

Introduction

The latest international evaluation for dairy production traits took place as scheduled at the Interbull Centre. Data from thirty one (30) 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:

AUS GUE/HOL Base change moving one year ahead. For BSW, RDC and GUE EBVs are based on the new model tested in September (multi traits multi lactations random regression)

BEL HOL Changes in genetic groups

CAN ALL New model, new parameter

CHE HOL/SIM Sent in by QUALITAS, new parameters, Data cut-off have been altered for some traits. Inclusion of Red Holstein (CHR) in B&W (CHE)

DEA BSW,SIM Base change shifting for 4 months

DEU ALL cow base moved to cow birth 2010

EST HOL/RDC Data inclusion: test days within 305 milking days (was 365 milking days) updated definitions for fixed lactation curve groups

GBR pedigree correction for dams

ITA HOL Base change, data with birth year=1999 was deleted

ITA JER Base change.

JPN HOL Changes in model, introduced new database

NLD ALL Base change

NOR RDC Delivered RBV's for all traits. The scaling is according to a rolling base that change somewhat at each evaluation. Therefore percentage changes in sire standard deviations between evaluations may solely be due to changes in the standard deviation in the rolling base.

URY HOL Base change

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

- 1) Data submission for pedigree, EBV/PTA, and parameters is possible only through uploading of the data to the Interbull Data Exchange Area (IDEA);
- 2) Interbull Centre has moved to a completely new MACE evaluation software called "Dairy System for International Evaluation (DAISIE)", partly because of the extended use of IDEA for EBV/PTA, and partly because of our continuous efforts to make the system

- more effective than before;
- 3) All trait groups (including conformation traits) are now evaluated in-house.
 - 4) The file containing heritability values now contain more decimal places for heritability, and one extra field for the definition of reference base population;
 - 5) The file containing genetic correlations has changed name from rG_columns_all to cor{RUNID}.csv, and also contains one extra field for the number of common bulls;
 - 6) The file containing sire genetic standard deviations has changed name from sire_std_columns_all to std{RUNID}.csv;
 - 7) Sire-MGS based pedigree files are not distributed anymore;
 - 8) Parent averages in the "ipa" format are not distributed anymore;
 - 9) An import AI bull (type of proof = 21) with official publication status 'Y' from a given country is included in the distribution file if the bull has a first country proof included from a different country OR a second country proof is included with minimum required number of daughters or EDC (20, 10, 150, 20, 20, and 80) and herds (20, 10, 150, 20, 20, and 80) for different breeds (BSW, GUE, HOL, JER, RDC and SIM), respectively;
 - 10) Bulls with some missing pedigree information (sires and/or dam and/or birthdate) are excluded from evaluations;
 - 11) Standardization factors are not used anymore;
 - 12) Post-processing of genetic correlation are now applied to all trait groups.

DATA AND METHOD OF ANALYSIS

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

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

Table 2 presents the date of evaluation as supplied by each country in the 01x-proof file.

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

SCIENTIFIC LITERATURE

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

International genetic evaluation computation:

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

Verification and Genetic trend validation:

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

Weighting factors:

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

De-regression:

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

Genetic parameter estimation:

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

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

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

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

 NEXT ROUTINE INTERNATIONAL EVALUATION

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

 NEXT TEST INTERNATIONAL EVALUATION

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

 PUBLICATION OF INTERBULL TEST RUN

Test evaluation results are meant for review purposes only and should not be published.

^LTable 1. National evaluation data considered in the Interbull evaluation for dairy production traits (April Routine Evaluation 2015).
 Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
ARG			1313			
AUS	140	118	6769	1528	592	
BEL			1031			
CAN	201	93	10484	573	716	
CHE	2840		2719			2802
CZE			3716			
DEA	5490					21651
DEU			25131	120	391	
DFS			11800	1921	7036	
ESP			2910			
EST			894		376	
FRA	332		15532			373
FRM						4123
FRR			202			
GBR	125	308	6128	809	513	87
HUN			2794			196
IRL			1960	97	34	82
ISR			1170			
ITA	1900		8894	157		1392
JPN			4958			
KOR			1019			
LTU			594		377	
LVA			838		658	
NLD	152		13650	112	52	262
NOR					3695	
NZL	45	58	6513	4207	1208	
POL			8282			
PRT			2227			
SVK			982			526
SVN	307		380			504
URY			861			
USA	975	728	33093	3778	605	
ZAF		37	1191	633	135	
HRV			558			690
No. Records	12507	1342	178593	13935	16388	32688
Pub. Proofs	10242	1079	139799	11479	14800	29823

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

BSW mil

	AUS	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
AUS	337.02										
CAN	0.78	602.29									
CHE	0.79	0.90	481.03								
DEA	0.76	0.86	0.93	461.20							
FRA	0.79	0.89	0.91	0.86	643.99						
GBR	0.76	0.86	0.88	0.86	0.87	258.57					
ITA	0.76	0.88	0.88	0.90	0.86	0.86	577.08				
NLD	0.78	0.90	0.88	0.86	0.89	0.88	0.86	519.04			
NZL	0.86	0.76	0.77	0.77	0.76	0.76	0.76	0.76	343.68		
SVN	0.77	0.87	0.86	0.86	0.86	0.87	0.86	0.86	0.78	10.51	
USA	0.75	0.92	0.88	0.86	0.89	0.86	0.88	0.89	0.76	0.87	627.92

BSW fat

	AUS	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
AUS	14.58										
CAN	0.75	25.73									
CHE	0.76	0.86	19.12								
DEA	0.76	0.87	0.93	17.58							
FRA	0.78	0.90	0.89	0.86	27.41						
GBR	0.76	0.86	0.87	0.86	0.88	9.70					
ITA	0.76	0.88	0.88	0.89	0.86	0.86	22.15				
NLD	0.76	0.89	0.87	0.87	0.88	0.88	0.85	24.47			
NZL	0.86	0.76	0.77	0.81	0.76	0.76	0.76	0.76	15.15		
SVN	0.78	0.87	0.86	0.86	0.86	0.87	0.86	0.86	0.78	10.51	
USA	0.75	0.91	0.86	0.85	0.90	0.87	0.88	0.88	0.76	0.87	23.75

BSW pro

	AUS	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
AUS	11.02										
CAN	0.75	21.87									
CHE	0.77	0.86	15.02								
DEA	0.76	0.86	0.91	14.42							
FRA	0.76	0.87	0.88	0.85	21.02						
GBR	0.76	0.85	0.87	0.86	0.87	7.53					
ITA	0.76	0.86	0.87	0.89	0.86	0.86	20.20				
NLD	0.76	0.87	0.86	0.86	0.86	0.87	0.85	17.48			
NZL	0.86	0.76	0.77	0.77	0.76	0.76	0.76	0.76	10.67		
SVN	0.78	0.87	0.86	0.86	0.86	0.87	0.86	0.86	0.78	10.45	
USA	0.75	0.89	0.85	0.85	0.88	0.85	0.87	0.86	0.76	0.87	18.91

GUE mil

	AUS	CAN	GBR	NZL	USA	ZAF
AUS	487.27					
CAN	0.85	732.38				
GBR	0.78	0.86	236.49			
NZL	0.86	0.76	0.76	332.45		
USA	0.77	0.94	0.86	0.76	688.90	
ZAF	0.81	0.86	0.86	0.76	0.86	345.98

GUE fat

AUS AUS CAN GBR NZL USA ZAF
AUS 17.85
CAN 0.83 30.38
GBR 0.77 0.87 10.09
NZL 0.87 0.78 0.76 16.60
USA 0.77 0.94 0.87 0.76 25.31
ZAF 0.76 0.86 0.86 0.77 0.86 13.59

GUE pro

AUS AUS CAN GBR NZL USA ZAF
AUS 14.09
CAN 0.78 22.34
GBR 0.76 0.86 6.39
NZL 0.86 0.76 0.76 11.05
USA 0.75 0.92 0.86 0.76 19.09
ZAF 0.76 0.86 0.86 0.76 0.86 10.55

HOL mil

	ARG	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	NZL
FRR	GBR	HRV	HUN	IRL	ISR	ITA	JPN	KOR	LTU	LVA	NLD	NZL
POL	PRT	SVK	SVN	URY	USA	ZAF						
ARG	181.01											
AUS	0.76	466.51										
BEL	0.85	0.81	479.90									
CAN	0.85	0.82	0.86	759.62								
CHE	0.85	0.84	0.85	0.89	586.60							
CZE	0.85	0.75	0.85	0.86	0.85	535.28						
DEU	0.85	0.77	0.87	0.91	0.89	0.87	622.52					
DFS	0.85	0.78	0.85	0.93	0.93	0.85	0.93	11.16				
ESP	0.85	0.81	0.86	0.93	0.90	0.85	0.91	0.92	544.65			
EST	0.86	0.78	0.85	0.89	0.87	0.85	0.85	0.90	0.86	605.88		
FRA	0.85	0.83	0.85	0.91	0.94	0.85	0.89	0.93	0.92	0.85	671.21	
FRR	0.88	0.82	0.93	0.86	0.88	0.91	0.90	0.88	0.88	0.88	0.90	
675.81												
GBR	0.85	0.79	0.85	0.86	0.89	0.85	0.85	0.89	0.85	0.85	0.87	
0.86	268.06											
HRV	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.86	0.85	12.35										
HUN	0.85	0.75	0.85	0.86	0.85	0.85	0.85	0.88	0.87	0.85	0.88	
0.87	0.85	0.85	642.08									
IRL	0.75	0.85	0.79	0.80	0.82	0.75	0.78	0.81	0.80	0.76	0.87	
0.79	0.82	0.76	0.76	169.04								
ISR	0.76	0.76	0.76	0.77	0.79	0.75	0.79	0.81	0.83	0.76	0.81	
0.76	0.75	0.76	0.79	0.76	377.99							
ITA	0.85	0.76	0.85	0.89	0.88	0.85	0.88	0.90	0.90	0.85	0.89	
0.86	0.85	0.85	0.90	0.77	0.82	574.04						
JPN	0.85	0.82	0.85	0.93	0.90	0.85	0.91	0.94	0.91	0.86	0.91	
0.87	0.85	0.85	0.85	0.79	0.87	0.89	638.36					
KOR	0.85	0.76	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.88	0.85	0.86	0.85	0.76	0.76	0.85	0.85	463.97				
LTU	0.86	0.76	0.86	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.88	0.85	0.85	0.86	0.76	0.76	0.85	0.86	0.86	347.91			
LVA	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
0.86	0.85	0.85	0.85	0.76	0.76	0.85	0.85	0.86	0.86	412.68		
NLD	0.85	0.82	0.89	0.92	0.91	0.85	0.92	0.94	0.92	0.85	0.91	
0.88	0.88	0.85	0.85	0.83	0.81	0.87	0.92	0.85	0.85	0.85	652.28	
NZL	0.75	0.85	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.75	
0.79	0.75	0.75	0.75	0.85	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
315.61												
POL	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
0.87	0.85	0.85	0.85	0.75	0.76	0.85	0.85	0.85	0.85	0.85	0.85	
0.75	440.84											
PRT	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
0.86	0.85	0.85	0.85	0.75	0.76	0.85	0.85	0.85	0.85	0.85	0.85	
0.75	0.85	632.59										
SVK	0.86	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.86	0.85	0.86	0.86	0.76	0.77	0.85	0.85	0.85	0.86	0.86	0.85	
0.75	0.85	0.85	405.79									
SVN	0.86	0.76	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.86	0.85	0.86	0.85	0.76	0.76	0.85	0.85	0.86	0.86	0.86	0.85	
0.75	0.85	0.85	0.86	11.67								
URY	0.85	0.78	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.88	0.85	0.86	0.85	0.76	0.76	0.85	0.85	0.85	0.86	0.86	0.85	
0.76	0.85	0.85	0.85	0.86	168.77							
USA	0.85	0.77	0.85	0.93	0.89	0.85	0.90	0.93	0.92	0.88	0.92	
0.86	0.86	0.85	0.90	0.79	0.81	0.92	0.93	0.85	0.85	0.85	0.90	
0.75	0.85	0.85	0.85	0.85	0.85	669.53						
ZAF	0.85	0.82	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.86	0.85	0.85	0.85	0.77	0.82	0.85	0.85	0.85	0.86	0.85	0.85	
0.75	0.85	0.85	0.85	0.85	0.85	0.85	525.12					

HOL	fat											
	ARG	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	NZL
FRR	GBR	HRV	HUN	IRL	ISR	ITA	JPN	KOR	LTU	LVA	NLD	NZL
POL	PRT	SVK	SVN	URY	USA	ZAF						
ARG	5.92											
AUS	0.75	18.30										
BEL	0.85	0.79	19.86									
CAN	0.85	0.79	0.85	30.68								
CHE	0.85	0.77	0.85	0.88	23.15							
CZE	0.85	0.75	0.85	0.87	0.85	21.58						
DEU	0.85	0.75	0.87	0.90	0.88	0.87	24.18					
DFS	0.85	0.76	0.85	0.93	0.92	0.85	0.91	11.22				
ESP	0.85	0.78	0.85	0.91	0.87	0.86	0.90	0.88	21.74			
EST	0.86	0.78	0.87	0.88	0.86	0.85	0.86	0.89	0.85	22.99		
FRA	0.85	0.81	0.85	0.92	0.91	0.85	0.89	0.92	0.91	0.86	27.01	
FRR	0.89	0.81	0.90	0.88	0.86	0.90	0.85	0.86	0.89	0.89	0.88	
24.57												
GBR	0.85	0.76	0.85	0.86	0.89	0.85	0.86	0.89	0.85	0.85	0.89	
0.86	9.71											
HRV	0.86	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	12.79										
HUN	0.85	0.75	0.85	0.86	0.85	0.85	0.86	0.85	0.88	0.86	0.89	
0.87	0.85	0.85	23.21									
IRL	0.75	0.85	0.83	0.78	0.81	0.75	0.76	0.81	0.79	0.81	0.85	
0.80	0.78	0.76	0.75	6.10								
ISR	0.77	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.82	0.76	0.78	
0.78	0.76	0.76	0.80	0.76	14.34							
ITA	0.85	0.75	0.85	0.90	0.85	0.85	0.86	0.86	0.90	0.86	0.88	
0.86	0.85	0.85	0.91	0.75	0.77	23.40						
JPN	0.85	0.76	0.85	0.93	0.89	0.85	0.89	0.92	0.86	0.88	0.90	
0.86	0.85	0.85	0.85	0.78	0.76	0.85	24.22					
KOR	0.85	0.77	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.90	0.85	0.86	0.85	0.75	0.77	0.85	0.85	18.78				
LTU	0.86	0.76	0.86	0.86	0.86	0.85	0.85	0.86	0.85	0.86	0.86	
0.90	0.86	0.86	0.86	0.76	0.77	0.85	0.86	0.86	14.68			
LVA	0.86	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	0.85	0.85	0.76	0.76	0.85	0.85	0.86	0.86	17.81		
NLD	0.85	0.77	0.85	0.91	0.89	0.85	0.91	0.91	0.89	0.85	0.90	
0.85	0.88	0.85	0.85	0.81	0.77	0.85	0.89	0.85	0.85	0.85	24.87	
NZL	0.75	0.85	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.79	0.75	
0.78	0.75	0.76	0.75	0.85	0.76	0.75	0.75	0.75	0.76	0.76	0.75	
12.71												
POL	0.85	0.75	0.85	0.87	0.85	0.87	0.87	0.85	0.90	0.86	0.86	
0.88	0.85	0.85	0.85	0.75	0.76	0.86	0.85	0.85	0.85	0.85	0.85	
0.75	16.76											
PRT	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.86	0.85	0.85	0.85	0.75	0.76	0.85	0.85	0.85	0.85	0.85	0.85	
0.75	0.85	25.95										
SVK	0.86	0.75	0.85	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	0.86	0.85	0.76	0.77	0.85	0.85	0.86	0.86	0.86	0.85	
0.75	0.85	0.85	15.12									
SVN	0.86	0.76	0.85	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	0.86	0.86	0.76	0.77	0.85	0.86	0.86	0.87	0.86	0.85	
0.76	0.85	0.85	0.86	12.49								
URY	0.85	0.79	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.89	0.85	0.86	0.85	0.78	0.77	0.85	0.85	0.85	0.86	0.86	0.85	
0.77	0.85	0.85	0.86	0.86	5.99							
USA	0.85	0.76	0.85	0.94	0.88	0.85	0.90	0.91	0.92	0.87	0.92	
0.86	0.87	0.85	0.91	0.77	0.84	0.92	0.90	0.85	0.85	0.85	0.89	
0.75	0.86	0.85	0.85	0.85	0.85	24.84						
ZAF	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	0.86	0.85	0.75	0.76	0.85	0.85	0.85	0.86	0.86	0.85	
0.75	0.85	0.85	0.86	0.86	0.85	0.85	18.21					

HOL	pro											
	ARG	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	NZL
FRR	GBR	HRV	HUN	IRL	ISR	ITA	JPN	KOR	LTU	LVA	NLD	NZL
POL	PRT	SVK	SVN	URY	USA	ZAF						
ARG	5.40											
AUS	0.75	10.54										
BEL	0.85	0.75	14.06									
CAN	0.85	0.75	0.85	21.01								
CHE	0.85	0.76	0.85	0.85	16.89							
CZE	0.85	0.75	0.85	0.85	0.85	16.41						
DEU	0.85	0.75	0.85	0.87	0.85	0.85	17.84					
DFS	0.85	0.75	0.85	0.92	0.90	0.85	0.92	10.82				
ESP	0.85	0.75	0.85	0.89	0.85	0.85	0.86	0.90	15.84			
EST	0.86	0.76	0.86	0.86	0.86	0.85	0.85	0.86	0.85	18.12		
FRA	0.85	0.76	0.85	0.87	0.92	0.85	0.85	0.91	0.87	0.86	18.49	
FRR	0.90	0.78	0.86	0.87	0.86	0.87	0.85	0.86	0.86	0.90	0.86	
19.19												
GBR	0.85	0.76	0.85	0.85	0.88	0.85	0.85	0.89	0.85	0.86	0.87	
0.86	7.21											
HRV	0.86	0.75	0.85	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	11.70										
HUN	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.86	0.87	
0.87	0.85	0.85	19.55									
IRL	0.75	0.85	0.76	0.76	0.78	0.75	0.75	0.76	0.77	0.76	0.80	
0.77	0.79	0.76	0.75	4.70								
ISR	0.77	0.76	0.76	0.76	0.77	0.76	0.76	0.78	0.82	0.77	0.82	
0.79	0.76	0.76	0.78	0.76	9.84							
ITA	0.85	0.75	0.85	0.86	0.85	0.85	0.85	0.89	0.87	0.85	0.86	
0.86	0.85	0.85	0.88	0.75	0.79	17.61						
JPN	0.85	0.75	0.85	0.91	0.87	0.85	0.86	0.92	0.88	0.86	0.86	
0.87	0.85	0.86	0.85	0.75	0.81	0.87	17.32					
KOR	0.85	0.75	0.85	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.91	0.85	0.86	0.85	0.75	0.77	0.85	0.85	13.03				
LTU	0.86	0.76	0.86	0.86	0.87	0.86	0.85	0.86	0.85	0.87	0.86	
0.91	0.86	0.86	0.86	0.76	0.78	0.86	0.86	0.86	10.34			
LVA	0.86	0.76	0.85	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	0.85	0.85	0.76	0.77	0.85	0.85	0.86	0.86	12.37		
NLD	0.85	0.75	0.85	0.87	0.85	0.85	0.89	0.90	0.87	0.85	0.86	
0.85	0.88	0.85	0.85	0.78	0.76	0.85	0.87	0.85	0.86	0.85	18.07	
NZL	0.75	0.85	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.75	
0.78	0.75	0.76	0.75	0.85	0.76	0.75	0.75	0.75	0.76	0.76	0.75	
9.13												
POL	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
0.86	0.85	0.85	0.85	0.75	0.76	0.85	0.85	0.85	0.85	0.85	0.85	
0.75	11.86											
PRT	0.85	0.75	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.86	0.85	0.85	0.85	0.75	0.76	0.85	0.85	0.85	0.85	0.85	0.85	
0.75	0.85	20.20										
SVK	0.86	0.76	0.85	0.85	0.86	0.85	0.85	0.85	0.85	0.86	0.85	
0.87	0.85	0.86	0.86	0.76	0.78	0.85	0.85	0.86	0.87	0.86	0.85	
0.75	0.85	0.85	11.42									
SVN	0.87	0.76	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.86	0.86	
0.87	0.85	0.86	0.86	0.76	0.77	0.85	0.86	0.87	0.87	0.86	0.85	
0.76	0.85	0.86	0.87	11.19								
URY	0.85	0.75	0.86	0.85	0.86	0.86	0.85	0.85	0.85	0.87	0.85	
0.91	0.85	0.87	0.85	0.76	0.78	0.85	0.85	0.86	0.87	0.87	0.85	
0.75	0.86	0.85	0.86	0.87	4.95							
USA	0.85	0.75	0.85	0.91	0.85	0.85	0.87	0.92	0.89	0.85	0.89	
0.86	0.85	0.85	0.88	0.75	0.80	0.90	0.91	0.85	0.86	0.85	0.86	
0.75	0.85	0.85	0.85	0.86	0.85	17.51						
ZAF	0.85	0.77	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	
0.88	0.85	0.86	0.85	0.75	0.81	0.85	0.85	0.85	0.87	0.86	0.85	
0.75	0.85	0.85	0.86	0.86	0.85	0.85	14.39					

JER mil

	AUS	CAN	DEU	DFS	GBR	IRL	ITA	NLD	NZL	USA	ZAF
AUS	483.21										
CAN	0.86	573.43									
DEU	0.77	0.89	458.75								
DFS	0.78	0.93	0.90	9.27							
GBR	0.76	0.86	0.85	0.87	210.60						
IRL	0.83	0.82	0.81	0.84	0.84	174.99					
ITA	0.79	0.90	0.87	0.88	0.85	0.81	529.65				
NLD	0.80	0.92	0.91	0.93	0.87	0.84	0.87	588.52			
NZL	0.86	0.79	0.76	0.76	0.75	0.82	0.80	0.76	281.58		
USA	0.78	0.92	0.89	0.93	0.85	0.82	0.89	0.89	0.75	611.92	
ZAF	0.83	0.89	0.86	0.89	0.85	0.83	0.87	0.86	0.78	0.85	374.43

JER fat

	AUS	CAN	DEU	DFS	GBR	IRL	ITA	NLD	NZL	USA	ZAF
AUS	18.75										
CAN	0.84	25.38									
DEU	0.76	0.89	21.01								
DFS	0.76	0.91	0.90	11.67							
GBR	0.75	0.86	0.86	0.87	8.52						
IRL	0.81	0.80	0.79	0.83	0.82	6.14					
ITA	0.76	0.89	0.86	0.86	0.85	0.79	25.89				
NLD	0.76	0.89	0.90	0.89	0.87	0.82	0.86	24.71			
NZL	0.86	0.75	0.76	0.76	0.75	0.79	0.76	0.76	12.00		
USA	0.80	0.92	0.88	0.91	0.86	0.82	0.89	0.88	0.75	24.60	
ZAF	0.75	0.85	0.86	0.86	0.85	0.82	0.86	0.86	0.75	0.85	14.96

JER pro

	AUS	CAN	DEU	DFS	GBR	IRL	ITA	NLD	NZL	USA	ZAF
AUS	11.78										
CAN	0.80	18.09									
DEU	0.76	0.87	16.07								
DFS	0.76	0.90	0.91	10.60							
GBR	0.75	0.86	0.85	0.87	5.95						
IRL	0.82	0.78	0.78	0.81	0.82	5.30					
ITA	0.76	0.86	0.85	0.87	0.85	0.79	18.87				
NLD	0.76	0.87	0.89	0.89	0.87	0.80	0.86	18.50			
NZL	0.85	0.75	0.76	0.76	0.75	0.80	0.76	0.76	8.48		
USA	0.75	0.89	0.87	0.92	0.85	0.80	0.88	0.86	0.75	18.38	
ZAF	0.76	0.85	0.86	0.86	0.85	0.82	0.86	0.86	0.75	0.85	11.78

SIM mil

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	IRL	ITA	NLD	SVK
SVN											
CHE	560.71										
DEA	0.86	507.63									
FRA	0.93	0.90	692.69								
FRM	0.95	0.90	0.92	637.25							
GBR	0.90	0.90	0.87	0.90	319.04						
HRV	0.86	0.85	0.86	0.91	0.86	10.62					
HUN	0.86	0.86	0.88	0.91	0.85	0.87	364.39				
IRL	0.78	0.76	0.86	0.77	0.80	0.77	0.77	147.15			
ITA	0.86	0.85	0.89	0.85	0.85	0.85	0.89	0.77	484.00		
NLD	0.89	0.93	0.91	0.91	0.88	0.86	0.86	0.80	0.86	685.56	
SVK	0.87	0.85	0.86	0.86	0.86	0.86	0.87	0.78	0.86	0.86	337.26
SVN	0.88	0.86	0.86	0.88	0.86	0.86	0.88	0.77	0.86	0.86	0.86

8.73

SIM fat

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	IRL	ITA	NLD	SVK
SVN											
CHE	22.31										
DEA	0.87	19.35									
FRA	0.91	0.93	27.78								
FRM	0.94	0.92	0.92	25.11							
GBR	0.91	0.89	0.89	0.88	11.65						
HRV	0.86	0.85	0.86	0.91	0.86	10.63					
HUN	0.86	0.86	0.89	0.91	0.85	0.87	13.40				
IRL	0.77	0.76	0.85	0.76	0.78	0.77	0.75	5.49			
ITA	0.86	0.85	0.89	0.85	0.85	0.85	0.89	0.76	19.29		
NLD	0.88	0.93	0.89	0.91	0.88	0.86	0.85	0.78	0.85	27.26	
SVK	0.87	0.85	0.86	0.86	0.86	0.86	0.87	0.77	0.86	0.86	13.21
SVN	0.88	0.86	0.86	0.88	0.86	0.86	0.88	0.77	0.86	0.87	0.86

9.15

SIM pro

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	IRL	ITA	NLD	SVK
SVN											
CHE	16.40										
DEA	0.85	15.45									
FRA	0.91	0.88	21.85								
FRM	0.93	0.90	0.91	19.81							
GBR	0.89	0.91	0.87	0.89	9.05						
HRV	0.86	0.85	0.86	0.91	0.86	10.73					
HUN	0.86	0.86	0.87	0.91	0.85	0.87	10.84				
IRL	0.77	0.76	0.80	0.76	0.78	0.77	0.75	4.73			
ITA	0.86	0.85	0.86	0.85	0.86	0.85	0.88	0.76	15.39		
NLD	0.86	0.92	0.86	0.88	0.88	0.86	0.85	0.77	0.85	21.91	
SVK	0.87	0.85	0.86	0.86	0.86	0.86	0.87	0.77	0.86	0.86	10.20
SVN	0.88	0.86	0.86	0.88	0.86	0.86	0.88	0.77	0.86	0.87	0.86

9.18

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
AUS	0	66	75	85	44	47	73	36	18	14	90
CAN	66	0	103	111	74	62	101	44	20	22	142
CHE	46	85	0	508	135	67	392	73	18	52	284
DEA	54	93	401	0	179	72	597	116	26	74	287
FRA	32	66	98	135	0	50	157	71	17	42	114
GBR	38	63	53	50	42	0	71	35	17	17	83
ITA	47	89	338	498	125	51	0	102	21	68	211
NLD	25	40	66	110	58	29	85	0	18	32	67
NZL	14	20	15	21	13	15	16	11	0	4	24
SVN	10	20	52	69	42	13	69	33	3	0	29
USA	81	138	267	254	75	77	147	59	21	23	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
AUS	0	66	75	85	44	47	73	36	18	14	90
CAN	66	0	103	111	74	62	101	44	20	22	142
CHE	46	85	0	508	135	67	392	73	18	52	284
DEA	54	93	401	0	179	72	597	116	26	74	287
FRA	32	66	98	135	0	50	157	71	17	42	114
GBR	38	63	53	50	42	0	71	35	17	17	83
ITA	47	89	338	498	125	51	0	102	21	68	211
NLD	25	40	66	110	58	29	85	0	18	32	67
NZL	14	20	15	21	13	15	16	11	0	4	24
SVN	10	20	52	69	42	13	69	33	3	0	29
USA	81	138	267	254	75	77	147	59	21	23	0

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	CHE	DEA	FRA	GBR	ITA	NLD	NZL	SVN	USA
AUS	0	66	75	85	44	47	73	36	18	14	90
CAN	66	0	103	111	74	62	101	44	20	22	142
CHE	46	85	0	508	135	67	392	73	18	52	284
DEA	54	93	401	0	179	72	597	116	26	74	287
FRA	32	66	98	135	0	50	157	71	17	42	114
GBR	38	63	53	50	42	0	71	35	17	17	83
ITA	47	89	338	498	125	51	0	102	21	68	211
NLD	25	40	66	110	58	29	85	0	18	32	67
NZL	14	20	15	21	13	15	16	11	0	4	24
SVN	10	20	52	69	42	13	69	33	3	0	29
USA	81	138	267	254	75	77	147	59	21	23	0

GUE

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

AUS 0 42 34 27 50 6
CAN 38 0 28 14 61 5
GBR 26 23 0 15 77 5
NZL 27 11 13 0 31 5
USA 45 52 80 29 0 11
ZAF 5 2 4 3 8 0

GUE

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

AUS 0 42 34 27 50 6
CAN 38 0 28 13 60 4
GBR 26 23 0 15 77 5
NZL 27 11 13 0 31 5
USA 45 51 80 29 0 11
ZAF 5 2 4 3 8 0

GUE

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

AUS 0 42 34 27 50 6
CAN 38 0 28 13 60 4
GBR 26 23 0 15 77 5
NZL 27 11 13 0 31 5
USA 45 51 80 29 0 11
ZAF 5 2 4 3 8 0

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	ARG	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	FRR	GBR	HRV	HUN	IRL	ISR	ITA
JPN	KOR	LTU	LVA	NLD	NZL	POL	PRT	SVK	SVN	URY	USA	ZAF						
ARG	0	338	171	503	187	356	530	409	367	77	394	0	428	115	371	185	42	461
408	303	86	163	416	276	396	444	149	63	317	750	271						
AUS	189	0	395	925	371	608	1230	910	610	138	937	11	990	172	490	450	70	886
619	289	132	218	1040	904	635	582	224	110	292	1325	377						
BEL	104	275	0	399	327	369	672	481	376	89	527	27	483	140	308	267	47	459
296	158	75	146	698	298	407	399	162	92	144	511	214						
CAN	422	758	344	0	572	819	1886	1012	970	161	1087	7	1233	184	704	347	73	1250
1028	487	142	304	1023	571	875	809	339	125	369	2385	416						
CHE	120	276	291	409	0	389	858	482	386	98	432	28	483	131	315	247	43	497
317	163	66	182	628	283	424	379	161	89	144	680	197						
CZE	240	288	254	502	256	0	1605	1019	691	190	1018	28	854	247	735	356	93	1044
669	368	159	310	1193	515	1004	682	386	149	287	1336	340						
DEU	306	668	584	1014	681	1149	0	2332	1234	301	2069	111	1743	438	1003	618	117	2182
1223	468	347	522	2830	817	1710	1097	628	204	390	2986	523						
DFS	250	467	384	667	388	575	1229	0	796	201	1342	34	1233	266	719	524	104	1299
771	369	205	338	1613	680	1129	818	344	168	326	1625	436						
ESP	281	343	337	507	292	445	727	537	0	137	874	10	847	196	583	348	81	989
700	335	146	247	851	432	749	704	255	127	285	1192	385						
EST	43	45	53	84	53	118	202	114	62	0	174	14	173	77	136	87	39	190
135	74	50	128	266	103	216	148	90	55	77	247	79						
FRA	197	482	467	584	363	555	862	553	576	70	0	15	1263	185	731	518	95	1525
980	383	154	276	1571	665	1137	793	329	130	308	2093	411						
FRR	0	7	22	3	19	20	85	21	6	13	10	0	14	12	4	4	1	14
2	1	0	19	72	5	68	13	19	10	1	20	6						
GBR	314	677	407	1322	419	528	1109	788	637	93	658	10	0	232	681	646	95	1260
826	377	173	289	1374	757	949	833	304	144	345	1704	446						
HRV	69	91	119	92	88	189	455	204	153	58	103	12	167	0	173	114	44	247
139	84	92	169	308	149	307	231	94	67	88	248	116						
HUN	292	299	241	592	243	640	761	528	459	83	461	4	576	131	0	299	77	794
554	340	131	220	760	409	693	604	263	108	297	1003	337						
IRL	115	312	231	272	221	221	448	360	304	41	335	4	578	77	243	0	61	454
298	140	87	129	610	496	381	365	147	72	177	532	252						
ISR	21	41	27	44	28	67	96	83	54	26	50	1	66	34	62	44	0	97
72	42	29	45	111	81	95	89	35	31	45	115	53						
ITA	306	424	354	698	402	632	1135	767	658	99	633	13	787	180	630	312	65	0
966	447	188	343	1411	642	1127	868	333	168	357	2163	444						
JPN	216	260	171	410	186	247	407	348	293	42	286	2	348	69	291	152	30	355
0	404	129	232	823	452	694	573	247	113	298	1574	362						
KOR	259	158	89	431	103	260	287	235	225	37	190	0	263	38	276	84	25	340
219	0	85	149	362	238	393	371	157	65	233	642	220						
LTU	37	38	26	57	18	92	325	100	59	18	32	0	69	67	70	33	13	89
27	39	0	109	193	115	205	145	64	33	72	215	75						
LVA	114	92	85	165	98	213	399	219	141	88	123	16	175	151	164	74	28	216
101	87	85	0	356	168	395	298	126	74	127	419	130						
NLD	277	739	732	816	580	969	2278	1177	711	187	794	38	1064	273	608	487	91	922
360	225	93	238	0	852	1247	933	441	170	338	1963	450						
NZL	180	817	219	562	234	333	591	436	309	53	343	4	619	87	326	374	69	420
214	165	48	96	753	0	501	503	211	92	264	894	324						
POL	304	316	328	577	318	745	1290	786	494	144	575	61	669	264	577	254	73	749
312	307	139	308	992	338	0	798	337	157	300	1408	342						
PRT	421	395	390	825	345	575	1033	715	724	98	688	13	787	197	601	333	74	798
323	311	92	240	975	435	795	0	268	122	329	1095	395						
SVK	87	98	84	223	80	301	465	168	124	42	161	9	162	49	185	76	14	169
77	93	30	62	286	128	212	197	0	53	142	446	152						
SVN	30	63	73	87	62	113	180	139	92	36	84	9	103	58	87	49	24	135
61	36	15	49	140	64	136	102	33	0	50	156	74						
URY	335	207	106	351	108	221	267	232	244	42	176	0	292	49	255	132	24	256
175	192	38	81	264	206	246	319	102	31	0	533	224						
USA	821	1052	389	2170	571	929	1680	994	690	157	936	10	1317	184	919	399	95	1061
560	724	120	339	1511	813	1106	1142	282	121	666	0	564						
ZAF	249	289	169	354	168	225	392	318	342	40	272	4	383	81	286	206	39	323
233	169	24	79	375	267	243	379	90	53	197	534	0						

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	ARG	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	FRR	GBR	HRV	HUN	IRL	ISR	ITA
JPN	KOR	LTU	LVA	NLD	NZL	POL	PRT	SVK	SVN	URY	USA	ZAF						
ARG	0	338	171	503	187	356	530	409	367	77	394	0	428	115	371	185	42	461
407	303	86	163	416	276	396	444	149	63	213	750	271						
AUS	189	0	395	925	371	608	1230	910	610	138	937	11	990	172	490	450	70	886
618	289	132	218	1040	904	635	582	224	110	172	1325	377						
BEL	104	275	0	399	327	369	672	481	376	89	527	27	483	140	308	267	47	459
295	158	75	146	698	298	407	399	162	92	97	511	214						
CAN	422	758	344	0	572	819	1886	1012	970	161	1087	7	1233	184	704	347	73	1250
1025	487	142	304	1023	571	875	809	339	125	230	2385	416						
CHE	120	276	291	409	0	389	858	482	386	98	432	28	483	131	315	247	43	497
317	163	66	182	628	283	424	379	161	89	96	680	197						
CZE	240	288	254	502	256	0	1605	1019	691	190	1018	28	854	247	735	356	93	1044
666	368	159	310	1193	515	1004	682	386	149	165	1336	340						
DEU	306	668	584	1013	681	1148	0	2332	1234	301	2069	111	1743	438	1003	618	117	2183
1221	468	347	522	2830	817	1710	1097	628	204	233	2986	523						
DFS	250	467	384	666	388	574	1229	0	796	201	1342	34	1233	266	719	524	104	1299
769	369	205	338	1613	680	1129	818	344	168	196	1625	436						
ESP	281	343	337	505	292	444	727	537	0	137	874	10	847	196	583	348	81	989
697	335	146	247	851	432	749	704	255	127	170	1192	385						
EST	43	45	53	84	53	118	202	114	62	0	174	14	173	77	136	87	39	190
133	74	50	128	266	103	216	148	90	55	39	247	79						
FRA	197	482	467	584	363	555	862	553	576	70	0	15	1263	185	731	518	95	1526
978	383	154	276	1571	665	1137	793	329	130	192	2093	411						
FRR	0	7	22	3	19	20	85	21	6	13	10	0	14	12	4	4	1	14
2	1	0	19	72	5	68	13	19	10	0	20	6						
GBR	314	677	407	1320	419	528	1109	788	637	93	658	10	0	232	681	646	95	1260
824	377	173	289	1374	757	949	833	304	144	205	1704	446						
HRV	69	91	119	92	88	189	455	204	153	58	103	12	167	0	173	114	44	247
138	84	92	169	308	149	307	231	94	67	53	248	116						
HUN	292	299	241	591	243	640	761	528	459	83	461	4	576	131	0	299	77	794
551	340	131	220	760	409	693	604	263	108	179	1003	337						
IRL	115	312	231	272	221	221	448	360	304	41	335	4	578	77	243	0	61	454
297	140	87	129	610	496	381	365	147	72	112	532	252						
ISR	21	41	27	44	28	67	96	83	54	26	50	1	66	34	62	44	0	97
72	42	29	45	111	81	95	89	35	31	24	115	53						
ITA	306	424	354	697	403	632	1138	767	658	99	634	13	788	180	632	312	65	0
962	447	188	343	1412	642	1127	868	333	168	210	2164	444						
JPN	212	258	170	408	186	244	405	346	290	40	283	2	345	68	288	151	30	351
0	403	128	231	821	452	690	571	246	110	179	1570	361						
KOR	258	158	89	431	103	260	287	235	225	37	190	0	263	38	276	84	25	339
217	0	85	149	362	238	393	371	157	65	145	642	220						
LTU	37	38	26	57	18	92	325	100	59	18	32	0	69	67	70	33	13	89
27	39	0	109	193	115	205	145	64	33	42	215	75						
LVA	114	92	85	165	98	213	399	219	141	88	123	16	175	151	164	74	28	216
100	87	85	0	356	168	395	298	126	74	84	419	130						
NLD	277	739	732	814	580	968	2278	1177	711	187	794	38	1064	273	608	487	91	926
357	225	93	238	0	852	1247	933	441	170	195	1963	450						
NZL	180	817	219	561	234	333	591	436	309	53	343	4	619	87	326	374	69	422
213	165	48	96	753	0	501	503	211	92	149	894	324						
POL	304	316	328	577	318	744	1290	786	494	144	575	61	669	264	577	254	73	750
308	306	139	308	992	338	0	798	337	157	167	1408	342						
PRT	421	395	390	824	345	574	1033	715	724	98	688	13	787	197	601	333	74	798
319	311	92	240	975	435	795	0	268	122	200	1095	395						
SVK	87	98	84	223	80	300	465	168	124	42	161	9	162	49	185	76	14	169
76	93	30	62	286	128	212	197	0	53	90	446	152						
SVN	30	63	73	87	62	113	180	139	92	36	84	9	103	58	87	49	24	135
58	35	15	49	140	64	136	102	33	0	29	156	74						
URY	207	123	73	207	71	118	162	148	147	20	114	0	173	28	151	88	12	159
107	114	22	51	153	115	126	190	55	22	0	286	146						
USA	821	1052	389	2168	571	929	1680	994	690	157	936	10	1317	184	919	399	95	1064
553	722	120	339	1511	813	1106	1142	282	121	336	0	564						
ZAF	249	289	169	353	168	225	392	318	342	40	272	4	383	81	286	206	39	323
232	169	24	79	375	267	243	379	90	53	130	534	0						

HOL

common bulls below diagonal
common three quarter sib group above diagonal

	ARG	AUS	BEL	CAN	CHE	CZE	DEU	DFS	ESP	EST	FRA	FRR	GBR	HRV	HUN	IRL	ISR	ITA
JPN	KOR	LTU	LVA	NLD	NZL	POL	PRT	SVK	SVN	URY	USA	ZAF						
ARG	0	338	171	503	187	356	530	409	367	77	394	0	428	115	371	185	42	461
407	303	86	163	416	276	396	444	149	63	210	749	271						
AUS	189	0	395	925	371	608	1230	910	610	138	937	11	990	172	490	450	70	886
618	289	132	218	1040	904	635	582	224	110	176	1322	377						
BEL	104	275	0	399	327	369	672	481	376	89	527	27	483	140	308	267	47	459
295	158	75	146	698	298	407	399	162	92	98	510	214						
CAN	422	758	344	0	572	819	1886	1012	970	161	1087	7	1233	184	704	347	73	1250
1024	487	142	304	1023	571	875	808	339	125	228	2379	416						
CHE	120	276	291	409	0	389	858	482	386	98	432	28	483	131	315	247	43	497
316	163	66	182	628	283	424	379	161	89	98	680	197						
CZE	240	288	254	502	256	0	1605	1019	691	190	1018	28	854	247	735	356	93	1044
666	368	159	310	1193	515	1004	682	386	149	166	1336	340						
DEU	306	668	584	1014	681	1148	0	2332	1234	301	2069	111	1743	438	1003	618	117	2183
1221	468	347	522	2830	817	1710	1096	628	204	233	2982	523						
DFS	250	467	384	667	388	574	1229	0	796	201	1342	34	1233	266	719	524	104	1299
769	369	205	338	1613	680	1129	818	344	168	193	1623	436						
ESP	281	343	337	507	292	444	727	537	0	137	874	10	847	196	583	348	81	989
697	335	146	247	851	432	749	704	255	127	168	1191	385						
EST	43	45	53	84	53	118	202	114	62	0	174	14	173	77	136	87	39	190
132	74	50	128	266	103	216	148	90	55	41	247	79						
FRA	197	482	467	584	363	555	862	553	576	70	0	15	1263	185	731	518	95	1526
978	383	154	276	1571	665	1137	793	329	130	192	2092	411						
FRR	0	7	22	3	19	20	85	21	6	13	10	0	14	12	4	4	1	14
2	1	0	19	72	5	68	13	19	10	0	20	6						
GBR	314	677	407	1322	419	528	1109	788	637	93	658	10	0	232	681	646	95	1260
824	377	173	289	1374	757	949	833	304	144	205	1703	446						
HRV	69	91	119	92	88	189	455	204	153	58	103	12	167	0	173	114	44	247
138	84	92	169	308	149	307	231	94	67	53	248	116						
HUN	292	299	241	592	243	640	761	528	459	83	461	4	576	131	0	299	77	794
551	340	131	220	760	409	693	604	263	108	181	1003	337						
IRL	115	312	231	272	221	221	448	360	304	41	335	4	578	77	243	0	61	454
297	140	87	129	610	496	381	365	147	72	114	532	252						
ISR	21	41	27	44	28	67	96	83	54	26	50	1	66	34	62	44	0	97
72	42	29	45	111	81	95	89	35	31	24	115	53						
ITA	306	424	354	698	402	632	1136	767	658	99	634	13	787	180	630	312	65	0
962	447	188	343	1412	642	1127	867	333	168	211	2164	444						
JPN	212	258	170	407	186	244	405	346	290	39	283	2	345	68	288	151	30	350
0	403	128	231	820	452	690	571	246	110	178	1567	361						
KOR	259	158	89	431	103	260	287	235	225	37	190	0	263	38	276	84	25	339
217	0	85	149	362	238	393	371	157	65	142	643	220						
LTU	37	38	26	57	18	92	325	100	59	18	32	0	69	67	70	33	13	89
27	39	0	109	193	115	205	145	64	33	42	215	75						
LVA	114	92	85	165	98	213	399	219	141	88	123	16	175	151	164	74	28	216
100	87	85	0	356	168	395	298	126	74	84	419	130						
NLD	277	739	732	816	580	968	2278	1177	711	187	794	38	1064	273	608	487	91	923
356	225	93	238	0	852	1247	933	441	170	195	1962	450						
NZL	180	817	219	562	234	333	591	436	309	53	343	4	619	87	326	374	69	420
213	165	48	96	753	0	501	503	211	92	153	894	324						
POL	304	316	328	577	318	744	1290	786	494	144	575	61	669	264	577	254	73	749
308	306	139	308	992	338	0	798	337	157	168	1408	342						
PRT	421	395	390	824	345	574	1033	715	724	98	688	13	787	197	601	333	74	798
319	311	92	240	975	435	795	0	268	122	199	1094	395						
SVK	87	98	84	223	80	300	465	168	124	42	161	9	162	49	185	76	14	169
76	93	30	62	286	128	212	197	0	53	88	445	152						
SVN	30	63	73	87	62	113	180	139	92	36	84	9	103	58	87	49	24	135
58	35	15	49	140	64	136	102	33	0	30	156	74						
URY	206	127	76	207	72	120	164	146	145	21	115	0	173	28	153	89	12	159
110	114	22	50	154	120	129	191	56	22	0	284	146						
USA	821	1052	388	2167	571	929	1678	994	690	157	936	10	1317	184	919	399	95	1062
552	724	120	339	1511	813	1106	1142	281	121	338	0	564						
ZAF	249	289	169	354	168	225	392	318	342	40	272	4	383	81	286	206	39	323
232	169	24	79	375	267	243	379	90	53	133	534	0						

JER

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	GBR	IRL	ITA	NLD	NZL	USA	ZAF
AUS	0	176	48	98	158	27	71	51	339	369	184
CAN	176	0	44	65	123	5	63	28	137	297	112
DEU	39	39	0	80	67	8	60	42	59	74	63
DFS	64	50	74	0	126	12	90	63	109	136	112
GBR	152	123	64	111	0	29	96	62	168	188	138
IRL	22	3	8	9	30	0	8	8	59	21	18
ITA	67	60	58	87	97	9	0	49	78	91	85
NLD	40	22	38	61	56	8	46	0	56	65	57
NZL	380	150	52	84	169	64	77	48	0	294	167
USA	393	307	74	109	202	22	98	69	369	0	238
ZAF	169	109	57	87	134	18	80	52	171	250	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	GBR	IRL	ITA	NLD	NZL	USA	ZAF
AUS	0	176	48	98	158	27	71	51	339	369	184
CAN	176	0	44	65	123	5	63	28	137	297	112
DEU	39	39	0	80	67	8	60	42	59	74	63
DFS	64	50	74	0	126	12	90	63	109	136	112
GBR	152	123	64	111	0	29	96	62	168	188	138
IRL	22	3	8	9	30	0	8	8	59	21	18
ITA	67	60	58	87	97	9	0	49	78	91	85
NLD	40	22	38	61	56	8	46	0	56	65	57
NZL	380	150	52	84	169	64	77	48	0	294	167
USA	393	307	74	109	202	22	98	69	369	0	238
ZAF	169	109	57	87	134	18	80	52	171	250	0

JER

common bulls below diagonal
common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	GBR	IRL	ITA	NLD	NZL	USA	ZAF
AUS	0	176	48	98	158	27	71	51	339	369	184
CAN	176	0	44	65	123	5	63	28	137	297	112
DEU	39	39	0	80	67	8	60	42	59	74	63
DFS	64	50	74	0	126	12	90	63	109	136	112
GBR	152	123	64	111	0	29	96	62	168	188	138
IRL	22	3	8	9	30	0	8	8	59	21	18
ITA	67	60	58	87	97	9	0	49	78	91	85
NLD	40	22	38	61	56	8	46	0	56	65	57
NZL	380	150	52	84	169	64	77	48	0	294	167
USA	393	307	74	109	202	22	98	69	369	0	238
ZAF	169	109	57	87	134	18	80	52	171	250	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	EST	GBR	IRL	LTU	LVA	NLD	NOR	NZL	USA	ZAF
AUS	0	73	28	130	18	42	6	38	32	16	45	108	86	31
CAN	72	0	11	106	1	61	2	14	9	3	4	68	165	70
DEU	27	10	0	57	22	5	3	31	31	13	17	14	20	1
DFS	108	102	48	0	78	48	8	101	109	26	93	141	129	47
EST	17	1	21	67	0	1	0	21	44	8	14	4	11	0
GBR	41	60	5	46	1	0	6	11	9	11	12	45	68	34
IRL	5	2	3	6	0	6	0	2	2	7	33	3	13	0
LTU	34	13	29	83	20	10	2	0	45	11	23	23	27	5
LVA	30	9	27	77	39	8	2	40	0	10	20	14	18	2
NLD	14	3	13	25	7	11	6	10	9	0	26	7	24	2
NOR	37	4	17	73	14	13	33	18	18	25	0	32	47	0
NZL	110	68	14	139	3	42	3	19	12	7	31	0	86	33
USA	87	150	20	129	10	61	13	20	16	22	47	85	0	58
ZAF	31	72	1	44	0	29	0	5	2	2	0	29	53	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	EST	GBR	IRL	LTU	LVA	NLD	NOR	NZL	USA	ZAF
AUS	0	73	28	130	18	42	6	38	32	16	45	108	86	31
CAN	72	0	11	106	1	61	2	14	9	3	4	68	165	70
DEU	27	10	0	57	22	5	3	31	31	13	18	14	20	1
DFS	108	102	48	0	78	48	8	101	109	25	94	141	129	47
EST	17	1	21	67	0	1	0	21	44	8	15	4	11	0
GBR	41	60	5	46	1	0	6	11	9	11	12	45	67	34
IRL	5	2	3	6	0	6	0	2	2	7	33	3	13	0
LTU	34	13	29	83	20	10	2	0	45	11	23	23	27	5
LVA	30	9	27	77	39	8	2	40	0	10	21	14	18	2
NLD	14	3	13	25	7	11	6	10	9	0	26	7	24	2
NOR	37	4	18	74	15	13	33	18	19	25	0	32	47	0
NZL	110	68	14	139	3	42	3	19	12	7	31	0	86	33
USA	87	150	20	129	10	61	13	20	16	22	47	85	0	58
ZAF	31	72	1	44	0	29	0	5	2	2	0	29	53	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal

	AUS	CAN	DEU	DFS	EST	GBR	IRL	LTU	LVA	NLD	NOR	NZL	USA	ZAF
AUS	0	73	28	130	18	42	6	38	32	16	45	108	86	31
CAN	72	0	11	106	1	61	2	14	9	3	4	68	165	70
DEU	27	10	0	57	22	5	3	31	31	13	18	14	20	1
DFS	108	102	48	0	78	48	8	100	109	25	94	141	129	47
EST	17	1	21	67	0	1	0	21	44	8	15	4	11	0
GBR	41	60	5	46	1	0	6	11	9	11	12	45	67	34
IRL	5	2	3	6	0	6	0	2	2	7	33	3	13	0
LTU	34	13	29	83	20	10	2	0	45	11	23	23	27	5
LVA	30	9	27	77	39	8	2	40	0	10	21	14	18	2
NLD	14	3	13	25	7	11	6	10	9	0	26	7	24	2
NOR	37	4	18	74	15	13	33	18	19	25	0	32	47	0
NZL	110	68	14	139	3	42	3	19	12	7	31	0	86	33
USA	87	150	20	129	10	61	13	20	16	22	47	85	0	58
ZAF	31	72	1	44	0	29	0	5	2	2	0	29	53	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	IRL	ITA	NLD	SVK	SVN
CHE	0	259	10	141	52	0	1	45	70	68	27	5
DEA	226	0	179	214	50	409	44	46	686	177	326	141
FRA	8	142	0	2	0	66	10	0	101	38	41	39
FRM	181	246	1	0	69	2	3	59	143	100	52	17
GBR	59	47	0	87	0	0	0	34	44	50	8	0
HRV	0	428	60	1	0	0	16	2	180	67	73	59
HUN	0	29	7	1	0	16	0	1	16	3	12	9
IRL	42	39	0	64	30	1	1	0	47	42	10	1
ITA	74	584	92	173	49	172	15	44	0	128	117	75
NLD	71	181	38	121	50	65	3	37	123	0	45	35
SVK	19	333	35	52	3	57	10	3	99	38	0	39
SVN	5	127	36	17	0	49	7	1	70	33	39	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	IRL	ITA	NLD	SVK	SVN
CHE	0	259	10	141	52	0	1	45	70	68	27	5
DEA	226	0	179	214	50	407	44	46	686	177	326	141
FRA	8	142	0	2	0	66	10	0	101	38	41	39
FRM	181	246	1	0	69	2	3	59	143	100	52	17
GBR	59	47	0	87	0	0	0	34	44	50	8	0
HRV	0	426	60	1	0	0	16	2	178	67	71	59
HUN	0	29	7	1	0	16	0	1	16	3	12	9
IRL	42	39	0	64	30	1	1	0	47	42	10	1
ITA	74	584	92	173	49	170	15	44	0	128	117	75
NLD	71	181	38	121	50	65	3	37	123	0	45	35
SVK	19	333	35	52	3	55	10	3	99	38	0	39
SVN	5	127	36	17	0	49	7	1	70	33	39	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRA	FRM	GBR	HRV	HUN	IRL	ITA	NLD	SVK	SVN
CHE	0	259	10	141	52	0	1	45	70	68	27	5
DEA	226	0	179	214	50	408	44	46	686	177	326	141
FRA	8	142	0	2	0	66	10	0	101	38	41	39
FRM	181	246	1	0	69	2	3	59	143	100	52	17
GBR	59	47	0	87	0	0	0	34	44	50	8	0
HRV	0	427	60	1	0	0	16	2	179	67	72	59
HUN	0	29	7	1	0	16	0	1	16	3	12	9
IRL	42	39	0	64	30	1	1	0	47	42	10	1
ITA	74	584	92	173	49	171	15	44	0	128	117	75
NLD	71	181	38	121	50	65	3	37	123	0	45	35
SVK	19	333	35	52	3	56	10	3	99	38	0	39
SVN	5	127	36	17	0	49	7	1	70	33	39	0