	213	881	375	358	332							
USA	2306	1733	1055	979	1111	1568	0	773	1748	910	1345	524	552	1250	1379	166	261	121
20	1041	1493	573	1606	445	454	235	1072	673	564	272							
CHE	493	786	476	420	490	679	672	0	555	323	421	358	279	443	449	105	118	46
28	362	507	225	365	204	182	89	420	194	170	156							
GBR	1375	1152	835	683	826	1115	1375	500	0	769	1012	498	670	880	877	156	187	100
15	703	994	457	845	307	312	190	799	392	369	250							
NZL	582	613	459	361	439	777	835	267	638	0	913	310	530	443	522	100	108	86
5	423	525	331	462	178	215	125	474	249	280	159							
AUS	782	689	487	502	443	762	1085	313	704	832	0	408	466	624	615	115	145	74
11	505	658	384	631	229	229	144	566	299	306	186							
BEL	361	613	406	485	374	757	402	324	425	231	288	0	282	393	381	101	96	49
28	316	429	220	307	155	170	83	390	166	157	152							
IRL	289	475	382	353	333	523	424	250	605	409	327	242	0	361	371	77	95	64
4	314	404	260	311	137	153	94	349	148	188	124							
ESP	547	757	564	608	689	745	728	345	664	326	360	351	314	0	720	136	148	85
10	610	797	395	727	264	262	156	695	358	308	212							
CZE	531	1183	608	584	659	1008	967	306	547	341	293	265	232	461	0	160	205	97
29	763	1053	346	689	328	397	173	669	383	311	267							
SVN	95	196	146	90	140	147	127	73	110	70	65	78	53	98	119	0	61	32
10	120	173	78	120	79	54	38	126	72	55	75							
EST	92	216	124	78	109	200	173	67	101	56	50	60	46	69	130	38	0	41
14	147	232	81	149	139	92	58	146	82	83	86							
ISR	47	100	89	51	69	96	102	32	69	71	42	27	47	55	69	25	26	0
1	81	102	53	77	47	36	32	84	44	53	49							
FRR	3	85	22	12	14	38	10	19	10	4	7	23	4	6	21	9	13	1
0	4	74	6	2	20	19	0	9	1	1	12							
HUN	623	785	550	475	658	627	963	288	596	337	307	248	250	481	663	94	92	64
4	0	732	345	571	233	271	142	596	359	315	191							
POL	618	1385	843	617	797	1057	1188	394	712	362	332	347	272	522	780	150	160	79
78	611	0	352	729	422	352	228	794	425	334	332							
ZAF	365	402	328	279	328	381	546	182	392	272	298	174	208	351	230	55	42	39
4	292	253	0	373	135	154	81	376	228	238	119							
JPN	425	419	359	297	370	374	577	212	366	222	269	177	160	306	255	64	50	32
2	300	327	241	0	244	250	141	571	423	318	153							
LVA	174	423	226	129	230	248	362	109	184	104	96	92	78	149	226	54	93	30
16	172	328	83	107	0	137	118	304	162	143	187							
SVK	229	473	175	173	177	295	289	92	166	130	101	89	77	130	311	33	43	15
9	192	229	92	79	69	0	69	269	162	150	100							
LTU	68	358	110	39	98	107	139	30	78	54	43	30	35	63	106	17	24	14
0	79	165	28	32	90	32	0	151	95	79	104							
PRT	795	922	645	610	749	863	1077	361	706	382	362	367	287	647	536	99	100	65
9	570	784	335	319	238	183	94	0	375	331	236							
KOR	458	305	251	207	366	240	762	128	281	176	166	96	89	243	270	41	42	27
0	294	333	173	233	97	98	43	300	0	250	96							
URY	369	286	245	189	272	278	704	126	308	219	215	112	143	257	234	33	47	27
0	265	275	207	190	93	106	42	302	205	0	98							
HRV	97	478	217	115	195	289	201	102	173	88	93	125	80	163	197	59	63	34
12	143	288	81	68	155	50	72	189	41	55	0							

HOL

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR
FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV							
CAN	0	1932	1053	1127	1287	1060	2469	651	1270	584	938	414	366	1015	855	136	174	78
7 737	932	424	1049	322	346	157	808	511	393	203								
DEU	1056	0	2394	2109	2222	2885	3045	951	1783	831	1245	691	641	1283	1651	218	316	121
112 1033	1803	532	1243	549	641	377	1045	492	415	468								
DFS	729	1316	0	1371	1340	1670	1676	559	1271	695	929	499	544	833	1060	178	217	111
35 736	1193	444	790	353	355	225	773	385	347	290								
FRA	628	904	592	0	1563	1607	2137	500	1285	680	953	542	537	916	1056	142	186	101
17 759	1190	417	1003	294	340	171	757	402	330	204								
ITA	739	1182	813	669	0	1446	2219	575	1293	655	898	475	477	1043	1083	176	204	102
15 824	1188	452	995	368	341	206	846	471	378	269								
NLD	857	2353	1254	842	967	0	2004	710	1415	869	1056	717	641	888	1233	179	279	115
72 785	1310	456	841	375	452	213	881	375	358	332								
USA	2303	1733	1055	979	1114	1568	0	773	1748	910	1345	524	552	1250	1379	166	261	121
20 1041	1493	573	1604	445	454	235	1072	673	564	272								
CHE	492	786	476	420	491	679	672	0	555	323	421	358	279	443	449	105	118	46
28 362	507	225	364	204	182	89	420	194	170	156								
GBR	1374	1152	835	683	827	1115	1375	500	0	769	1012	498	670	880	877	156	187	100
15 703	994	457	844	307	312	190	799	392	369	250								
NZL	581	613	459	361	441	777	835	267	638	0	913	310	530	443	522	100	108	86
5 423	525	331	462	178	215	125	474	249	280	159								
AUS	782	689	487	502	443	762	1085	313	704	832	0	408	466	624	615	115	145	74
11 505	658	384	631	229	229	144	566	299	306	186								
BEL	361	613	406	485	374	757	402	324	425	231	288	0	282	393	381	101	96	49
28 316	429	220	307	155	170	83	390	166	157	152								
IRL	289	475	382	353	333	523	424	250	605	409	327	242	0	361	371	77	95	64
4 314	404	260	310	137	153	94	349	148	188	124								
ESP	545	757	564	608	689	745	728	345	664	326	360	351	314	0	720	136	148	85
10 610	797	395	725	264	262	156	695	358	308	212								
CZE	530	1182	607	584	659	1007	967	306	547	341	293	265	232	460	0	160	205	97
29 763	1053	346	688	328	397	173	669	383	311	267								
SVN	95	196	146	90	140	147	127	73	110	70	65	78	53	98	119	0	61	32
10 120	173	78	119	79	54	38	126	72	55	75								
EST	92	216	124	78	109	200	173	67	101	56	50	60	46	69	130	38	0	41
14 147	232	81	148	139	92	58	146	82	83	86								
ISR	47	100	89	51	69	96	102	32	69	71	42	27	47	55	69	25	26	0
1 81	102	53	77	47	36	32	84	44	53	49								
FRR	3	85	22	12	14	38	10	19	10	4	7	23	4	6	21	9	13	1
0 4	74	6	2	20	19	0	9	1	1	12								
HUN	622	785	550	475	660	627	963	288	596	337	307	248	250	481	663	94	92	64
4 0	732	345	570	233	271	142	596	359	315	191								
POL	618	1385	843	617	798	1057	1188	394	712	362	332	347	272	522	779	150	160	79
78 611	0	352	727	422	352	228	794	425	334	332								
ZAF	364	402	328	279	328	381	546	182	392	272	298	174	208	351	230	55	42	39
4 292	253	0	372	135	154	81	376	228	238	119								
JPN	424	418	358	295	368	372	572	211	364	221	268	177	159	304	254	63	49	32
2 299	325	240	0	244	249	141	570	423	317	153								
LVA	173	423	226	129	230	248	362	109	184	104	96	92	78	149	226	54	93	30
16 172	328	83	107	0	137	118	304	162	143	187								
SVK	229	473	175	173	177	295	289	92	166	130	101	89	77	130	310	33	43	15
9 192	229	92	78	69	0	69	269	162	150	100								
LTU	68	358	110	39	98	107	139	30	78	54	43	30	35	63	106	17	24	14
0 79	165	28	32	90	32	0	151	95	79	104								
PRT	795	922	646	610	749	864	1078	361	706	382	362	367	287	648	537	99	100	65
9 570	784	336	318	238	184	94	0	375	331	236								
KOR	457	305	251	207	366	240	761	128	281	176	166	96	89	243	270	41	42	27
0 294	333	173	232	97	98	43	300	0	250	96								
URY	369	286	245	189	272	278	704	126	308	219	215	112	143	257	234	33	47	27
0 265	275	207	187	93	106	42	303	205	0	98								
HRV	97	478	217	115	195	289	201	102	173	88	93	125	80	163	197	59	63	34
12 143	288	81	68	155	50	72	189	41	55	0								

HOL

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR
FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV							
CAN	0	1932	1053	1127	1287	1060	2463	651	1270	584	938	414	366	1015	855	136	174	78
7 737	932	424	1048	322	346	157	808	511	393	203								
DEU	1057	0	2394	2109	2222	2885	3041	951	1783	831	1245	691	641	1283	1651	218	316	121
112 1033	1803	532	1242	549	641	377	1045	492	415	468								
DFS	730	1316	0	1371	1340	1670	1674	559	1271	695	929	499	544	833	1060	178	217	111
35 736	1193	444	789	353	355	225	773	385	347	290								
FRA	628	904	592	0	1563	1607	2136	500	1285	680	953	542	537	916	1056	142	186	101
17 759	1190	417	1002	294	340	171	756	402	330	204								
ITA	740	1180	813	669	0	1446	2219	575	1293	655	898	475	477	1043	1083	176	204	102
15 824	1188	452	994	368	341	206	845	471	378	269								
NLD	858	2353	1254	842	964	0	2003	710	1415	869	1056	717	641	888	1233	179	279	115
72 785	1310	456	839	375	452	213	880	375	358	332								
USA	2301	1731	1055	979	1112	1568	0	773	1747	910	1342	523	552	1249	1379	166	261	121
20 1041	1493	573	1600	445	453	235	1071	674	564	272								
CHE	493	786	476	420	490	679	672	0	555	323	421	358	279	443	449	105	118	46
28 362	507	225	363	204	182	89	420	194	170	156								
GBR	1375	1152	835	683	826	1115	1375	500	0	769	1012	498	670	880	877	156	187	100
15 703	994	457	843	307	312	190	798	392	369	250								
NZL	582	613	459	361	439	777	835	267	638	0	913	310	530	443	522	100	108	86
5 423	525	331	462	178	215	125	474	249	280	159								
AUS	782	689	487	502	443	762	1085	313	704	832	0	408	466	624	615	115	145	74
11 505	658	384	630	229	229	144	566	299	306	186								
BEL	361	613	406	485	374	757	401	324	425	231	288	0	282	393	381	101	96	49
28 316	429	220	306	155	170	83	390	166	157	152								
IRL	289	475	382	353	333	523	424	250	605	409	327	242	0	361	371	77	95	64
4 314	404	260	310	137	153	94	349	148	188	124								
ESP	546	757	564	608	689	745	728	345	664	326	360	351	314	0	720	136	148	85
10 610	797	395	724	264	262	156	694	358	308	212								
CZE	530	1182	607	584	659	1007	967	306	547	341	293	265	232	460	0	160	205	97
29 763	1053	346	687	328	397	173	668	383	311	267								
SVN	95	196	146	90	140	147	127	73	110	70	65	78	53	98	119	0	61	32
10 120	173	78	118	79	54	38	126	72	55	75								
EST	92	216	124	78	109	200	173	67	101	56	50	60	46	69	130	38	0	41
14 147	232	81	146	139	92	58	146	82	83	86								
ISR	47	100	89	51	69	96	102	32	69	71	42	27	47	55	69	25	26	0
1 81	102	53	77	47	36	32	84	44	53	49								
FRR	3	85	22	12	14	38	10	19	10	4	7	23	4	6	21	9	13	1
0 4	74	6	2	20	19	0	9	1	1	12								
HUN	623	785	550	475	658	627	963	288	596	337	307	248	250	481	663	94	92	64
4 0	732	345	569	233	271	142	595	359	315	191								
POL	618	1385	843	617	797	1057	1188	394	712	362	332	347	272	522	779	150	160	79
78 611	0	352	726	422	352	228	793	425	334	332								
ZAF	365	402	328	279	328	381	546	182	392	272	298	174	208	351	230	55	42	39
4 292	253	0	372	135	154	81	376	228	238	119								
JPN	423	417	357	294	366	370	570	211	363	221	267	176	159	303	253	62	47	32
2 298	324	240	0	243	249	140	568	423	317	152								
LVA	173	423	226	129	230	248	362	109	184	104	96	92	78	149	226	54	93	30
16 172	328	83	106	0	137	118	304	162	143	187								
SVK	229	473	175	173	177	295	288	92	166	130	101	89	77	130	310	33	43	15
9 192	229	92	78	69	0	69	268	162	150	100								
LTU	68	358	110	39	98	107	139	30	78	54	43	30	35	63	106	17	24	14
0 79	165	28	32	90	32	0	151	95	79	104								
PRT	796	922	646	610	748	864	1077	361	705	382	362	367	287	647	537	99	100	65
9 570	783	336	317	238	184	94	0	374	330	236								
KOR	457	305	251	207	366	240	763	128	281	176	166	96	89	243	270	41	42	27
0 294	333	173	232	97	98	43	299	0	250	96								
URY	369	286	245	189	272	278	704	126	308	219	215	112	143	257	234	33	47	27
0 265	275	207	187	93	106	42	302	205	0	98								
HRV	97	478	217	115	195	289	201	102	173	88	93	125	80	163	197	59	63	34
12 143	288	81	67	155	50	72	189	41	55	0								

JER

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL
CAN	0	65	311	141	183	129	28	120	65	44	5
DFS	50	0	137	109	99	130	65	113	93	78	14
USA	319	110	0	302	378	195	66	247	96	76	25
NZL	155	85	379	0	344	171	56	174	81	58	68
AUS	180	65	399	386	0	163	51	189	73	48	29
GBR	126	115	207	173	153	0	65	141	100	67	32
NLD	22	63	70	49	40	58	0	57	51	41	10
ZAF	115	88	255	178	170	137	52	0	88	64	20
ITA	62	90	103	80	69	101	49	82	0	59	10
DEU	39	72	76	52	39	64	37	58	57	0	10
IRL	3	11	25	74	24	33	10	20	11	10	0

JER

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL
CAN	0	65	311	141	183	127	28	120	65	44	5
DFS	50	0	137	109	99	130	65	113	93	78	14
USA	319	110	0	302	378	193	66	247	96	76	25
NZL	155	85	379	0	344	171	56	174	81	58	68
AUS	180	65	399	386	0	161	51	189	73	48	29
GBR	126	115	207	173	153	0	65	141	100	67	32
NLD	22	63	70	49	40	58	0	57	51	41	10
ZAF	115	88	255	178	170	137	52	0	88	64	20
ITA	62	90	103	80	69	101	49	82	0	59	10
DEU	39	72	76	52	39	64	37	58	57	0	10
IRL	3	11	25	74	24	33	10	20	11	10	0

JER

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL
CAN	0	65	311	141	183	128	28	120	65	44	5
DFS	50	0	137	109	99	130	65	113	93	78	14
USA	319	110	0	302	378	194	66	247	96	76	25
NZL	155	85	379	0	344	171	56	174	81	58	68
AUS	180	65	399	386	0	162	51	189	73	48	29
GBR	126	115	207	173	153	0	65	141	100	67	32
NLD	22	63	70	49	40	58	0	57	51	41	10
ZAF	115	88	255	178	170	137	52	0	88	64	20
ITA	62	90	103	80	69	101	49	82	0	59	10
DEU	39	72	76	52	39	64	37	58	57	0	10
IRL	3	11	25	74	24	33	10	20	11	10	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
CAN	0	4	172	70	76	63	114	11	73	1	9	14	2	4
NOR	4	0	49	34	47	18	96	17	0	14	20	24	33	27
USA	155	49	0	92	92	73	138	21	61	12	19	28	13	25
NZL	70	33	91	0	114	48	146	15	35	5	14	24	3	9
AUS	76	39	93	116	0	43	134	30	33	19	32	38	6	18
GBR	61	19	66	45	43	0	52	5	35	1	9	12	7	14
DFS	111	73	137	144	112	50	0	57	50	80	110	106	8	28
DEU	10	17	21	15	29	5	48	0	2	22	31	31	3	13
ZAF	75	0	56	31	33	30	47	2	0	0	2	5	0	2
EST	1	14	11	4	18	1	69	21	0	0	44	22	0	9
LVA	9	18	17	12	30	8	78	27	2	40	0	46	2	10
LTU	13	19	22	20	34	11	90	29	5	21	42	0	2	11
IRL	2	33	13	3	5	7	6	3	0	0	2	2	0	7
NLD	4	26	23	9	16	14	27	13	2	8	9	10	6	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
CAN	0	4	172	70	76	63	114	11	73	1	9	14	2	4
NOR	4	0	49	34	47	18	97	18	0	15	21	24	33	27
USA	155	49	0	92	92	72	138	21	61	12	19	28	13	25
NZL	70	33	91	0	114	48	146	15	35	5	14	24	3	9
AUS	76	39	93	116	0	43	134	30	33	19	32	38	6	18
GBR	61	19	66	45	43	0	52	5	35	1	9	12	7	14
DFS	111	74	137	144	112	50	0	57	50	80	110	105	8	27
DEU	10	18	21	15	29	5	48	0	2	22	31	31	3	13
ZAF	75	0	56	31	33	30	47	2	0	0	2	5	0	2
EST	1	15	11	4	18	1	69	21	0	0	44	22	0	9
LVA	9	19	17	12	30	8	78	27	2	40	0	46	2	10
LTU	13	19	22	20	34	11	89	29	5	21	42	0	2	11
IRL	2	33	13	3	5	7	6	3	0	0	2	2	0	7
NLD	4	26	23	9	16	14	27	13	2	8	9	10	6	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
CAN	0	4	172	70	76	63	114	11	73	1	9	14	2	4
NOR	4	0	49	34	47	18	97	18	0	15	21	24	33	27
USA	155	49	0	92	92	72	138	21	61	12	19	28	13	25
NZL	70	33	91	0	114	48	146	15	35	5	14	24	3	9
AUS	76	39	93	116	0	43	134	30	33	19	32	38	6	18
GBR	61	19	66	45	43	0	52	5	35	1	9	12	7	14
DFS	111	74	137	144	112	50	0	57	50	80	110	105	8	27
DEU	10	18	21	15	29	5	48	0	2	22	31	31	3	13
ZAF	75	0	56	31	33	30	47	2	0	0	2	5	0	2
EST	1	15	11	4	18	1	69	21	0	0	44	22	0	9
LVA	9	19	17	12	30	8	78	27	2	40	0	46	2	10
LTU	13	19	22	20	34	11	89	29	5	21	42	0	2	11
IRL	2	33	13	3	5	7	6	3	0	0	2	2	0	7
NLD	4	26	23	9	16	14	27	13	2	8	9	10	6	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	274	157	74	6	11	2	71	48	30	53	0	17
DEA	245	0	221	716	145	187	44	191	51	333	51	419	15
FRM	205	268	0	144	17	2	3	100	62	54	69	2	22
ITA	76	622	174	0	80	105	16	137	51	124	45	187	18
SVN	6	130	17	75	0	41	9	36	1	39	0	59	0
FRA	9	147	1	95	38	0	10	41	1	43	0	69	0
HUN	1	29	1	14	7	7	0	3	1	12	0	13	0
NLD	72	200	121	133	34	41	3	0	46	48	50	69	14
IRL	45	46	67	47	1	1	1	41	0	11	36	3	12
SVK	22	340	54	105	39	37	10	40	4	0	9	72	3
GBR	61	52	88	50	0	0	0	50	32	4	0	0	17
HRV	0	440	1	176	49	62	13	66	2	55	0	0	0
USA	17	20	35	24	0	0	0	17	12	3	24	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	274	157	74	6	11	2	71	48	30	53	0	17
DEA	245	0	221	716	145	187	44	191	51	333	51	417	15
FRM	205	268	0	144	17	2	3	100	62	54	69	2	22
ITA	76	622	174	0	80	105	16	137	51	124	45	185	18
SVN	6	130	17	75	0	41	9	36	1	39	0	59	0
FRA	9	147	1	95	38	0	10	41	1	43	0	69	0
HUN	1	29	1	14	7	7	0	3	1	12	0	13	0
NLD	72	200	121	133	34	41	3	0	46	48	50	69	14
IRL	45	46	67	47	1	1	1	41	0	11	36	3	12
SVK	22	340	54	105	39	37	10	40	4	0	9	70	3
GBR	61	52	88	50	0	0	0	50	32	4	0	0	17
HRV	0	438	1	174	49	62	13	66	2	53	0	0	0
USA	17	20	35	24	0	0	0	17	12	3	24	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	274	157	74	6	11	2	71	48	30	53	0	17
DEA	245	0	221	716	145	187	44	191	51	333	51	418	15
FRM	205	268	0	144	17	2	3	100	62	54	69	2	22
ITA	76	622	174	0	80	105	16	137	51	124	45	186	18
SVN	6	130	17	75	0	41	9	36	1	39	0	59	0
FRA	9	147	1	95	38	0	10	41	1	43	0	69	0
HUN	1	29	1	14	7	7	0	3	1	12	0	13	0
NLD	72	200	121	133	34	41	3	0	46	48	50	69	14
IRL	45	46	67	47	1	1	1	41	0	11	36	3	12
SVK	22	340	54	105	39	37	10	40	4	0	9	71	3
GBR	61	52	88	50	0	0	0	50	32	4	0	0	17
HRV	0	439	1	175	49	62	13	66	2	54	0	0	0
USA	17	20	35	24	0	0	0	17	12	3	24	0	0