

Introduction

The latest international evaluation for dairy **production** traits took place as scheduled at the Interbull Centre. Data from thirty-four (34) 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, Uruguay and Mexico 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:

BEL HOL Some corrections were made in our pedigree and therefore some bulls lost information (daughters, herds) leading sometimes to decreases in EDC and in reliabilities, improvement of our program that determines the type of proof for bulls

FRA BSW/HOL Some animals changed from official to unofficial as they do not
SIM pass the publication rules anymore

JPN HOL Little changes in proofs caused by additional records and modification of pedigree.

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. They deliver RBV's for all traits. The scaling is according to a rolling base that change somewhat at each evaluation causing slight changes in sire standard deviation.

EST HOL/RDC Decrease in number of daughters/herds of some bulls is due to the update of field data.

SVN HOL/BSW Some decrease in information (herds/daughters/EDC) These changes are mostly consequences of changes in data base related to the pedigree completeness as well as phenotypic data improvement.

SVN SIM Some decrease in information (herds/daughters/EDC) These changes are mostly consequences of changes in data base related to the pedigree completeness as well as phenotypic data improvement.

DEU HOL In general small decreases in number of daughters and/or herds are caused by data/pedigree corrections.

ZAF HOL/JER Some clean-ups on data were done, especially with regards to RDC alias numbers of foreign bulls.

CHE BSW/HOL/SIM Many bulls with decreases in herds/daughters/EDC. In most of the cases the decreases are very small. The reason for this can be found in the continuous work on the raw data by herd-book organizations.

NZL ALL Decrease in information due to continuous parentage verification

IRL HOL Update calculations of type of proof

IRL SIM Base change

ESP HOL Base change

AUS HOL Data corrections have been done resulting in some extreme changes in BVs.

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

Sub-setting:

As decided by the ITC in Orlando, new sub-setting was introduced in the September test run. Sub-setting is necessary for operational purposes and restrictions of time scales. To minimize the effect of sub-setting, larger subsets with 10-12 countries and with 4 link providing countries have been applied.

Window:

According to the decision taken by ITC in Orlando, the following changes have been introduced in regards to the windows used for post processing:

The upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations. The lower values have been set to about the 25% percentile value. The largest changes are for the lower values for conformation traits, with the lowest window being 40% for OFL otherwise it is about 50% for all other confirmation traits. It is anticipated that these low values may not have large impact on evaluations since there were very few countries combinations whose estimated correlations fell between the old limit of 0.30 and these new limits.

DATA AND METHOD OF ANALYSIS

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

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

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

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

SCIENTIFIC LITERATURE

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

International genetic evaluation computation:

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

Verification and Genetic trend validation:

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

Weighting factors:

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

De-regression:

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

Genetic parameter estimation:

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

Post-processing of estimated genetic correlations:

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

Time edits

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

International reliability estimation

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

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.

Table 1. National evaluation data considered in the Interbull evaluation for dairy production traits (August Routine Evaluation 2017). Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	195	136	7721	1695	681	
BEL			1158			
CAN	208	96	11533	665	770	
CHE	2797		3153			3058
CZE			4065			
DEA	5739					22845
DEU			26625	171	412	
DFS			12644	2050	7472	
ESP			3464			
EST			1044		405	
FRA	365		16496			434
FRM						4417
GBR	138	321	6695	852	588	91
HUN			3062			204
IRL			2298	143	43	94
ISR			1316			
ITA	2019		9110	170		1563
JPN			5546			
KOR			1228			
LTU			727		422	
LVA			1023		689	
NLD	172		14680	131	62	310
NOR					3966	
NZL	48	60	7045	4557	1299	
POL			9590			
PRT			2150			
SVK			1069			561
SVN	348		480			572
URY			966			
USA	1049	762	35966	4283	677	43
ZAF			1258	676	141	
HRV			674			764
MEX			599			
No. Records	13078	1375	193385	15393	17627	34956
Pub. Proofs	10703	1097	148413	12543	15825	31647

APPENDIX 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	611.97									
FRA	0.89	637.75								
USA	0.93	0.89	625.59							
CHE	0.90	0.89	0.87	487.89						
ITA	0.88	0.83	0.88	0.87	592.49					
DEA	0.88	0.83	0.86	0.93	0.90	460.85				
NLD	0.88	0.88	0.87	0.85	0.84	0.85	596.88			
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.65		
NZL	0.70	0.76	0.71	0.76	0.70	0.74	0.73	0.75	339.61	
GBR	0.85	0.87	0.85	0.86	0.82	0.83	0.87	0.84	0.71	249.28
AUS	0.76	0.77	0.74	0.73	0.71	0.72	0.77	0.73	0.84	0.75

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
AUS										
CAN	26.12									
FRA	0.89	27.19								
USA	0.91	0.89	23.51							
CHE	0.87	0.87	0.84	19.17						
ITA	0.89	0.83	0.85	0.87	22.67					
DEA	0.87	0.84	0.83	0.93	0.88	17.37				
NLD	0.87	0.87	0.86	0.85	0.84	0.86	25.16			
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.89		
NZL	0.71	0.74	0.71	0.74	0.70	0.83	0.71	0.75	14.90	
GBR	0.86	0.88	0.85	0.87	0.82	0.83	0.87	0.84	0.71	8.76
AUS	0.75	0.76	0.73	0.71	0.71	0.72	0.74	0.73	0.83	0.74

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR
AUS										
CAN	22.47									
FRA	0.84	20.50								
USA	0.90	0.86	18.78							
CHE	0.86	0.85	0.82	15.33						
ITA	0.85	0.82	0.83	0.86	20.79					
DEA	0.87	0.82	0.82	0.91	0.89	14.36				
NLD	0.86	0.84	0.84	0.83	0.82	0.83	19.96			
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.53		
NZL	0.70	0.71	0.70	0.71	0.70	0.75	0.71	0.75	10.35	
GBR	0.84	0.86	0.83	0.84	0.81	0.83	0.86	0.84	0.71	7.36
AUS	0.70	0.73	0.70	0.71	0.69	0.72	0.73	0.73	0.82	0.73

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	725.01				
USA	0.94	706.91			
AUS	0.82	0.78	485.63		
GBR	0.86	0.83	0.77	244.29	
NZL	0.70	0.70	0.84	0.70	325.33

GUE fat

	CAN	USA	AUS	GBR	NZL
CAN	30.29				
USA	0.93	25.43			
AUS	0.80	0.76	17.73		
GBR	0.86	0.84	0.76	10.36	
NZL	0.72	0.71	0.84	0.70	16.39

GUE pro

	CAN	USA	AUS	GBR	NZL
CAN	21.96				
USA	0.92	19.58			
AUS	0.74	0.70	13.90		
GBR	0.85	0.83	0.74	7.28	
NZL	0.70	0.69	0.82	0.69	10.79

HOL mil

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	
AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN
LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX				
CAN	767.15										
DEU	0.92	624.59									
DFS	0.94	0.93	11.19								
FRA	0.91	0.89	0.93	663.72							
ITA	0.90	0.87	0.89	0.88	570.86						
NLD	0.92	0.92	0.93	0.91	0.87	661.06					
USA	0.94	0.90	0.93	0.92	0.91	0.91	670.22				
CHE	0.90	0.89	0.92	0.94	0.88	0.91	0.89	581.37			
GBR	0.86	0.84	0.87	0.87	0.83	0.87	0.85	0.89	272.69		
NZL	0.68	0.69	0.71	0.77	0.70	0.72	0.70	0.77	0.70	315.08	
AUS	0.79	0.77	0.76	0.81	0.74	0.79	0.78	0.81	0.77	0.84	
418.19											
BEL	0.85	0.87	0.83	0.83	0.81	0.86	0.81	0.82	0.82	0.70	
0.79	477.06										
IRL	0.84	0.81	0.83	0.89	0.77	0.86	0.82	0.85	0.82	0.84	
0.85	0.82	170.25									
ESP	0.93	0.91	0.92	0.92	0.90	0.91	0.93	0.90	0.84	0.69	
0.79	0.86	0.84	544.38								
CZE	0.86	0.87	0.84	0.82	0.82	0.83	0.84	0.82	0.82	0.69	
0.72	0.83	0.76	0.84	734.86							
SVN	0.82	0.81	0.82	0.82	0.81	0.82	0.81	0.82	0.82	0.70	
0.70	0.82	0.72	0.81	0.82	11.83						
EST	0.88	0.84	0.89	0.84	0.84	0.85	0.87	0.86	0.82	0.72	
0.77	0.83	0.77	0.86	0.85	0.82	638.52					
ISR	0.83	0.82	0.83	0.83	0.84	0.82	0.84	0.83	0.81	0.64	
0.72	0.81	0.71	0.84	0.81	0.83	0.82	380.61				
HUN	0.86	0.84	0.88	0.88	0.90	0.85	0.90	0.85	0.83	0.69	
0.70	0.81	0.77	0.86	0.83	0.81	0.85	0.82	675.19			
POL	0.89	0.89	0.89	0.88	0.88	0.89	0.88	0.84	0.82	0.69	
0.76	0.82	0.79	0.90	0.86	0.80	0.87	0.83	0.87	407.22		
ZAF	0.84	0.81	0.82	0.84	0.81	0.82	0.84	0.82	0.81	0.70	
0.82	0.81	0.80	0.83	0.81	0.82	0.83	0.84	0.81	0.81	524.74	
JPN	0.94	0.90	0.93	0.91	0.89	0.92	0.93	0.90	0.84	0.72	
0.80	0.85	0.83	0.91	0.85	0.81	0.86	0.87	0.85	0.90	0.84	635.04
LVA	0.80	0.81	0.81	0.81	0.81	0.82	0.82	0.80	0.82	0.70	
0.70	0.82	0.74	0.81	0.81	0.82	0.82	0.82	0.81	0.80	0.82	0.81
448.94											
SVK	0.80	0.82	0.83	0.82	0.82	0.82	0.81	0.82	0.82	0.70	
0.70	0.82	0.74	0.82	0.82	0.83	0.83	0.83	0.85	0.81	0.82	0.82
0.82	393.49										
LTU	0.81	0.81	0.82	0.82	0.82	0.82	0.81	0.83	0.83	0.71	
0.71	0.83	0.76	0.82	0.82	0.83	0.83	0.82	0.80	0.83	0.82	
0.82	0.83	353.05									
PRT	0.80	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.80	0.69	
0.68	0.80	0.70	0.80	0.80	0.81	0.81	0.83	0.80	0.80	0.81	
0.80	0.80	0.81	651.87								
KOR	0.86	0.81	0.84	0.82	0.81	0.82	0.84	0.82	0.82	0.72	
0.76	0.83	0.76	0.84	0.82	0.82	0.84	0.82	0.81	0.80	0.81	0.85
0.82	0.82	0.83	0.80	483.26							
URY	0.80	0.80	0.80	0.80	0.81	0.80	0.80	0.81	0.80	0.77	
0.76	0.80	0.76	0.80	0.80	0.82	0.82	0.84	0.80	0.80	0.81	
0.81	0.81	0.81	0.80	0.80	175.76						
HRV	0.81	0.81	0.82	0.82	0.81	0.82	0.82	0.80	0.82	0.70	
0.70	0.82	0.71	0.82	0.82	0.82	0.82	0.82	0.82	0.80	0.82	0.82
0.82	0.83	0.82	0.80	0.83	0.81	11.85					
MEX	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.69	
0.69	0.80	0.69	0.80	0.80	0.82	0.81	0.85	0.80	0.80	0.80	0.80
0.81	0.81	0.82	0.80	0.80	0.80	0.81	380.78				

HOL fat

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	
AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN
LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX				
CAN	30.46										
DEU	0.91	24.17									
DFS	0.92	0.91	11.18								
FRA	0.91	0.89	0.92	26.87							
ITA	0.89	0.87	0.86	0.88	23.56						
NLD	0.90	0.91	0.91	0.89	0.85	25.18					
USA	0.93	0.90	0.91	0.92	0.92	0.89	24.88				
CHE	0.88	0.88	0.91	0.91	0.85	0.90	0.87	23.16			
GBR	0.86	0.86	0.88	0.89	0.83	0.88	0.87	0.90	9.33		
NZL	0.68	0.69	0.70	0.73	0.70	0.69	0.70	0.73	0.70	12.63	
AUS	0.77	0.73	0.73	0.79	0.72	0.74	0.77	0.74	0.74	0.74	0.83
14.55											
BEL	0.84	0.87	0.82	0.84	0.81	0.84	0.82	0.82	0.82	0.82	0.72
0.77	19.84										
IRL	0.81	0.78	0.82	0.86	0.74	0.83	0.79	0.82	0.80	0.83	
0.82	0.84	6.01									
ESP	0.91	0.89	0.87	0.91	0.90	0.89	0.93	0.86	0.84	0.69	
0.76	0.83	0.79	21.78								
CZE	0.86	0.86	0.84	0.83	0.83	0.82	0.85	0.82	0.82	0.69	
0.71	0.82	0.72	0.85	22.23							
SVN	0.81	0.81	0.82	0.82	0.81	0.82	0.81	0.82	0.82	0.70	
0.71	0.82	0.71	0.81	0.82	12.03						
EST	0.87	0.86	0.89	0.86	0.87	0.84	0.87	0.84	0.82	0.79	
0.78	0.87	0.83	0.85	0.85	0.82	23.74					
ISR	0.83	0.81	0.81	0.81	0.82	0.81	0.85	0.82	0.81	0.64	
0.69	0.81	0.66	0.82	0.81	0.83	0.82	14.24				
HUN	0.86	0.85	0.83	0.88	0.91	0.83	0.91	0.82	0.83	0.69	
0.70	0.81	0.70	0.89	0.85	0.81	0.83	0.83	24.83			
POL	0.89	0.90	0.86	0.89	0.89	0.86	0.89	0.81	0.81	0.68	
0.71	0.83	0.76	0.92	0.87	0.81	0.88	0.83	0.88	16.17		
ZAF	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.80	0.81	0.69	
0.70	0.81	0.70	0.81	0.81	0.82	0.82	0.82	0.81	0.80	17.39	
JPN	0.92	0.89	0.92	0.90	0.86	0.89	0.90	0.89	0.84	0.71	
0.74	0.83	0.81	0.86	0.84	0.81	0.88	0.81	0.81	0.87	0.81	24.23
LVA	0.80	0.81	0.81	0.81	0.81	0.81	0.82	0.80	0.82	0.82	0.70
0.71	0.82	0.71	0.81	0.81	0.82	0.85	0.82	0.81	0.80	0.82	0.81
18.67											
SVK	0.80	0.81	0.82	0.82	0.82	0.82	0.80	0.83	0.82	0.70	
0.71	0.82	0.70	0.82	0.82	0.83	0.85	0.83	0.84	0.80	0.82	0.82
0.82	15.06										
LTU	0.81	0.81	0.82	0.83	0.82	0.82	0.81	0.83	0.83	0.71	
0.72	0.83	0.74	0.82	0.82	0.83	0.83	0.82	0.82	0.80	0.83	0.82
0.82	0.83	15.40									
PRT	0.80	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.80	0.69	
0.68	0.80	0.70	0.80	0.80	0.81	0.81	0.83	0.80	0.80	0.81	
0.80	0.80	0.81	26.81								
KOR	0.84	0.81	0.82	0.83	0.81	0.82	0.86	0.82	0.82	0.70	
0.76	0.82	0.76	0.85	0.82	0.82	0.85	0.82	0.81	0.83	0.81	0.83
0.82	0.82	0.83	0.80	19.38							
URY	0.80	0.80	0.80	0.82	0.81	0.80	0.80	0.81	0.80	0.77	
0.74	0.81	0.78	0.80	0.80	0.82	0.84	0.83	0.80	0.80	0.81	
0.81	0.81	0.82	0.80	0.80	6.68						
HRV	0.81	0.81	0.82	0.82	0.81	0.82	0.80	0.82	0.82	0.70	
0.71	0.82	0.70	0.82	0.82	0.82	0.82	0.82	0.82	0.80	0.82	0.82
0.82	0.83	0.82	0.80	0.83	0.81	12.18					
MEX	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.80	0.81	0.70	
0.69	0.81	0.70	0.81	0.81	0.83	0.83	0.86	0.81	0.81	0.81	0.81
0.83	0.82	0.85	0.81	0.81	0.81	0.82	13.32				

HOL pro

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	
AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN
LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX				
CAN	21.31										
DEU	0.88	17.73									
DFS	0.91	0.91	10.64								
FRA	0.87	0.84	0.92	18.29							
ITA	0.87	0.84	0.87	0.85	17.44						
NLD	0.88	0.90	0.89	0.85	0.83	18.71					
USA	0.91	0.87	0.91	0.89	0.89	0.86	17.46				
CHE	0.85	0.84	0.89	0.91	0.85	0.85	0.85	16.97			
GBR	0.85	0.83	0.87	0.87	0.82	0.87	0.84	0.87	7.21		
NZL	0.68	0.69	0.69	0.69	0.70	0.69	0.69	0.70	0.69	9.03	
AUS	0.70	0.70	0.70	0.73	0.69	0.72	0.69	0.72	0.73	0.81	
10.95											
BEL	0.80	0.82	0.82	0.82	0.81	0.82	0.80	0.82	0.82	0.69	
0.70	14.08										
IRL	0.74	0.72	0.76	0.81	0.71	0.78	0.74	0.77	0.78	0.82	
0.81	0.76	4.72									
ESP	0.90	0.87	0.89	0.88	0.86	0.87	0.90	0.85	0.84	0.69	
0.71	0.82	0.77	15.81								
CZE	0.80	0.81	0.81	0.81	0.81	0.81	0.80	0.81	0.82	0.69	
0.69	0.81	0.69	0.81	17.14							
SVN	0.81	0.81	0.82	0.82	0.81	0.82	0.81	0.82	0.82	0.71	
0.70	0.82	0.71	0.82	0.82	11.43						
EST	0.81	0.83	0.84	0.82	0.82	0.82	0.81	0.83	0.83	0.71	
0.71	0.82	0.71	0.82	0.82	0.83	18.96					
ISR	0.83	0.81	0.82	0.83	0.82	0.82	0.81	0.83	0.83	0.81	0.64
0.65	0.82	0.65	0.83	0.82	0.83	0.83	9.85				
HUN	0.83	0.82	0.85	0.86	0.87	0.82	0.87	0.83	0.81	0.69	
0.69	0.81	0.70	0.83	0.81	0.82	0.82	0.82	20.89			
POL	0.85	0.84	0.85	0.82	0.83	0.83	0.83	0.83	0.80	0.68	
0.69	0.80	0.69	0.86	0.80	0.81	0.84	0.83	0.83	10.88		
ZAF	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.80	0.82	0.81	0.69
0.75	0.81	0.73	0.81	0.81	0.82	0.83	0.83	0.81	0.80	13.60	
JPN	0.91	0.86	0.91	0.87	0.87	0.87	0.87	0.91	0.86	0.83	0.70
0.71	0.81	0.76	0.88	0.81	0.82	0.84	0.83	0.82	0.86	0.81	17.25
LVA	0.80	0.81	0.81	0.82	0.81	0.82	0.82	0.80	0.82	0.82	0.70
0.70	0.82	0.70	0.81	0.81	0.82	0.82	0.83	0.82	0.80	0.82	0.82
13.17											
SVK	0.80	0.81	0.83	0.82	0.82	0.82	0.82	0.80	0.82	0.82	0.70
0.70	0.82	0.70	0.82	0.81	0.83	0.83	0.84	0.85	0.80	0.82	0.82
0.82	11.07										
LTU	0.81	0.81	0.82	0.83	0.82	0.83	0.81	0.84	0.83	0.83	0.71
0.72	0.83	0.71	0.82	0.82	0.84	0.84	0.84	0.82	0.80	0.83	0.82
0.82	0.84	10.69									
PRT	0.80	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.80	0.80	0.69
0.68	0.80	0.70	0.80	0.80	0.81	0.81	0.83	0.80	0.80	0.80	0.81
0.80	0.80	0.81	20.59								
KOR	0.83	0.81	0.82	0.82	0.81	0.82	0.80	0.82	0.82	0.82	0.70
0.70	0.82	0.71	0.83	0.81	0.83	0.84	0.83	0.81	0.80	0.81	0.82
0.82	0.82	0.83	0.80	13.29							
URY	0.80	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.81	0.80	0.71
0.69	0.80	0.70	0.80	0.80	0.82	0.82	0.84	0.80	0.80	0.80	0.81
0.81	0.81	0.82	0.80	0.80	5.29						
HRV	0.81	0.81	0.82	0.82	0.81	0.82	0.80	0.82	0.82	0.82	0.70
0.70	0.82	0.70	0.82	0.81	0.82	0.83	0.82	0.82	0.80	0.82	0.82
0.82	0.83	0.83	0.80	0.83	0.82	11.59					
MEX	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.70
0.69	0.81	0.70	0.81	0.81	0.83	0.84	0.87	0.81	0.81	0.81	0.81
0.83	0.82	0.86	0.81	0.81	0.81	0.83	11.36				

RDC mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST
LVA	LTU	IRL	NLD							
CAN	586.14									
NOR	0.89	12.52								
USA	0.92	0.89	669.02							
NZL	0.69	0.73	0.70	318.19						
AUS	0.77	0.77	0.77	0.84	407.91					
GBR	0.84	0.83	0.83	0.70	0.77	251.47				
DFS	0.91	0.91	0.90	0.69	0.80	0.84	10.20			
DEU	0.92	0.91	0.89	0.70	0.78	0.84	0.92	603.46		
ZAF	0.82	0.88	0.84	0.70	0.78	0.81	0.82	0.81	545.42	
EST	0.88	0.85	0.88	0.75	0.76	0.83	0.86	0.84	0.83	515.20
LVA	0.82	0.83	0.82	0.73	0.73	0.82	0.83	0.82	0.83	0.83
301.44										
LTU	0.83	0.83	0.82	0.73	0.73	0.83	0.82	0.82	0.84	0.84
0.83	318.00									
IRL	0.83	0.73	0.81	0.84	0.85	0.81	0.83	0.81	0.80	0.79
0.77	0.79	146.89								
NLD	0.92	0.89	0.90	0.73	0.81	0.87	0.93	0.92	0.81	0.86
0.83	0.84	0.85	711.96							

RDC fat

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST
LVA	LTU	IRL	NLD							
CAN	22.13									
NOR	0.88	12.11								
USA	0.91	0.84	24.88							
NZL	0.69	0.76	0.69	13.45						
AUS	0.74	0.75	0.78	0.85	15.62					
GBR	0.84	0.82	0.84	0.69	0.75	8.36				
DFS	0.90	0.88	0.89	0.71	0.78	0.86	10.33			
DEU	0.90	0.89	0.89	0.70	0.76	0.86	0.90	24.18		
ZAF	0.81	0.88	0.85	0.70	0.70	0.81	0.81	0.81	19.16	
EST	0.87	0.85	0.87	0.79	0.76	0.84	0.86	0.85	0.83	19.13
LVA	0.82	0.83	0.82	0.73	0.72	0.83	0.83	0.83	0.83	0.86
13.51										
LTU	0.83	0.83	0.82	0.73	0.73	0.84	0.82	0.82	0.85	0.84
0.83	14.93									
IRL	0.81	0.72	0.79	0.82	0.82	0.79	0.82	0.79	0.72	0.83
0.75	0.78	5.86								
NLD	0.90	0.87	0.89	0.70	0.76	0.87	0.91	0.91	0.81	0.85
0.83	0.85	0.82	28.09							

 ^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	73	149	110	102	119	46	26	19	59	79
FRA	50	0	117	146	170	194	79	49	19	54	58
USA	114	78	0	297	222	302	74	36	26	86	120
CHE	71	109	281	0	402	530	86	67	21	69	106
ITA	68	134	154	345	0	645	113	86	24	74	107
DEA	78	143	266	426	546	0	130	93	29	74	114
NLD	38	64	64	77	92	123	0	38	21	40	53
SVN	20	48	28	64	85	86	39	0	6	21	25
NZL	14	15	23	16	18	24	14	5	0	18	24
GBR	46	43	77	51	52	50	31	15	15	0	54
AUS	64	45	113	68	76	79	40	20	20	48	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	73	149	110	102	119	46	26	19	59	79
FRA	50	0	117	146	170	194	79	49	19	54	58
USA	114	78	0	297	222	302	74	36	26	86	120
CHE	71	109	281	0	402	530	86	67	21	69	106
ITA	68	134	154	345	0	645	113	86	24	74	107
DEA	78	143	266	426	546	0	130	93	29	74	114
NLD	38	64	64	77	92	123	0	38	21	40	53
SVN	20	48	28	64	85	86	39	0	6	21	25
NZL	14	15	23	16	18	24	14	5	0	18	24
GBR	46	43	77	51	52	50	31	15	15	0	54
AUS	64	45	113	68	76	79	40	20	20	48	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	73	149	110	102	119	46	26	19	59	79
FRA	50	0	117	146	170	194	79	49	19	54	58
USA	114	78	0	297	222	302	74	36	26	86	120
CHE	71	109	281	0	402	530	86	67	21	69	106
ITA	68	134	154	345	0	645	113	86	24	74	107
DEA	78	143	266	426	546	0	130	93	29	74	114
NLD	38	64	64	77	92	123	0	38	21	40	53
SVN	20	48	28	64	85	86	39	0	6	21	25
NZL	14	15	23	16	18	24	14	5	0	18	24
GBR	46	43	77	51	52	50	31	15	15	0	54
AUS	64	45	113	68	76	79	40	20	20	48	0

GUE

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

CAN 0 64 44 29 14
USA 55 0 60 86 31
AUS 43 56 0 38 27
GBR 24 88 33 0 15
NZL 10 28 26 13 0

GUE

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

CAN 0 64 44 29 14
USA 55 0 60 86 31
AUS 43 56 0 38 27
GBR 24 88 33 0 15
NZL 10 28 26 13 0

GUE

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

CAN 0 63 44 29 13
USA 54 0 60 86 31
AUS 43 56 0 38 27
GBR 24 88 33 0 15
NZL 10 28 26 13 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	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX					
CAN	0	2118	1167	1253	1388	1197	2755	733	1384	621	1180	459	397	1110	941	167	203
92	818	1064	458	1143	372	385	190	859	574	421	229	351					
DEU	1288	0	2564	2354	2298	3124	3287	1037	1917	879	1535	751	691	1388	1763	262	359
138	1124	2026	567	1341	631	689	434	1109	548	447	531	345					
DFS	860	1528	0	1485	1402	1844	1799	631	1379	738	1140	542	586	895	1136	213	248
124	799	1333	479	854	409	384	259	819	417	376	334	281					
FRA	731	1103	696	0	1583	1770	2273	579	1382	720	1141	602	573	1003	1139	176	222
112	841	1393	452	1085	354	389	195	809	448	362	236	291					
ITA	871	1277	899	716	0	1500	2283	628	1370	671	1071	514	499	1107	1154	208	228
110	882	1316	464	1046	416	371	232	880	510	398	307	321					
NLD	1021	2680	1458	983	1047	0	2164	774	1532	916	1305	779	679	966	1333	214	308
129	846	1483	491	920	436	497	248	931	417	381	373	291					
USA	2743	2030	1213	1099	1254	1753	0	853	1883	954	1653	570	595	1363	1487	200	293
141	1130	1683	610	1712	518	497	278	1139	742	609	305	438					
CHE	576	883	548	498	541	749	758	0	608	345	530	395	307	496	488	126	141
52	397	577	249	409	240	210	101	455	225	189	174	170					
GBR	1510	1299	949	778	908	1244	1550	554	0	821	1234	539	718	960	943	184	215
111	756	1106	486	913	355	343	217	843	431	394	279	312					
NZL	608	660	497	392	448	821	878	291	693	0	1081	339	571	473	552	113	120
95	448	569	352	489	206	234	137	498	271	309	184	189					
AUS	1101	1039	755	714	681	1088	1548	463	999	1069	0	492	564	771	773	160	189
90	622	871	451	771	310	285	176	692	380	378	240	259					
BEL	411	696	465	554	419	837	452	372	482	259	403	0	304	431	419	126	113
55	344	478	237	339	187	190	94	419	190	173	171	155					
IRL	326	537	434	393	359	577	472	284	663	451	447	274	0	390	401	90	104
69	339	449	277	337	158	167	107	368	168	208	134	139					
ESP	628	854	637	693	752	835	827	401	738	354	532	405	350	0	769	165	174
94	671	890	426	800	304	296	179	729	403	330	235	274					
CZE	616	1301	688	656	734	1139	1090	339	603	368	467	303	265	522	0	188	228
107	820	1155	373	745	374	437	207	713	421	337	302	265					
SVN	116	246	177	121	169	182	150	94	131	77	114	98	63	122	143	0	75
39	141	208	89	144	99	72	44	142	85	64	85	60					
EST	104	247	143	99	122	221	188	78	118	61	86	67	52	80	143	44	0
43	169	264	94	169	158	104	67	167	88	90	103	66					
ISR	60	113	100	60	72	107	127	36	75	79	60	33	49	59	81	31	28
0	93	112	56	88	56	44	36	90	50	58	55	40					
HUN	711	857	594	528	715	674	1069	318	643	355	459	271	270	525	725	108	104
73	0	812	374	627	273	295	163	634	397	334	216	279					
POL	761	1642	981	800	901	1249	1456	459	839	409	597	407	328	599	891	186	183
89	698	0	390	832	496	397	275	869	481	365	380	305					
ZAF	390	431	356	304	341	409	581	200	417	288	384	190	223	373	245	60	47
39	305	285	0	398	150	170	90	404	247	256	133	205					
JPN	484	472	406	338	413	422	650	247	410	239	379	205	182	346	294	81	56
39	333	392	257	0	281	280	160	608	470	346	176	286					
LVA	202	502	260	162	261	292	425	121	212	117	154	110	91	166	255	67	105
40	206	394	89	118	0	155	142	339	184	158	211	132					
SVK	261	513	197	198	206	335	322	106	192	139	142	101	83	148	352	42	49
19	210	263	94	98	75	0	78	291	184	160	114	119					
LTU	88	409	131	49	108	130	175	38	97	58	66	34	43	72	128	20	31
17	96	202	33	41	104	38	0	169	109	92	119	64					
PRT	844	996	694	656	783	914	1155	392	754	401	517	396	303	687	577	109	110
67	606	862	359	347	266	196	107	0	409	357	272	327					
KOR	516	351	282	245	400	277	846	151	311	195	271	119	108	283	297	51	45
32	332	392	189	266	108	113	50	336	0	269	109	243					
URY	393	316	267	208	286	296	763	140	327	241	282	122	154	267	249	36	50
31	286	307	217	204	99	113	52	319	222	0	113	224					

HRV	113	544	254	139	222	330	228	116	196	106	148	136	90	182	225	70	73
40	164	331	89	79	173	58	81	219	48	64	0	102					
MEX	352	283	233	225	294	241	523	148	280	149	212	138	113	248	218	45	49
25	267	286	192	216	89	74	29	340	230	212	69	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	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX					
CAN	0	2119	1167	1254	1391	1197	2756	733	1384	621	1180	459	397	1110	941	167	203
92	818	1065	458	1143	372	385	190	857	575	421	229	134					
DEU	1290	0	2564	2354	2302	3124	3287	1037	1916	879	1535	751	691	1388	1763	262	359
138	1124	2026	567	1340	631	689	434	1107	548	447	531	129					
DFS	861	1528	0	1485	1405	1844	1799	631	1378	738	1140	542	586	895	1136	213	248
124	799	1333	479	853	409	384	259	817	417	376	334	116					
FRA	732	1103	696	0	1586	1770	2273	579	1381	720	1141	602	573	1003	1139	176	222
112	841	1393	452	1084	354	389	195	809	448	362	236	120					
ITA	874	1282	902	719	0	1503	2288	630	1371	674	1074	516	501	1110	1154	208	228
112	884	1319	465	1046	416	371	232	881	512	400	307	118					
NLD	1022	2680	1458	983	1052	0	2164	774	1531	916	1305	779	679	966	1333	214	308
129	846	1483	491	919	436	497	248	931	417	381	373	120					
USA	2745	2030	1213	1099	1264	1753	0	853	1883	954	1653	570	595	1363	1487	200	293
141	1130	1683	610	1711	518	497	278	1138	742	609	305	141					
CHE	577	883	548	498	543	749	758	0	607	345	530	395	307	496	488	126	141
52	397	577	249	408	240	210	101	455	225	189	174	92					
GBR	1511	1299	949	778	909	1244	1550	554	0	820	1233	538	718	960	942	184	215
111	756	1105	486	912	354	343	217	842	431	394	278	124					
NZL	609	660	497	392	452	821	878	291	693	0	1081	339	571	473	552	113	120
95	448	569	352	489	206	234	137	498	271	309	184	96					
AUS	1101	1039	755	714	684	1088	1548	463	999	1069	0	492	564	771	773	160	189
90	622	871	451	770	310	285	176	692	380	378	240	114					
BEL	411	696	465	554	420	837	452	372	482	259	403	0	304	431	419	126	113
55	344	478	237	339	187	190	94	419	190	173	171	87					
IRL	326	537	434	393	361	577	472	284	663	451	447	274	0	390	401	90	104
69	339	449	277	336	158	167	107	368	168	208	134	74					
ESP	629	854	637	693	757	835	827	401	738	354	532	405	350	0	769	165	174
94	671	890	426	799	304	296	179	729	403	330	235	115					
CZE	616	1300	687	656	734	1138	1090	339	603	368	467	303	265	521	0	188	228
107	820	1155	373	744	374	437	207	712	421	337	302	91					
SVN	116	246	177	121	169	182	150	94	131	77	114	98	63	122	143	0	75
39	141	208	89	143	99	72	44	142	85	64	85	33					
EST	104	247	143	99	122	221	188	78	118	61	86	67	52	80	143	44	0
43	169	264	94	168	158	104	67	167	88	90	103	27					
ISR	60	113	100	60	74	107	127	36	75	79	60	33	49	59	81	31	28
0	93	112	56	88	56	44	36	90	50	58	55	14					
HUN	712	857	594	528	717	674	1069	318	643	355	459	271	270	525	725	108	104
73	0	812	374	626	273	295	163	634	397	334	216	106					
POL	762	1642	981	800	903	1249	1456	459	839	409	597	407	328	599	890	186	183
89	698	0	390	831	496	397	275	868	481	365	380	97					
ZAF	391	431	356	304	343	409	581	200	417	288	384	190	223	373	245	60	47
39	305	285	0	397	150	170	90	404	247	256	133	99					
JPN	483	470	404	335	408	420	644	245	407	236	375	205	181	343	291	79	55
39	332	388	256	0	281	279	160	607	470	345	176	123					
LVA	202	502	260	162	261	292	425	121	212	117	154	110	91	166	255	67	105
40	206	394	89	117	0	155	142	339	184	158	211	41					
SVK	261	513	197	198	206	335	322	106	192	139	142	101	83	148	351	42	49
19	210	263	94	97	75	0	78	291	184	160	114	54					
LTU	88	409	131	49	108	130	175	38	97	58	66	34	43	72	128	20	31
17	96	202	33	41	104	38	0	169	109	92	119	23					

PRT	845	996	694	656	785	916	1157	392	755	401	517	397	304	689	577	109	110
67	607	864	360	346	266	197	107	0	408	357	272	119					
KOR	517	351	282	245	404	277	845	151	311	195	271	119	108	283	297	51	45
32	332	392	189	265	108	113	50	336	0	269	109	93					
URY	393	316	267	208	289	296	763	140	327	241	282	122	154	267	249	36	50
31	286	307	217	201	99	113	52	321	222	0	113	95					
HRV	113	544	254	139	222	330	228	116	196	106	148	136	90	182	225	70	73
40	164	331	89	79	173	58	81	219	48	64	0	41					
MEX	162	143	120	124	124	130	181	93	149	93	118	92	75	131	72	26	18
9	113	99	110	119	27	40	7	142	96	102	29	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	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX					
CAN	0	2118	1167	1253	1388	1197	2749	733	1384	621	1180	459	397	1110	941	167	203
92	818	1064	458	1141	372	385	190	859	574	421	229	133					
DEU	1288	0	2564	2354	2298	3124	3283	1037	1916	879	1535	751	691	1388	1763	262	359
138	1124	2026	567	1340	631	689	434	1109	548	447	531	128					
DFS	860	1528	0	1485	1402	1844	1797	631	1378	738	1140	542	586	895	1136	213	248
124	799	1333	479	853	409	384	259	819	417	376	334	115					
FRA	731	1103	696	0	1583	1770	2272	579	1381	720	1141	602	573	1003	1139	176	222
112	841	1393	452	1084	354	389	195	808	448	362	236	119					
ITA	871	1277	899	716	0	1500	2283	628	1369	671	1071	514	499	1107	1154	208	228
110	882	1316	464	1045	416	371	232	879	510	398	307	117					
NLD	1021	2680	1458	983	1047	0	2163	774	1531	916	1305	779	679	966	1333	214	308
129	846	1483	491	918	436	497	248	930	417	381	373	119					
USA	2739	2028	1213	1099	1254	1753	0	853	1882	954	1650	569	595	1362	1487	200	293
141	1130	1683	610	1708	518	496	278	1138	743	609	305	140					
CHE	576	883	548	498	541	749	758	0	607	345	530	395	307	496	488	126	141
52	397	577	249	407	240	210	101	455	225	189	174	91					
GBR	1510	1299	949	778	908	1244	1550	554	0	820	1233	538	718	960	942	184	215
111	756	1105	486	912	354	343	217	841	431	394	278	123					
NZL	608	660	497	392	448	821	878	291	693	0	1081	339	571	473	552	113	120
95	448	569	352	489	206	234	137	498	271	309	184	95					
AUS	1101	1039	755	714	681	1088	1546	463	999	1069	0	492	564	771	773	160	189
90	622	871	451	770	310	285	176	692	380	378	240	113					
BEL	411	696	465	554	419	837	451	372	482	259	403	0	304	431	419	126	113
55	344	478	237	339	187	190	94	419	190	173	171	86					
IRL	326	537	434	393	359	577	472	284	663	451	447	274	0	390	401	90	104
69	339	449	277	336	158	167	107	368	168	208	134	73					
ESP	628	854	637	693	752	835	827	401	738	354	532	405	350	0	769	165	174
94	671	890	426	799	304	296	179	728	403	330	235	114					
CZE	616	1300	687	656	734	1138	1090	339	603	368	467	303	265	521	0	188	228
107	820	1155	373	744	374	437	207	712	421	337	302	90					
SVN	116	246	177	121	169	182	150	94	131	77	114	98	63	122	143	0	75
39	141	208	89	143	99	72	44	142	85	64	85	33					
EST	104	247	143	99	122	221	188	78	118	61	86	67	52	80	143	44	0
43	169	264	94	167	158	104	67	167	88	90	103	27					
ISR	60	113	100	60	72	107	127	36	75	79	60	33	49	59	81	31	28
0	93	112	56	88	56	44	36	90	50	58	55	14					
HUN	711	857	594	528	715	674	1069	318	643	355	459	271	270	525	725	108	104
73	0	812	374	626	273	295	163	633	397	334	216	105					
POL	761	1642	981	800	901	1249	1456	459	839	409	597	407	328	599	890	186	183
89	698	0	390	831	496	397	275	868	481	365	380	96					
ZAF	390	431	356	304	341	409	581	200	417	288	384	190	223	373	245	60	47
39	305	285	0	397	150	170	90	404	247	256	133	98					
JPN	481	470	404	335	408	419	643	245	407	236	375	205	181	343	291	79	54
39	332	388	256	0	281	279	160	606	470	345	176	122					

LVA	202	502	260	162	261	292	425	121	212	117	154	110	91	166	255	67	105
40	206	394	89	117	0	155	142	339	184	158	211	41					
SVK	261	513	197	198	206	335	321	106	192	139	142	101	83	148	351	42	49
19	210	263	94	97	75	0	78	290	184	160	114	54					
LTU	88	409	131	49	108	130	175	38	97	58	66	34	43	72	128	20	31
17	96	202	33	41	104	38	0	169	109	92	119	23					
PRT	846	996	695	655	782	915	1156	392	753	400	516	396	303	687	577	108	110
66	606	862	360	346	266	197	107	0	408	356	272	118					
KOR	515	351	282	245	400	277	847	151	311	195	271	119	108	283	297	51	45
32	332	392	189	265	108	113	50	336	0	269	109	93					
URY	393	316	267	208	286	296	763	140	327	241	282	122	154	267	249	36	50
31	286	307	217	201	99	113	52	320	222	0	113	94					
HRV	113	544	254	139	222	330	228	116	196	106	148	136	90	182	225	70	73
40	164	331	89	79	173	58	81	218	48	64	0	40					
MEX	159	141	119	123	123	129	179	92	147	92	117	91	74	130	70	26	17
9	112	98	109	117	27	40	7	141	96	100	28	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	71	350	157	224	140	30	134	67	61	7
DFS	56	0	144	116	114	135	79	120	96	104	20
USA	362	116	0	324	441	208	68	267	100	104	29
NZL	167	90	398	0	404	185	61	184	85	80	86
AUS	227	79	476	454	0	187	58	212	83	77	39
GBR	135	119	219	186	184	0	69	150	102	90	41
NLD	24	77	72	54	50	63	0	62	55	53	16
ZAF	128	96	275	190	198	150	58	0	91	82	22
ITA	64	93	107	83	77	103	54	84	0	72	11
DEU	59	97	107	76	67	89	49	79	74	0	14
IRL	3	16	28	94	33	42	15	20	11	14	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	71	350	157	224	139	30	134	67	61	7
DFS	56	0	144	116	114	134	79	120	96	104	20
USA	362	116	0	324	441	207	68	267	100	104	29
NZL	167	90	398	0	404	184	61	184	85	80	86
AUS	227	79	476	454	0	186	58	212	83	77	39
GBR	135	119	219	186	184	0	69	150	101	90	41
NLD	24	77	72	54	50	63	0	62	55	53	16
ZAF	128	96	275	190	198	150	58	0	91	82	22
ITA	64	93	107	83	77	103	54	84	0	72	11
DEU	59	97	107	76	67	89	49	79	74	0	14
IRL	3	16	28	94	33	42	15	20	11	14	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	71	350	157	224	139	30	134	67	61	7
DFS	56	0	144	116	114	134	79	120	96	104	20
USA	362	116	0	324	441	207	68	267	100	104	29
NZL	167	90	398	0	404	184	61	184	85	80	86
AUS	227	79	476	454	0	186	58	212	83	77	39
GBR	135	119	219	186	184	0	69	150	101	90	41
NLD	24	77	72	54	50	63	0	62	55	53	16
ZAF	128	96	275	190	198	150	58	0	91	82	22
ITA	64	93	107	83	77	103	54	84	0	72	11
DEU	59	97	107	76	67	89	49	79	74	0	14
IRL	3	16	28	94	33	42	15	20	11	14	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	186	75	93	74	131	13	74	1	10	15	2	4
NOR	4	0	61	40	54	37	107	18	0	17	20	27	40	29
USA	169	62	0	105	115	94	160	26	63	14	23	33	19	31
NZL	74	39	104	0	128	67	158	20	37	8	17	27	5	13
AUS	92	45	113	130	0	71	158	41	37	24	36	45	8	22
GBR	72	38	86	63	70	0	87	18	37	7	17	25	14	25
DFS	131	80	153	155	133	83	0	64	51	87	119	113	12	34
DEU	12	18	26	20	40	17	54	0	2	24	35	38	5	14
ZAF	76	0	57	32	36	32	48	2	0	0	2	5	0	2
EST	1	17	13	7	22	6	76	23	0	0	47	26	0	12
LVA	10	18	20	14	32	16	80	30	2	41	0	53	3	11
LTU	14	22	27	23	40	23	96	35	5	25	47	0	4	13
IRL	2	39	19	5	7	13	10	5	0	0	3	4	0	9
NLD	4	28	30	13	20	23	33	14	2	11	10	12	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	186	75	93	74	131	13	74	1	10	15	2	4
NOR	4	0	61	40	54	37	108	19	0	18	21	27	40	29
USA	169	62	0	105	115	93	160	26	63	14	23	33	19	31
NZL	74	39	104	0	128	67	158	20	37	8	17	27	5	13
AUS	92	45	113	130	0	71	158	41	37	24	36	45	8	22
GBR	72	38	86	63	70	0	87	18	37	7	17	25	14	25
DFS	131	81	153	155	133	83	0	64	51	87	119	113	12	34
DEU	12	19	26	20	40	17	54	0	2	24	35	38	5	14
ZAF	76	0	57	32	36	32	48	2	0	0	2	5	0	2
EST	1	18	13	7	22	6	76	23	0	0	47	26	0	12
LVA	10	19	20	14	32	16	80	30	2	41	0	53	3	11
LTU	14	22	27	23	40	23	96	35	5	25	47	0	4	13
IRL	2	39	19	5	7	13	10	5	0	0	3	4	0	9
NLD	4	28	30	13	20	23	33	14	2	11	10	12	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	186	75	93	74	131	13	74	1	10	15	2	4
NOR	4	0	61	40	54	37	108	19	0	18	21	27	40	29
USA	169	62	0	105	115	93	160	26	63	14	23	33	19	31
NZL	74	39	104	0	128	67	158	20	37	8	17	27	5	13
AUS	92	45	113	130	0	71	158	41	37	24	36	45	8	22
GBR	72	38	86	63	70	0	87	18	37	7	17	25	14	25
DFS	131	81	153	155	133	83	0	64	51	87	119	112	12	34
DEU	12	19	26	20	40	17	54	0	2	24	35	38	5	14
ZAF	76	0	57	32	36	32	48	2	0	0	2	5	0	2
EST	1	18	13	7	22	6	76	23	0	0	47	26	0	12
LVA	10	19	20	14	32	16	80	30	2	41	0	53	3	11
LTU	14	22	27	23	40	23	95	35	5	25	47	0	4	13
IRL	2	39	19	5	7	13	10	5	0	0	3	4	0	9
NLD	4	28	30	13	20	23	33	14	2	11	10	12	8	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	296	172	82	6	12	2	79	55	30	55	1	18
DEA	263	0	233	795	167	233	44	217	57	355	53	470	17
FRM	221	276	0	151	17	3	3	108	68	56	72	2	28
ITA	82	696	185	0	96	131	19	153	56	133	47	204	20
SVN	6	154	17	92	0	53	10	43	1	45	0	67	0
FRA	9	193	1	117	49	0	11	53	1	52	0	83	0
HUN	1	30	1	15	8	8	0	4	1	12	0	17	0
NLD	80	223	130	149	41	53	4	0	49	57	51	79	15
IRL	51	48	73	54	1	1	1	44	0	11	38	3	14
SVK	22	362	55	112	44	45	10	48	4	0	10	83	3
GBR	63	55	91	51	0	0	0	52	33	5	0	0	18
HRV	1	495	1	195	57	77	16	78	2	66	0	0	0
USA	19	24	43	27	0	0	0	18	14	3	25	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	296	172	82	6	12	2	79	55	30	55	1	18
DEA	263	0	233	795	167	233	44	217	57	355	53	468	17
FRM	221	276	0	151	17	3	3	108	68	56	72	2	28
ITA	82	696	185	0	96	131	19	153	56	133	47	202	20
SVN	6	154	17	92	0	53	10	43	1	45	0	67	0
FRA	9	193	1	117	49	0	11	53	1	52	0	83	0
HUN	1	30	1	15	8	8	0	4	1	12	0	17	0
NLD	80	223	130	149	41	53	4	0	49	57	51	79	15
IRL	51	48	73	54	1	1	1	44	0	11	38	3	14
SVK	22	362	55	112	44	45	10	48	4	0	10	81	3
GBR	63	55	91	51	0	0	0	52	33	5	0	0	18
HRV	1	493	1	193	57	77	16	78	2	64	0	0	0
USA	19	24	43	27	0	0	0	18	14	3	25	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	296	172	82	6	12	2	79	55	30	55	1	18
DEA	263	0	233	795	167	233	44	217	57	355	53	469	17
FRM	221	276	0	151	17	3	3	108	68	56	72	2	28
ITA	82	696	185	0	96	131	19	153	56	133	47	203	20
SVN	6	154	17	92	0	53	10	43	1	45	0	67	0
FRA	9	193	1	117	49	0	11	53	1	52	0	83	0
HUN	1	30	1	15	8	8	0	4	1	12	0	17	0
NLD	80	223	130	149	41	53	4	0	49	57	51	79	15
IRL	51	48	73	54	1	1	1	44	0	11	38	3	14
SVK	22	362	55	112	44	45	10	48	4	0	10	82	3
GBR	63	55	91	51	0	0	0	52	33	5	0	0	18
HRV	1	494	1	194	57	77	16	78	2	65	0	0	0
USA	19	24	43	27	0	0	0	18	14	3	25	0	0
