

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, Croatia, Czech Republic, Denmark-Finland-Sweden, Estonia, France, Hungary, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Netherlands, New Zealand, Norway, Poland, Republic of South Africa, Slovak Republic, Slovenia, Spain, Switzerland, the United Kingdom, the United States of America, Portugal, Korea, 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:

EST HOL/RDC Updates in database between two evaluation runs cause most of changes in Daughters/Herds/EDC.

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.

DEA BSW/SIM Continuous shift of the base group in each evaluation. Inclusion of CZE proofs in the SIM evaluation

HRV HOL,SIM Participating for the first time

BEL HOL Improvement in herd identification caused some bulls to be missing from previous run

ISR HOL Changes in the procedures for computation of records, exclusion of bulls with no daughters

NZL ALL Herd and daughter numbers change due to parentage verification

SVN BSW,HOL Changed time period for data inclusion. Average cut was 4 years
SIM Changed definition of genetic reference base to year 2010
Recalculated genetic parameters. Changed herd to herd-year effect.
Performed cleaning data based on genomic parentage test as a consequence the pedigree changed for some animals

USA ALL Changed in Multi trait model

ZAF HOL,JER Data since 2011/11 from ARC herds were included. As SA Holstein Society contracted SASB in 2014 as their service provider, data cleanups were done on the data as received from the Australian system, which they previously used. Changed h2 for milk.

INTERBULL CHANGES COMPARED TO THE PREVIOUS RUN

No changes made.

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 dairy production traits (December Routine Evaluation 2014).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
ARG			1313			
AUS		117	6618	1487	604	
BEL			1008			
CAN	196	91	10321	557	708	
CHE	2801		1162			3143
CHR			1867			
CZE			3667			
DEA	5415					21469
DEU			24870	116	385	
DFS			11719	1907	6983	
ESP			2910			
EST			866		362	
FRA	327		15365			366
FRM						4078
FRR			200			
GBR	117	305	6036	799	510	85
HUN			2758			190
IRL			1949	98	34	81
ISR			1170			
ITA	1881		9064	158		1367
JPN			4814			
KOR			999			
LTU			577		369	
LVA			813		651	
NLD	148		13515	109	49	255
NOR					3623	
NZL	44	58	6493	4203	1200	
POL			8078			
PRT			2227			
SVK			968			522
SVN	300		360			427
URY			787			
USA	963	723	32674	3720	593	
ZAF		37	1191	633	135	
HRV			558			692
No. Records	12192	1331	176917	13787	16206	32675
Pub. Proofs	10086	1071	138676	11381	14685	29939

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

BSW mil

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
CAN	646.67									
FRA	0.89	648.17								
USA	0.93	0.89	627.82							
CHE	0.90	0.91	0.88	474.54						
ITA	0.91	0.87	0.88	0.88	573.48					
DEA	0.86	0.86	0.86	0.93	0.90	461.16				
NLD	0.91	0.89	0.89	0.89	0.87	0.87	538.96			
SVN	0.87	0.86	0.87	0.86	0.86	0.86	0.86	10.19		
NZL	0.76	0.76	0.76	0.77	0.76	0.77	0.76	0.78	339.67	
GBR	0.86	0.87	0.86	0.88	0.86	0.86	0.89	0.87	0.76	258.78

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
CAN	27.97									
FRA	0.89	27.40								
USA	0.91	0.90	23.87							
CHE	0.87	0.89	0.86	18.89						
ITA	0.91	0.86	0.88	0.88	22.04					
DEA	0.86	0.86	0.85	0.93	0.88	17.51				
NLD	0.90	0.88	0.88	0.88	0.85	0.87	24.61			
SVN	0.87	0.86	0.87	0.86	0.86	0.86	0.86	10.20		
NZL	0.76	0.76	0.76	0.77	0.76	0.80	0.76	0.78	14.90	
GBR	0.87	0.88	0.86	0.87	0.86	0.86	0.88	0.87	0.76	10.05

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
CAN	23.19									
FRA	0.87	21.10								
USA	0.90	0.87	18.89							
CHE	0.87	0.88	0.85	14.87						
ITA	0.88	0.86	0.87	0.87	20.10					
DEA	0.86	0.85	0.85	0.91	0.89	14.42				
NLD	0.88	0.86	0.86	0.87	0.85	0.86	17.72			
SVN	0.87	0.86	0.87	0.86	0.86	0.86	0.86	10.05		
NZL	0.76	0.76	0.76	0.77	0.76	0.77	0.76	0.78	10.42	
GBR	0.86	0.87	0.85	0.87	0.86	0.86	0.88	0.87	0.76	7.60

GUE mil

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	708.42					
USA	0.94	698.53				
AUS	0.82	0.77	485.34			
GBR	0.87	0.86	0.77	236.46		
ZAF	0.86	0.86	0.80	0.86	342.78	
NZL	0.76	0.76	0.86	0.76	0.76	332.28

GUE fat

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	27.90					
USA	0.94	25.36				
AUS	0.81	0.76	17.86			
GBR	0.87	0.86	0.78	9.97		
ZAF	0.86	0.86	0.76	0.86	13.17	
NZL	0.77	0.76	0.87	0.76	0.77	16.47

GUE pro

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	21.41					
USA	0.92	19.40				
AUS	0.78	0.75	13.98			
GBR	0.86	0.85	0.76	6.33		
ZAF	0.86	0.86	0.76	0.86	10.42	
NZL	0.76	0.76	0.86	0.76	0.76	10.99

HOL mil

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	JPN
BEL	IRL	ESP	CZE	SVN	EST	ISR	CHR	FRR	HUN	POL	ZAF	
LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV					
CAN	780.95											
DEU	0.91	620.50										
DFS	0.94	0.93	11.16									
FRA	0.92	0.89	0.93	671.69								
ITA	0.91	0.88	0.90	0.89	574.25							
NLD	0.93	0.93	0.94	0.92	0.88	651.11						
USA	0.94	0.90	0.93	0.92	0.92	0.91	669.23					
CHE	0.92	0.90	0.93	0.96	0.89	0.94	0.90	557.63				
GBR	0.87	0.85	0.89	0.87	0.85	0.89	0.86	0.90	272.41			
NZL	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.75	315.40		
AUS	0.80	0.77	0.77	0.83	0.76	0.80	0.77	0.85	0.78	0.85	468.92	
BEL	0.86	0.87	0.85	0.85	0.85	0.88	0.85	0.85	0.85	0.75	0.79	
478.18												
IRL	0.85	0.82	0.85	0.91	0.80	0.87	0.82	0.88	0.82	0.85	0.86	
0.83	169.44											
ESP	0.93	0.91	0.92	0.92	0.90	0.92	0.92	0.92	0.85	0.75	0.80	
0.87	0.85	544.63										
CZE	0.85	0.87	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.76	0.85	531.29									
SVN	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.76	
0.85	0.76	0.85	0.85	11.88								
EST	0.86	0.85	0.90	0.85	0.86	0.85	0.86	0.86	0.85	0.76	0.76	
0.86	0.77	0.86	0.85	0.86	683.37							
ISR	0.79	0.79	0.80	0.80	0.83	0.81	0.81	0.79	0.75	0.75	0.76	
0.75	0.76	0.83	0.76	0.77	0.78	377.98						
CHR	0.90	0.89	0.91	0.93	0.88	0.91	0.89	0.98	0.87	0.75	0.82	
0.85	0.86	0.89	0.85	0.86	0.87	0.79	526.89					
FRR	0.87	0.90	0.89	0.90	0.86	0.87	0.86	0.90	0.87	0.79	0.82	
0.90	0.81	0.88	0.92	0.87	0.87	0.78	0.89	679.55				
HUN	0.86	0.85	0.88	0.88	0.90	0.86	0.90	0.85	0.85	0.75	0.75	
0.85	0.77	0.87	0.85	0.86	0.86	0.79	0.85	0.87	643.16			
POL	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75
0.85	0.75	0.85	0.85	0.85	0.85	0.76	0.85	0.87	0.85	440.06		
ZAF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.82	
0.85	0.80	0.85	0.85	0.85	0.86	0.82	0.85	0.87	0.85	0.85	525.17	
JPN	0.91	0.88	0.91	0.88	0.87	0.89	0.91	0.89	0.85	0.75	0.78	
0.85	0.82	0.89	0.85	0.86	0.86	0.85	0.89	0.87	0.85	0.85	0.85	
783.76												
LVA	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.76	
0.85	0.76	0.85	0.85	0.86	0.86	0.76	0.86	0.87	0.85	0.85	0.86	
0.85	422.41											
SVK	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.75	
0.85	0.77	0.85	0.85	0.86	0.86	0.78	0.86	0.87	0.86	0.85	0.85	
0.85	0.86	404.68										
LTU	0.86	0.85	0.86	0.85	0.85	0.85	0.85	0.87	0.85	0.76	0.76	
0.86	0.76	0.85	0.86	0.86	0.87	0.77	0.87	0.90	0.86	0.85	0.86	
0.86	0.86	0.86	348.29									
PRT	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.85	0.86	0.76	0.85	0.86	0.85	0.85	0.85	
0.85	0.85	0.85	0.85	632.55								
KOR	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.76	
0.85	0.77	0.85	0.85	0.86	0.86	0.77	0.86	0.90	0.85	0.85	0.85	
0.85	0.86	0.86	0.86	0.85	471.71							
URY	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.76	0.78	
0.85	0.77	0.85	0.85	0.86	0.86	0.76	0.86	0.90	0.85	0.85	0.85	
0.85	0.86	0.86	0.86	0.85	0.85	160.40						
ARG	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.76	
0.85	0.76	0.85	0.85	0.86	0.86	0.76	0.86	0.90	0.85	0.85	0.85	
0.85	0.86	0.86	0.86	0.85	0.85	0.85	181.01					
HRV	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.75	
0.85	0.76	0.85	0.85	0.86	0.86	0.76	0.85	0.86	0.85	0.85	0.85	
0.85	0.85	0.86	0.86	0.85	0.86	0.86	0.86	12.51				

HOL	fat											
	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	JPN
BEL	IRL	ESP	CZE	SVN	EST	ISR	CHR	FRR	HUN	POL	ZAF	
LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV					
CAN	30.46											
DEU	0.91	24.15										
DFS	0.93	0.91	11.24									
FRA	0.93	0.89	0.92	27.05								
ITA	0.91	0.86	0.86	0.88	23.46							
NLD	0.91	0.92	0.91	0.90	0.85	24.74						
USA	0.94	0.89	0.91	0.92	0.92	0.89	24.83					
CHE	0.91	0.89	0.93	0.92	0.85	0.91	0.89	21.31				
GBR	0.87	0.86	0.88	0.89	0.85	0.89	0.87	0.88	9.86			
NZL	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	12.71		
AUS	0.77	0.75	0.76	0.81	0.75	0.76	0.76	0.78	0.76	0.85	18.42	
BEL	0.85	0.87	0.85	0.85	0.85	0.86	0.85	0.85	0.85	0.75	0.78	
19.86												
IRL	0.81	0.77	0.83	0.87	0.75	0.84	0.79	0.83	0.78	0.85	0.85	
0.85	6.10											
ESP	0.92	0.90	0.88	0.91	0.90	0.89	0.92	0.89	0.85	0.75	0.77	
0.85	0.80	21.74										
CZE	0.87	0.87	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.86	21.43									
SVN	0.86	0.85	0.85	0.86	0.85	0.85	0.86	0.86	0.85	0.76	0.76	
0.86	0.76	0.85	0.86	12.49								
EST	0.87	0.86	0.91	0.87	0.86	0.86	0.87	0.86	0.86	0.78	0.79	
0.86	0.82	0.86	0.86	0.87	24.94							
ISR	0.76	0.77	0.76	0.79	0.77	0.78	0.84	0.77	0.76	0.76	0.76	
0.76	0.76	0.82	0.76	0.77	0.77	14.34						
CHR	0.88	0.88	0.90	0.91	0.85	0.89	0.88	0.97	0.87	0.75	0.76	
0.85	0.82	0.85	0.85	0.86	0.87	0.77	21.51					
FRR	0.88	0.86	0.86	0.88	0.86	0.86	0.87	0.87	0.86	0.79	0.81	
0.90	0.79	0.89	0.90	0.88	0.88	0.79	0.86	24.86				
HUN	0.87	0.86	0.85	0.89	0.91	0.85	0.92	0.85	0.85	0.75	0.75	
0.85	0.75	0.89	0.85	0.86	0.86	0.80	0.85	0.88	23.22			
POL	0.87	0.87	0.85	0.86	0.86	0.85	0.86	0.85	0.85	0.75	0.75	
0.85	0.75	0.90	0.87	0.86	0.86	0.76	0.85	0.88	0.85	16.61		
ZAF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.86	0.86	0.76	0.85	0.89	0.85	0.85	18.21	
JPN	0.91	0.87	0.91	0.88	0.85	0.87	0.89	0.89	0.85	0.75	0.75	
0.85	0.80	0.85	0.85	0.86	0.87	0.76	0.89	0.87	0.85	0.85	0.85	
27.22												
LVA	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.76	
0.86	0.76	0.85	0.85	0.86	0.86	0.77	0.86	0.87	0.85	0.85	0.86	
0.86	18.19											
SVK	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.76	
0.85	0.76	0.85	0.85	0.87	0.86	0.78	0.86	0.88	0.85	0.85	0.86	
0.86	0.86	15.16										
LTU	0.86	0.85	0.86	0.86	0.86	0.86	0.86	0.87	0.86	0.76	0.76	
0.86	0.76	0.85	0.86	0.87	0.87	0.78	0.88	0.92	0.86	0.85	0.87	
0.87	0.86	0.87	14.36									
PRT	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.86	0.86	0.76	0.85	0.87	0.85	0.85	0.85	
0.85	0.85	0.85	0.86	25.95								
KOR	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.77	
0.86	0.75	0.85	0.85	0.87	0.87	0.77	0.86	0.91	0.85	0.85	0.85	
0.85	0.86	0.86	0.87	0.85	19.02							
URY	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.79	
0.85	0.78	0.85	0.85	0.87	0.87	0.77	0.86	0.90	0.85	0.85	0.85	
0.85	0.86	0.86	0.87	0.85	0.85	6.18						
ARG	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.87	0.86	0.77	0.86	0.91	0.85	0.85	0.85	
0.85	0.86	0.86	0.86	0.85	0.85	0.85	5.92					
HRV	0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.76	
0.85	0.76	0.85	0.85	0.86	0.86	0.77	0.86	0.87	0.85	0.85	0.86	
0.86	0.85	0.86	0.86	0.85	0.86	0.87	0.86	12.79				

HOL	pro											
	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	JPN
BEL	IRL	ESP	CZE	SVN	EST	ISR	CHR	FRR	HUN	POL	ZAF	
LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV					
CAN	21.71											
DEU	0.88	17.82										
DFS	0.92	0.92	10.83									
FRA	0.89	0.85	0.91	18.50								
ITA	0.88	0.85	0.89	0.86	17.75							
NLD	0.90	0.90	0.90	0.86	0.85	18.02						
USA	0.91	0.87	0.92	0.89	0.90	0.86	17.52					
CHE	0.89	0.86	0.91	0.93	0.86	0.89	0.86	15.62				
GBR	0.86	0.85	0.89	0.87	0.85	0.89	0.85	0.88	7.27			
NZL	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	9.15		
AUS	0.75	0.75	0.75	0.76	0.75	0.75	0.75	0.79	0.76	0.85	10.63	
BEL	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
14.02												
IRL	0.76	0.75	0.78	0.84	0.75	0.80	0.75	0.81	0.79	0.85	0.85	
0.76	4.70											
ESP	0.90	0.86	0.90	0.88	0.87	0.87	0.89	0.87	0.85	0.75	0.75	
0.85	0.79	15.84										
CZE	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	16.27									
SVN	0.86	0.85	0.85	0.86	0.85	0.85	0.86	0.86	0.86	0.76	0.76	
0.86	0.76	0.85	0.86	11.27								
EST	0.86	0.85	0.88	0.86	0.86	0.85	0.85	0.86	0.86	0.76	0.76	
0.86	0.76	0.86	0.86	0.87	20.71							
ISR	0.76	0.76	0.77	0.82	0.79	0.77	0.80	0.77	0.76	0.76	0.76	
0.76	0.76	0.82	0.76	0.77	0.77	9.84						
CHR	0.86	0.85	0.89	0.91	0.85	0.86	0.85	0.97	0.87	0.75	0.76	
0.85	0.78	0.85	0.85	0.86	0.88	0.77	14.60					
FRR	0.87	0.85	0.86	0.86	0.86	0.86	0.87	0.87	0.86	0.78	0.78	
0.86	0.77	0.86	0.87	0.88	0.89	0.79	0.86	19.29				
HUN	0.85	0.85	0.86	0.86	0.88	0.85	0.88	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.86	0.86	0.78	0.85	0.88	19.56			
POL	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.86	0.86	0.76	0.85	0.86	0.85	11.74		
ZAF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.77	
0.85	0.75	0.85	0.85	0.86	0.86	0.82	0.85	0.89	0.85	0.85	14.39	
JPN	0.89	0.86	0.89	0.86	0.86	0.87	0.89	0.87	0.85	0.75	0.75	
0.85	0.75	0.86	0.85	0.86	0.86	0.80	0.87	0.88	0.85	0.85	0.85	
21.40												
LVA	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.76	
0.86	0.76	0.85	0.85	0.86	0.86	0.77	0.86	0.87	0.85	0.85	0.86	
0.86	12.51											
SVK	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.76	
0.85	0.76	0.85	0.85	0.87	0.87	0.78	0.86	0.88	0.86	0.85	0.86	
0.86	0.86	11.38										
LTU	0.86	0.85	0.86	0.86	0.86	0.86	0.86	0.87	0.86	0.76	0.76	
0.86	0.76	0.85	0.86	0.87	0.87	0.78	0.88	0.91	0.86	0.85	0.87	
0.87	0.86	0.87	10.39									
PRT	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.86	0.86	0.76	0.85	0.87	0.85	0.85	0.85	
0.85	0.85	0.85	0.86	20.19								
KOR	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.75	
0.86	0.76	0.85	0.85	0.87	0.87	0.78	0.86	0.91	0.85	0.85	0.85	
0.85	0.86	0.86	0.87	0.85	13.22							
URY	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.75	
0.86	0.76	0.85	0.86	0.87	0.88	0.78	0.86	0.91	0.85	0.86	0.85	
0.85	0.87	0.86	0.87	0.85	0.86	4.76						
ARG	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.75	
0.85	0.75	0.85	0.85	0.87	0.87	0.77	0.86	0.91	0.85	0.85	0.85	
0.85	0.86	0.86	0.86	0.85	0.85	0.85	5.40					
HRV	0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.76	
0.85	0.76	0.85	0.85	0.86	0.86	0.77	0.86	0.87	0.85	0.85	0.86	
0.86	0.85	0.86	0.86	0.85	0.86	0.87	0.86	11.82				

SIM		fat									
	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR
HRV											
CHE	20.97										
DEA	0.87	19.33									
FRM	0.94	0.93	25.11								
ITA	0.86	0.85	0.85	19.01							
SVN	0.88	0.86	0.88	0.86	8.85						
FRA	0.91	0.93	0.92	0.89	0.86	27.95					
HUN	0.86	0.86	0.91	0.90	0.88	0.89	13.31				
NLD	0.88	0.92	0.91	0.85	0.87	0.89	0.85	27.56			
IRL	0.78	0.76	0.76	0.76	0.77	0.86	0.75	0.79	5.39		
SVK	0.87	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.77	13.30	
GBR	0.91	0.88	0.89	0.86	0.86	0.88	0.85	0.88	0.78	0.86	11.39
HRV	0.87	0.85	0.91	0.85	0.86	0.86	0.87	0.86	0.77	0.86	0.86
	10.77										

SIM		pro									
	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR
HRV											
CHE	14.81										
DEA	0.86	15.50									
FRM	0.94	0.90	19.84								
ITA	0.86	0.85	0.85	15.27							
SVN	0.88	0.86	0.88	0.86	9.00						
FRA	0.92	0.89	0.91	0.86	0.86	22.11					
HUN	0.86	0.86	0.91	0.88	0.88	0.87	10.58				
NLD	0.88	0.92	0.89	0.85	0.87	0.87	0.85	21.96			
IRL	0.78	0.76	0.77	0.76	0.77	0.83	0.75	0.78	4.70		
SVK	0.87	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.77	10.21	
GBR	0.90	0.90	0.88	0.86	0.86	0.87	0.85	0.88	0.78	0.86	8.91
HRV	0.87	0.85	0.91	0.85	0.86	0.86	0.87	0.86	0.77	0.86	0.86
	10.83										

^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
CAN	0	73	140	100	98	110	44	22	20	61
FRA	65	0	114	133	156	175	70	40	17	47
USA	135	75	0	280	210	286	65	28	24	81
CHE	83	96	262	0	385	499	70	51	18	64
ITA	86	124	146	330	0	590	99	66	21	67
DEA	91	132	252	395	490	0	113	72	26	68
NLD	40	57	59	65	82	108	0	31	18	31
SVN	20	40	23	51	67	66	31	0	4	16
NZL	20	13	21	15	16	21	11	3	0	17
GBR	62	40	75	50	49	47	26	12	15	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
CAN	0	73	140	100	98	110	44	22	20	61
FRA	65	0	114	133	156	175	70	40	17	47
USA	135	75	0	280	210	286	65	28	24	81
CHE	83	96	262	0	385	499	70	51	18	64
ITA	86	124	146	330	0	590	99	66	21	67
DEA	91	132	252	395	490	0	113	72	26	68
NLD	40	57	59	65	82	108	0	31	18	31
SVN	20	40	23	51	67	66	31	0	4	16
NZL	20	13	21	15	16	21	11	3	0	17
GBR	62	40	75	50	49	47	26	12	15	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
CAN	0	73	140	100	98	110	44	22	20	61
FRA	65	0	114	133	156	175	70	40	17	47
USA	135	75	0	280	210	286	65	28	24	81
CHE	83	96	262	0	385	499	70	51	18	64
ITA	86	124	146	330	0	590	99	66	21	67
DEA	91	132	252	395	490	0	113	72	26	68
NLD	40	57	59	65	82	108	0	31	18	31
SVN	20	40	23	51	67	66	31	0	4	16
NZL	20	13	21	15	16	21	11	3	0	17
GBR	62	40	75	50	49	47	26	12	15	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	0	60	42	28	4	13
USA	51	0	50	75	11	31
AUS	38	45	0	34	6	27
GBR	23	78	26	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	42	28	4	13
USA	51	0	50	75	11	31
AUS	38	45	0	34	6	27
GBR	23	78	26	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	42	28	4	13
USA	51	0	50	75	11	31
AUS	38	45	0	34	6	27
GBR	23	78	26	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

CHR	FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV	ESP	CZE	SVN	EST	ISR	
CAN		0	1852	992	1064	1247	999	2341	425	1210	562	893	387	342	965	802	114	153	73
350	7	680	839	413	980	292	329	135	803	473	335	498	179						
DEU	949	0	2314	2043	2188	2786	2950	530	1714	807	1199	656	614	1233	1582	190	294	115	
576	111	983	1659	523	1181	509	616	334	1096	457	354	529	436						
DFS	633	1201	0	1332	1312	1592	1610	368	1213	675	896	466	520	792	1002	158	194	104	
317	34	702	1104	436	735	329	337	199	817	362	297	409	266						
FRA	552	842	542	0	1544	1555	2077	355	1251	658	919	513	513	868	1000	120	166	94	
263	14	717	1109	411	955	265	322	149	791	377	286	394	184						
ITA	665	1124	762	632	0	1407	2183	368	1253	640	874	450	451	994	1028	158	185	98	
320	14	784	1106	446	944	334	331	178	873	442	325	462	246						
NLD	770	2231	1156	771	922	0	1945	391	1348	841	1019	684	606	846	1170	159	259	111	
464	71	744	1215	450	792	344	432	187	931	354	306	416	309						
USA	2080	1621	968	916	1057	1479	0	456	1679	887	1295	500	528	1192	1319	145	240	116	
453	20	982	1366	564	1528	407	439	206	1096	630	485	750	244						
CHE	295	432	308	319	294	374	362	0	387	233	297	248	214	325	291	63	57	35	
377	8	244	305	185	251	120	104	58	318	149	125	168	106						
GBR	1282	1073	770	642	773	1039	1284	345	0	742	964	470	638	839	827	136	166	94	
295	14	670	918	446	787	282	298	167	831	368	316	427	231						
NZL	547	577	429	336	417	737	804	204	605	0	885	291	491	428	505	86	98	80	
183	5	397	488	324	435	162	207	111	499	233	237	275	147						
AUS	708	633	448	467	409	717	1002	228	646	796	0	386	444	596	590	103	132	70	
240	11	475	610	376	589	211	219	129	579	281	267	338	171						
BEL	329	566	371	452	343	714	377	227	394	216	265	0	262	365	358	87	85	47	
246	27	292	393	212	275	143	157	72	392	151	131	170	141						
IRL	262	442	357	328	307	482	397	199	569	371	303	226	0	345	351	69	85	61	
168	4	293	373	251	286	126	146	84	363	136	162	185	116						
ESP	489	725	537	574	662	710	689	268	633	308	337	326	301	0	685	120	129	81	
243	10	575	739	385	678	240	250	144	704	332	261	367	197						
CZE	477	1123	560	540	623	945	912	197	509	326	276	248	219	444	0	137	184	92	
252	28	721	974	339	641	300	376	154	678	359	256	356	247						
SVN	81	167	133	79	129	134	113	44	97	61	60	70	48	89	106	0	55	31	
63	10	100	146	73	101	69	51	31	119	61	45	63	67						
EST	80	198	110	67	94	184	150	26	90	51	41	50	38	61	112	34	0	38	
64	13	133	209	78	127	121	87	47	145	70	70	77	77						
ISR	42	95	83	49	66	91	96	24	66	68	41	27	44	54	67	24	26	0	
21	1	77	93	53	72	44	34	28	89	42	39	42	44						
CHR	286	493	270	241	269	430	425	410	264	150	186	226	146	196	175	45	36	9	
0	27	199	281	137	180	126	124	42	255	111	95	122	99						
FRR	3	85	21	9	13	38	10	7	10	4	7	22	4	6	20	9	12	1	
18	0	4	67	6	2	19	18	0	13	1	1	0	12						
HUN	559	746	518	452	623	597	900	193	566	317	285	229	238	456	629	82	80	62	
159	4	0	677	333	524	208	258	128	597	332	273	369	173						
POL	533	1218	762	545	732	958	1053	224	638	327	296	314	248	491	721	128	138	73	
229	61	565	0	340	655	382	324	193	792	384	264	395	304						
ZAF	346	392	318	272	323	375	534	161	382	267	287	168	205	342	223	53	39	39	
113	4	283	242	0	356	127	151	74	395	219	213	271	115						
JPN	362	368	311	263	330	328	510	141	310	191	218	145	131	271	231	52	39	29	
119	2	276	285	223	0	218	238	120	564	387	273	403	134						
LVA	158	391	213	117	210	233	326	63	169	90	88	83	73	137	206	46	84	28	
78	16	154	302	77	93	0	121	103	292	141	107	159	167						
SVK	212	455	165	157	166	280	275	55	158	125	93	83	75	122	293	33	41	13	
64	8	182	201	89	73	61	0	61	263	152	130	149	92						
LTU	54	316	98	31	88	90	114	17	66	46	36	24	31	59	91	15	16	13	
14	0	69	130	24	24	81	29	0	142	81	61	86	86						
PRT	810	1030	715	685	802	973	1141	289	786	432	390	382	333	724	573	100	97	74	
237	13	592	787	379	308	235	194	90	0	368	303	444	234						
KOR	412	280	231	186	333	219	710	91	256	161	152	85	82	225	256	33	35	25	
71	0	270	297	169	203	84	91	38	310	0	214	301	80						
URY	318	243	211	163	234	239	612	93	264	187	186	94	123	224	193	27	38	20	
74	0	229	211	186	149	64	94	31	291	176	0	299	71						
ARG	417	306	250	197	306	277	821	109	314	180	189	104	115	281	240	30	42	21	
77	0	292	303	249	205	112	86	37	421	258	310	0	112						
HRV	89	445	202	99	182	276	183	72	168	87	91	119	78	153	189	57	58	34	
70	12	131	259	82	64	150	48	62	200	37	33	68	0						

HOL

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

CHR	FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV	ESP	CZE	SVN	EST	ISR	
CAN		0	1852	992	1064	1247	999	2339	426	1210	562	893	387	342	965	802	114	153	73
350	7	679	839	413	979	292	329	135	803	472	335	498	179						
DEU	949	0	2314	2043	2189	2786	2950	531	1714	807	1199	656	614	1233	1582	190	294	115	
576	111	983	1659	523	1181	509	616	334	1096	457	354	529	436						
DFS	633	1201	0	1332	1313	1592	1610	369	1213	675	896	466	520	792	1002	158	194	104	
317	34	702	1104	436	735	329	337	199	817	362	297	409	266						
FRA	552	842	542	0	1545	1555	2077	356	1251	658	919	513	513	868	1000	120	166	94	
263	14	717	1109	411	955	265	322	149	791	377	286	394	184						
ITA	665	1125	762	632	0	1408	2183	369	1254	640	874	451	452	994	1029	158	185	98	
320	14	784	1107	446	944	334	332	178	874	442	325	462	246						
NLD	770	2231	1156	771	923	0	1945	392	1348	841	1019	684	606	846	1170	159	259	111	
464	71	744	1215	450	792	344	432	187	931	354	306	416	309						
USA	2078	1621	968	916	1057	1479	0	457	1679	887	1295	500	528	1192	1319	145	240	116	
453	20	982	1366	564	1528	407	439	206	1096	630	485	750	244						
CHE	296	433	309	320	295	375	363	0	388	233	297	248	215	326	292	63	58	35	
378	8	245	306	185	252	120	104	58	319	149	125	168	106						
GBR	1282	1073	770	642	774	1039	1284	346	0	742	964	470	638	839	827	136	166	94	
295	14	670	918	446	787	282	298	167	831	368	316	427	231						
NZL	547	577	429	336	417	737	804	204	605	0	885	291	491	428	505	86	98	80	
183	5	397	488	324	435	162	207	111	499	233	237	275	147						
AUS	708	633	448	467	409	717	1002	228	646	796	0	386	444	596	590	103	132	70	
240	11	475	610	376	589	211	219	129	579	281	267	338	171						
BEL	329	566	371	452	344	714	377	227	394	216	265	0	262	365	358	87	85	47	
246	27	292	393	212	275	143	157	72	392	151	131	170	141						
IRL	262	442	357	328	308	482	397	200	569	371	303	226	0	345	351	69	85	61	
168	4	293	373	251	286	126	146	84	363	136	162	185	116						
ESP	489	725	537	574	662	710	689	269	633	308	337	326	301	0	685	120	129	81	
243	10	575	739	385	678	240	250	144	704	332	261	367	197						
CZE	477	1122	559	540	624	944	912	198	509	326	276	248	219	443	0	137	184	92	
252	28	721	974	339	641	300	376	154	678	359	256	356	247						
SVN	81	167	133	79	129	134	113	44	97	61	60	70	48	89	106	0	55	31	
63	10	100	146	73	101	69	51	31	119	61	45	63	67						
EST	80	198	110	67	94	184	150	27	90	51	41	50	38	61	112	34	0	38	
64	13	133	209	78	127	121	87	47	145	70	70	77	77						
ISR	42	95	83	49	66	91	96	24	66	68	41	27	44	54	67	24	26	0	
21	1	77	93	53	72	44	34	28	89	42	39	42	44						
CHR	286	493	270	241	269	430	425	411	264	150	186	226	146	196	175	45	36	9	
0	27	199	281	137	180	126	124	42	255	111	95	122	99						
FRR	3	85	21	9	13	38	10	7	10	4	7	22	4	6	20	9	12	1	
18	0	4	67	6	2	19	18	0	13	1	1	0	12						
HUN	558	746	518	452	623	597	900	194	566	317	285	229	238	456	629	82	80	62	
159	4	0	677	333	524	208	258	128	597	332	273	369	173						
POL	533	1218	762	545	733	958	1053	225	638	327	296	314	248	491	720	128	138	73	
229	61	565	0	340	655	382	324	193	792	384	264	395	304						
ZAF	346	392	318	272	323	375	534	161	382	267	287	168	205	342	223	53	39	39	
113	4	283	242	0	356	127	151	74	395	219	213	271	115						
JPN	361	368	311	263	330	328	510	142	310	191	218	145	131	271	231	52	39	29	
119	2	276	285	223	0	218	238	120	564	387	273	403	134						
LVA	158	391	213	117	210	233	326	63	169	90	88	83	73	137	206	46	84	28	
78	16	154	302	77	93	0	121	103	292	141	107	159	167						
SVK	212	455	165	157	167	280	275	55	158	125	93	83	75	122	292	33	41	13	
64	8	182	201	89	73	61	0	61	263	152	130	149	92						
LTU	54	316	98	31	88	90	114	17	66	46	36	24	31	59	91	15	16	13	
14	0	69	130	24	24	81	29	0	142	81	61	86	86						
PRT	810	1030	715	685	803	973	1141	290	786	432	390	382	333	724	572	100	97	74	
237	13	592	787	379	308	235	194	90	0	368	303	444	234						
KOR	411	280	231	186	332	219	708	91	256	161	152	85	82	225	256	32	35	25	
71	0	270	296	169	203	84	91	38	310	0	214	301	80						
URY	318	243	211	163	234	239	612	93	264	187	186	94	123	224	193	27	38	20	
74	0	229	211	186	149	64	94	31	291	176	0	299	71						
ARG	417	306	250	197	306	277	821	109	314	180	189	104	115	281	240	30	42	21	
77	0	292	303	249	205	112	86	37	421	257	310	0	112						
HRV	89	445	202	99	182	276	183	72	168	87	91	119	78	153	189	57	58	34	
70	12	131	259	82	64	150	48	62	200	37	33	68	0						

HOL

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

CHR	FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV	ESP	CZE	SVN	EST	ISR	
CAN		0	1852	992	1064	1247	999	2334	424	1210	562	893	387	342	965	802	114	153	73
350	7	680	839	413	978	292	329	135	802	472	206	498	179						
DEU	949	0	2314	2043	2188	2786	2946	529	1714	807	1199	656	614	1233	1581	190	294	115	
576	111	983	1659	523	1179	509	616	334	1095	457	210	529	436						
DFS	633	1201	0	1332	1312	1592	1608	368	1213	675	896	466	520	792	1002	158	194	104	
317	34	702	1104	436	734	329	337	199	817	362	172	409	266						
FRA	552	842	542	0	1544	1555	2076	354	1251	658	919	513	513	868	1000	120	166	94	
263	14	717	1109	411	954	265	322	149	791	377	172	394	184						
ITA	665	1124	762	632	0	1407	2183	367	1253	640	874	450	451	994	1028	158	185	98	
320	14	784	1106	446	943	334	331	178	872	442	189	462	246						
NLD	770	2231	1156	771	922	0	1944	390	1348	841	1019	684	606	846	1170	159	259	111	
464	71	744	1215	450	791	344	432	187	931	354	175	416	309						
USA	2076	1619	968	916	1057	1479	0	455	1678	887	1292	499	528	1191	1319	145	240	116	
453	20	982	1366	564	1524	407	438	206	1095	631	254	749	244						
CHE	293	430	307	317	292	372	360	0	386	233	296	247	214	324	291	63	57	35	
376	8	244	305	185	251	120	103	58	317	148	82	168	106						
GBR	1282	1073	770	642	773	1039	1284	343	0	742	964	470	638	839	827	136	166	94	
295	14	670	918	446	786	282	298	167	831	368	181	427	231						
NZL	547	577	429	336	417	737	804	204	605	0	885	291	491	428	505	86	98	80	
183	5	397	488	324	434	162	207	111	499	233	136	275	147						
AUS	708	633	448	467	409	717	1002	226	646	796	0	386	444	596	590	103	132	70	
240	11	475	610	376	588	211	219	129	579	281	155	338	171						
BEL	329	566	371	452	343	714	376	225	394	216	265	0	262	365	358	87	85	47	
246	27	292	393	212	274	143	157	72	392	151	87	170	141						
IRL	262	442	357	328	307	482	397	198	569	371	303	226	0	345	351	69	85	61	
168	4	293	373	251	285	126	146	84	363	136	102	185	116						
ESP	489	725	537	574	662	710	689	266	633	308	337	326	301	0	685	120	129	81	
243	10	575	739	385	677	240	250	144	704	332	152	367	197						
CZE	477	1122	559	540	623	944	912	196	509	326	276	248	219	443	0	137	184	92	
252	28	721	974	339	641	300	376	154	678	359	142	356	247						
SVN	81	167	133	79	129	134	113	44	97	61	60	70	48	89	106	0	55	31	
63	10	100	146	73	101	69	51	31	119	61	27	63	67						
EST	80	198	110	67	94	184	150	26	90	51	41	50	38	61	112	34	0	38	
64	13	133	209	78	127	121	87	47	145	70	39	77	77						
ISR	42	95	83	49	66	91	96	24	66	68	41	27	44	54	67	24	26	0	
21	1	77	93	53	72	44	34	28	89	42	22	42	44						
CHR	286	493	270	241	269	430	425	408	264	150	186	226	146	196	175	45	36	9	
0	27	199	281	137	179	126	124	42	255	111	61	122	99						
FRR	3	85	21	9	13	38	10	7	10	4	7	22	4	6	20	9	12	1	
18	0	4	67	6	2	19	18	0	13	1	0	0	12						
HUN	559	746	518	452	623	597	900	192	566	317	285	229	238	456	629	82	80	62	
159	4	0	677	333	523	208	258	128	597	332	162	369	173						
POL	533	1218	762	545	732	958	1053	223	638	327	296	314	248	491	720	128	138	73	
229	61	565	0	340	655	382	324	193	792	384	149	395	304						
ZAF	346	392	318	272	323	375	534	160	382	267	287	168	205	342	223	53	39	39	
113	4	283	242	0	355	127	151	74	395	219	136	271	115						
JPN	360	367	310	263	330	328	509	141	309	190	218	145	131	271	231	52	39	29	
119	2	276	285	223	0	218	238	120	564	387	164	403	134						
LVA	158	391	213	117	210	233	326	63	169	90	88	83	73	137	206	46	84	28	
78	16	154	302	77	93	0	121	103	292	141	68	159	167						
SVK	212	455	165	157	166	280	274	55	158	125	93	83	75	122	292	33	41	13	
64	8	182	201	89	73	61	0	61	263	152	83	149	92						
LTU	54	316	98	31	88	90	114	17	66	46	36	24	31	59	91	15	16	13	
14	0	69	130	24	24	81	29	0	142	81	39	86	86						
PRT	809	1030	715	685	802	973	1141	287	786	432	390	382	333	724	572	100	97	74	
237	13	592	787	379	308	235	194	90	0	368	183	444	234						
KOR	411	280	231	186	332	219	710	90	256	161	152	85	82	225	256	32	35	25	
71	0	270	296	169	203	84	91	38	310	0	131	301	80						
URY	189	147	125	104	138	137	305	58	151	106	105	64	79	132	100	20	18	11	
46	0	138	106	123	96	40	54	18	177	108	0	186	49						
ARG	417	306	250	197	306	277	821	109	314	180	189	104	115	281	240	30	42	21	
77	0	292	303	249	205	112	86	37	421	258	185	0	112						
HRV	89	445	202	99	182	276	183	72	168	87	91	119	78	153	189	57	58	34	
70	12	131	259	82	64	150	48	62	200	37	25	68	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	64	282	136	165	119	28	112	63	41	5
DFS	49	0	135	111	97	125	61	112	90	77	12
USA	293	108	0	296	358	183	64	239	92	72	21
NZL	148	84	368	0	336	168	57	168	80	58	60
AUS	165	63	379	373	0	152	50	181	68	45	27
GBR	120	109	197	167	147	0	60	136	95	64	29
NLD	22	59	68	50	39	54	0	57	49	42	8
ZAF	109	87	251	172	166	133	52	0	86	61	18
ITA	60	87	99	78	64	96	46	81	0	57	8
DEU	37	72	72	52	37	63	38	57	57	0	8
IRL	3	9	22	65	22	29	8	18	9	8	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	64	282	136	165	119	28	112	63	41	5
DFS	49	0	135	111	97	125	61	112	90	77	12
USA	293	108	0	296	358	183	64	239	92	72	21
NZL	148	84	368	0	336	168	57	168	80	58	60
AUS	165	63	379	373	0	152	50	181	68	45	27
GBR	120	109	197	167	147	0	60	136	95	64	29
NLD	22	59	68	50	39	54	0	57	49	42	8
ZAF	109	87	251	172	166	133	52	0	86	61	18
ITA	60	87	99	78	64	96	46	81	0	57	8
DEU	37	72	72	52	37	63	38	57	57	0	8
IRL	3	9	22	65	22	29	8	18	9	8	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	64	282	136	165	119	28	112	63	41	5
DFS	49	0	135	111	97	125	61	112	90	77	12
USA	293	108	0	296	358	183	64	239	92	72	21
NZL	148	84	368	0	336	168	57	168	80	58	60
AUS	165	63	379	373	0	152	50	181	68	45	27
GBR	120	109	197	167	147	0	60	136	95	64	29
NLD	22	59	68	50	39	54	0	57	49	42	8
ZAF	109	87	251	172	166	133	52	0	86	61	18
ITA	60	87	99	78	64	96	46	81	0	57	8
DEU	37	72	72	52	37	63	38	57	57	0	8
IRL	3	9	22	65	22	29	8	18	9	8	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	163	67	83	60	103	11	70	1	9	13	2	3
NOR	4	0	42	30	43	11	89	16	0	12	20	22	33	24
USA	148	42	0	80	89	67	121	17	58	8	16	24	12	21
NZL	66	29	79	0	110	44	139	13	33	4	14	22	3	6
AUS	82	36	90	112	0	45	130	29	34	17	32	40	6	16
GBR	59	12	60	41	45	0	47	5	33	1	9	11	5	11
DFS	99	69	121	137	108	45	0	55	47	75	109	101	8	24
DEU	10	15	17	13	27	5	45	0	1	20	31	29	3	13
ZAF	72	0	53	29	33	28	44	1	0	0	2	5	0	2
EST	1	11	6	3	16	1	63	18	0	0	43	21	0	8
LVA	9	18	15	12	30	8	77	27	2	37	0	45	2	10
LTU	12	17	17	18	36	10	83	28	5	20	40	0	2	10
IRL	2	33	12	3	5	5	6	3	0	0	2	2	0	7
NLD	3	23	19	6	14	11	23	12	2	7	9	9	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	163	67	83	60	103	11	70	1	9	13	2	3
NOR	4	0	42	30	43	11	90	17	0	13	21	22	33	24
USA	148	42	0	80	89	66	121	17	58	8	16	24	12	21
NZL	66	29	79	0	110	44	139	13	33	4	14	22	3	6
AUS	82	36	90	112	0	45	130	29	34	17	32	40	6	16
GBR	59	12	60	41	45	0	47	5	33	1	9	11	5	11
DFS	99	70	121	137	108	45	0	55	47	75	109	100	8	23
DEU	10	16	17	13	27	5	45	0	1	20	31	29	3	13
ZAF	72	0	53	29	33	28	44	1	0	0	2	5	0	2
EST	1	12	6	3	16	1	63	18	0	0	43	21	0	8
LVA	9	19	15	12	30	8	77	27	2	37	0	45	2	10
LTU	12	17	17	18	36	10	83	28	5	20	40	0	2	10
IRL	2	33	12	3	5	5	6	3	0	0	2	2	0	7
NLD	3	23	19	6	14	11	23	12	2	7	9	9	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	163	67	83	60	103	11	70	1	9	13	2	3
NOR	4	0	42	30	43	11	90	17	0	13	21	22	33	24
USA	148	42	0	80	89	66	121	17	58	8	16	24	12	21
NZL	66	29	79	0	110	44	139	13	33	4	14	22	3	6
AUS	82	36	90	112	0	45	130	29	34	17	32	40	6	16
GBR	59	12	60	41	45	0	47	5	33	1	9	11	5	11
DFS	99	70	121	137	108	45	0	55	47	75	109	100	8	23
DEU	10	16	17	13	27	5	45	0	1	20	31	29	3	13
ZAF	72	0	53	29	33	28	44	1	0	0	2	5	0	2
EST	1	12	6	3	16	1	63	18	0	0	43	21	0	8
LVA	9	19	15	12	30	8	77	27	2	37	0	45	2	10
LTU	12	17	17	18	36	10	83	28	5	20	40	0	2	10
IRL	2	33	12	3	5	5	6	3	0	0	2	2	0	7
NLD	3	23	19	6	14	11	23	12	2	7	9	9	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
CHE	0	290	146	70	8	14	1	69	45	27	52	1
DEA	235	0	190	672	126	171	44	167	44	322	47	410
FRM	188	150	0	137	17	2	3	100	59	52	68	2
ITA	71	572	160	0	70	96	18	119	47	115	40	180
SVN	8	113	17	66	0	37	9	28	1	38	0	54
FRA	10	137	1	88	34	0	10	32	0	40	0	62
HUN	0	29	1	15	7	7	0	3	1	12	0	16
NLD	71	162	121	113	28	34	3	0	42	45	50	64
IRL	43	36	64	44	1	0	1	37	0	10	34	2
SVK	19	329	52	97	38	34	10	38	3	0	8	73
GBR	57	31	85	41	0	0	0	49	30	3	0	0
HRV	1	424	1	172	44	57	15	63	1	57	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
CHE	0	290	146	70	8	14	1	69	45	27	52	1
DEA	235	0	190	673	126	171	44	167	44	322	47	408
FRM	188	150	0	137	17	2	3	100	59	52	68	2
ITA	71	574	160	0	70	96	18	119	47	115	40	178
SVN	8	113	17	66	0	37	9	28	1	38	0	54
FRA	10	137	1	88	34	0	10	32	0	40	0	62
HUN	0	29	1	15	7	7	0	3	1	12	0	16
NLD	71	162	121	113	28	34	3	0	42	45	50	64
IRL	43	36	64	44	1	0	1	37	0	10	34	2
SVK	19	329	52	97	38	34	10	38	3	0	8	71
GBR	57	31	85	41	0	0	0	49	30	3	0	0
HRV	1	422	1	170	44	57	15	63	1	55	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
CHE	0	288	146	70	8	14	1	69	45	27	52	1
DEA	233	0	190	672	126	171	44	167	44	322	47	409
FRM	188	150	0	137	17	2	3	100	59	52	68	2
ITA	71	572	160	0	70	96	18	119	47	115	40	179
SVN	8	113	17	66	0	37	9	28	1	38	0	54
FRA	10	137	1	88	34	0	10	32	0	40	0	62
HUN	0	29	1	15	7	7	0	3	1	12	0	16
NLD	71	162	121	113	28	34	3	0	42	45	50	64
IRL	43	36	64	44	1	0	1	37	0	10	34	2
SVK	19	329	52	97	38	34	10	38	3	0	8	72
GBR	57	31	85	41	0	0	0	49	30	3	0	0
HRV	1	423	1	171	44	57	15	63	1	56	0	0