

Introduction

The latest international evaluation for dairy **production traits** took place as scheduled at the Interbull Centre. Data from twenty nine (29) 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 and Uruguay were computed. Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental breed data were included in this evaluation.

Changes in national procedures

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

NOR RDC Standard deviation changed from 10 to 12, this mimics the expected effect of future change to a cow-base. The rolling definition of hys is causing the daughters to distribute somewhat differently over hys-classes at each evaluation. Therefore some bulls occasionally may loose EDC although the number of daughters stay the same. Reliability changes is a function of the EDC changes.

FRA HOL/MON Base change missing bulls: they are not missing, we corrected
BSW/SIM their ID (alias was sent in the previous run). Some decrease in information
RED which are expected

ISR HOL Base change

ITA HOL base change+ one year cut off of data

POL HOL New Test Day Model: herd-test-date of all three parities are combined and treated as fixed effect in the new TDM. The fixed lactation curves, modelled with Wilmlink function, are defined in the new TDM for parity x calving-season x calving age x calving year class x breed. Rounding errors in EDC and repeatability have been corrected.

DEU HOL/RDC Base change: all cows born 2010 - 2012 (16CB11), having at least 3 test day records
JER in BV prod

LTU HOL/RDC Base change

NZL HOL/JER Data provided by a new organization Dairy NewZealand (DNZ): daughter counts, herd counts and EDC have changed due to parentage verification.

CAN ALL Change in base. Evaluations for SCS is performed in a separate model from the evaluations for the three yield traits. This resulted in the elimination of correlations between SCS and the yield traits, genetic parameters have also been re-estimated.

CHE BSW Some bulls are missing in the current proof files. The reason for this is that for these bulls the information from which we deduce the status of bulls changed. Introduced the deduction of type of proofs for all traits. Implemented new rules for the publication of proofs, New genetic parameters for all traits.

ITA BSW Base change, changed procedure to estimate reliabilities and EDC, parentage correction. Changed formula to standardized the ebv. Since testrun we have apply a new rolling base for all traits that change every run

PRT HOL Change base to 2010

ZAF (HOL,JER) Data since 2012 on 18 ARC herds were added which influenced the breeding values of especially the 2004/2005 born bulls. Furthermore, quite a lot of French bulls entered the evaluation

SVN (HOL,BSW) Phenotypic data improvements and pedigree corrections

CZE (HOL) Base change

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

Subsetting:

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

Window:

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

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

DATA AND METHOD OF ANALYSIS

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

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

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

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

SCIENTIFIC LITERATURE

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

International genetic evaluation computation:

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

Verification and Genetic trend validation:

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

Weighting factors:

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

De-regression:

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

Genetic parameter estimation:

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

Post-processing of estimated genetic correlations:

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

Time edits

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

International reliability estimation

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

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 2016).
 Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	176	128	7001	1570	639	
BEL			1091			
CAN	208	94	10911	603	742	
CHE	2708		2975			2932
CZE			3869			
DEA	5594					22138
DEU			25672	155	397	
DFS			12130	1969	7208	
ESP			3110			
EST			956		390	
FRA	347		15883			387
FRM						4249
FRR			212			
GBR	130	315	6369	833	532	88
HUN			2905			200
IRL			2102	115	34	88
ISR			1246			
ITA	1942		8981	165		1455
JPN			5190			
KOR			1105			
LTU			659		396	
LVA			915		674	
NLD	159		14095	115	57	283
NOR					3826	
NZL	44	58	6761	4374	1259	
POL			8844			
PRT			2091			
SVK			1017			542
SVN	323		425			535
URY			903			
USA	1008	749	34301	3958	638	37
ZAF		37	1229	652	140	
HRV			598			705
No. Records	12639	1381	183546	14509	16932	33639
Pub. Proofs	10332	1104	143283	11922	15218	30587

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

BSW mil

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	612.50										
FRA	0.89	641.88									
USA	0.93	0.89	624.02								
CHE	0.90	0.89	0.87	487.06							
ITA	0.89	0.83	0.87	0.87	583.37						
DEA	0.87	0.84	0.86	0.93	0.90	462.93					
NLD	0.89	0.88	0.87	0.85	0.84	0.86	556.23				
SVN	0.83	0.84	0.82	0.81	0.81	0.84	0.84	10.18			
NZL	0.70	0.76	0.72	0.76	0.70	0.74	0.74	0.75	350.36		
GBR	0.85	0.87	0.85	0.85	0.82	0.84	0.87	0.85	0.71	249.25	
AUS	0.77	0.79	0.75	0.73	0.72	0.73	0.78	0.76	0.84	0.76	380.04

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	26.13										
FRA	0.89	27.43									
USA	0.91	0.89	23.60								
CHE	0.86	0.88	0.83	19.26							
ITA	0.89	0.83	0.85	0.88	22.30						
DEA	0.85	0.85	0.83	0.93	0.88	17.51					
NLD	0.87	0.87	0.87	0.85	0.84	0.87	24.68				
SVN	0.83	0.84	0.82	0.81	0.81	0.84	0.84	10.29			
NZL	0.71	0.74	0.71	0.74	0.70	0.84	0.71	0.75	14.95		
GBR	0.86	0.88	0.85	0.86	0.82	0.84	0.87	0.85	0.72	9.47	
AUS	0.75	0.77	0.74	0.71	0.71	0.73	0.75	0.76	0.84	0.74	14.80

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	22.22										
FRA	0.84	20.79									
USA	0.90	0.87	18.83								
CHE	0.85	0.85	0.82	15.27							
ITA	0.85	0.82	0.83	0.86	20.48						
DEA	0.84	0.83	0.82	0.91	0.89	14.47					
NLD	0.86	0.85	0.84	0.83	0.82	0.84	18.51				
SVN	0.83	0.84	0.82	0.81	0.81	0.84	0.84	10.14			
NZL	0.70	0.72	0.71	0.72	0.70	0.76	0.71	0.75	10.68		
GBR	0.85	0.86	0.83	0.83	0.81	0.84	0.87	0.85	0.71	7.15	
AUS	0.71	0.74	0.70	0.71	0.69	0.73	0.74	0.76	0.82	0.74	11.49

GUE mil

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	729.53					
USA	0.94	713.87				
AUS	0.83	0.79	470.55			
GBR	0.86	0.83	0.78	237.64		
ZAF	0.85	0.85	0.82	0.84	345.98	
NZL	0.70	0.70	0.84	0.70	0.72	331.60

GUE fat

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	30.17					
USA	0.93	25.52				
AUS	0.80	0.78	17.40			
GBR	0.86	0.84	0.77	9.97		
ZAF	0.81	0.81	0.74	0.84	13.59	
NZL	0.72	0.71	0.84	0.70	0.72	16.63

GUE pro

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	22.01					
USA	0.92	19.66				
AUS	0.74	0.71	13.65			
GBR	0.85	0.83	0.75	6.44		
ZAF	0.81	0.81	0.76	0.84	10.55	
NZL	0.70	0.69	0.82	0.70	0.71	11.01

SIM fat

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV
USA												
CHE	22.44											
DEA	0.88	19.34										
FRM	0.94	0.91	24.96									
ITA	0.85	0.84	0.82	19.42								
SVN	0.85	0.83	0.86	0.83	9.14							
FRA	0.91	0.93	0.90	0.87	0.84	27.87						
HUN	0.83	0.84	0.89	0.89	0.85	0.88	15.22					
NLD	0.88	0.92	0.90	0.83	0.84	0.89	0.84	27.66				
IRL	0.75	0.73	0.77	0.73	0.75	0.85	0.72	0.79	5.44			
SVK	0.84	0.83	0.84	0.83	0.85	0.84	0.85	0.84	0.75	13.08		
GBR	0.90	0.88	0.87	0.83	0.84	0.89	0.83	0.87	0.77	0.84	11.20	
HRV	0.83	0.83	0.90	0.82	0.84	0.84	0.84	0.84	0.75	0.84	0.83	10.43
USA	0.86	0.83	0.84	0.90	0.81	0.92	0.91	0.89	0.79	0.81	0.86	0.81
23.65												

SIM pro

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV
USA												
CHE	16.59											
DEA	0.85	15.53										
FRM	0.93	0.89	19.67									
ITA	0.83	0.82	0.82	15.67								
SVN	0.85	0.83	0.86	0.83	9.00							
FRA	0.90	0.87	0.90	0.84	0.84	21.94						
HUN	0.84	0.84	0.89	0.86	0.85	0.86	12.47					
NLD	0.84	0.92	0.88	0.83	0.84	0.85	0.83	22.42				
IRL	0.76	0.73	0.77	0.73	0.75	0.81	0.72	0.76	4.75			
SVK	0.84	0.83	0.84	0.83	0.85	0.84	0.86	0.84	0.75	10.21		
GBR	0.86	0.90	0.89	0.83	0.84	0.87	0.82	0.87	0.76	0.84	8.55	
HRV	0.84	0.83	0.90	0.82	0.84	0.84	0.84	0.84	0.75	0.84	0.84	10.63
USA	0.86	0.83	0.84	0.87	0.81	0.89	0.88	0.86	0.76	0.81	0.84	0.81
15.30												

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	77	149	110	104	113	46	22	20	64	78
FRA	69	0	117	145	165	188	76	45	17	53	52
USA	144	78	0	294	218	294	72	31	24	85	113
CHE	90	108	276	0	386	507	82	55	19	68	96
ITA	92	131	152	334	0	611	109	72	22	73	95
DEA	96	141	258	402	514	0	124	81	26	73	106
NLD	42	62	63	73	89	116	0	34	18	38	46
SVN	20	45	25	57	73	75	35	0	4	19	19
NZL	20	13	21	14	16	21	11	3	0	17	22
GBR	64	43	78	53	52	51	30	14	15	0	50
AUS	77	40	103	57	63	71	34	15	17	41	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	77	149	110	104	113	46	22	20	64	78
FRA	69	0	117	145	165	188	76	45	17	53	52
USA	144	78	0	294	218	294	72	31	24	85	113
CHE	90	108	276	0	386	507	82	55	19	68	96
ITA	92	131	152	334	0	611	109	72	22	73	95
DEA	96	141	258	402	514	0	124	81	26	73	106
NLD	42	62	63	73	89	116	0	34	18	38	46
SVN	20	45	25	57	73	75	35	0	4	19	19
NZL	20	13	21	14	16	21	11	3	0	17	22
GBR	64	43	78	53	52	51	30	14	15	0	50
AUS	77	40	103	57	63	71	34	15	17	41	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	77	149	110	104	113	46	22	20	64	78
FRA	69	0	117	145	165	188	76	45	17	53	52
USA	144	78	0	294	218	294	72	31	24	85	113
CHE	90	108	276	0	386	507	82	55	19	68	96
ITA	92	131	152	334	0	611	109	72	22	73	95
DEA	96	141	258	402	514	0	124	81	26	73	106
NLD	42	62	63	73	89	116	0	34	18	38	46
SVN	20	45	25	57	73	75	35	0	4	19	19
NZL	20	13	21	14	16	21	11	3	0	17	22
GBR	64	43	78	53	52	51	30	14	15	0	50
AUS	77	40	103	57	63	71	34	15	17	41	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	ZAF	NZL
CAN	0	62	44	28	5	14
USA	53	0	56	82	11	31
AUS	41	51	0	35	6	27
GBR	23	84	30	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 62 44 28 5 14
USA 53 0 56 82 11 31
AUS 41 51 0 35 6 27
GBR 23 84 30 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 61 44 28 4 13
USA 52 0 56 82 11 31
AUS 41 51 0 35 6 27
GBR 23 84 30 0 5 15
ZAF 2 8 5 4 0 5
NZL 11 29 27 13 3 0

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR
HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV									
CAN	0	1974	1067	1157	1306	1083	2525	671	1293	591	982	424	373	1017	873	145	179	79	7
754	962	440	1074	330	355	162	836	526	396	203									
DEU	1111	0	2414	2149	2228	2925	3097	972	1812	838	1291	706	649	1286	1672	231	324	122	113
1049	1855	546	1270	566	652	390	1078	504	420	468									
DFS	744	1343	0	1390	1342	1691	1690	578	1287	703	951	511	549	837	1073	188	222	112	37
747	1222	458	804	361	358	234	799	390	352	290									
FRA	649	925	607	0	1553	1628	2167	512	1305	685	973	552	542	924	1072	151	189	102	19
778	1221	430	1017	304	347	174	782	411	333	204									
ITA	759	1189	819	666	0	1444	2221	589	1303	656	907	485	480	1038	1096	186	207	102	15
837	1220	459	1010	377	348	209	869	479	380	269									
NLD	884	2395	1276	861	965	0	2033	727	1431	873	1080	734	646	891	1250	185	284	116	75
797	1347	469	858	387	462	221	910	383	362	332									
USA	2393	1805	1071	1002	1129	1591	0	791	1774	919	1393	535	559	1250	1404	176	268	123	20
1062	1540	591	1635	458	464	245	1110	688	568	274									
CHE	509	805	492	433	502	691	687	0	568	326	435	367	284	450	460	110	124	47	28
369	523	235	374	213	193	91	437	200	172	156									
GBR	1399	1188	854	704	839	1135	1411	512	0	784	1038	508	680	884	889	168	192	102	16
714	1017	469	864	316	319	194	822	402	372	251									
NZL	582	616	467	365	434	778	842	268	651	0	921	319	533	445	528	103	112	89	5
427	531	341	467	183	218	126	486	252	286	159									
AUS	842	736	514	526	457	790	1147	333	735	845	0	418	473	632	637	120	150	75	11
513	678	395	646	238	238	147	581	310	314	187									
BEL	374	637	425	499	383	784	418	337	444	242	306	0	286	399	394	110	101	50	28
326	444	227	317	166	175	84	404	170	159	153									
IRL	297	486	393	360	340	534	435	259	620	413	338	251	0	365	375	79	97	64	4
316	413	268	317	143	156	96	356	150	191	124									
ESP	545	758	566	616	683	748	730	348	668	327	369	359	317	0	723	143	151	86	10
617	805	408	738	272	267	161	709	366	310	212									
CZE	547	1202	619	596	670	1032	993	315	560	346	313	280	240	464	0	166	211	97	29
777	1081	359	706	339	407	180	694	390	313	267									
SVN	101	211	154	99	146	154	134	78	119	71	69	84	55	101	123	0	65	33	10
128	181	82	128	85	59	39	133	75	55	77									
EST	94	221	128	79	111	205	177	69	106	57	51	62	47	69	134	41	0	42	14
154	239	84	154	144	96	58	156	83	83	87									
ISR	49	101	90	52	68	96	105	33	70	73	42	28	48	55	70	26	28	0	1
83	102	53	77	49	36	32	88	44	54	49									
FRR	3	85	22	14	14	39	10	19	10	4	7	23	4	6	21	9	13	1	0
4	76	6	2	22	19	0	9	1	1	12									
HUN	638	798	558	489	669	633	987	296	603	340	318	256	253	484	676	98	96	66	4
0	749	359	583	244	276	146	613	367	317	192									
POL	654	1450	879	644	823	1096	1256	414	749	371	359	369	288	528	806	157	166	81	80
630	0	367	758	435	364	237	834	438	339	332									
ZAF	377	411	339	289	333	391	564	189	401	277	309	181	215	360	234	57	42	39	4
301	265	0	384	139	159	85	390	237	244	121									
JPN	442	432	371	308	379	386	597	221	379	225	281	186	165	310	261	68	50	32	2
305	342	250	0	255	259	146	593	436	323	153									
LVA	182	438	231	135	239	256	374	115	193	108	100	98	81	153	236	57	96	32	16
184	344	86	112	0	141	124	311	165	145	189									
SVK	235	483	178	175	184	305	297	98	173	130	106	93	78	131	321	34	44	15	9
196	238	92	83	72	0	73	276	164	154	101									
LTU	71	368	114	39	98	110	148	31	82	54	44	30	38	64	113	17	24	14	0
81	174	31	34	94	33	0	157	99	82	106									
PRT	819	954	670	632	764	892	1118	373	731	392	378	380	294	659	554	102	102	66	9
584	816	346	330	242	187	98	0	389	336	239									
KOR	469	315	255	212	373	246	777	133	287	180	175	100	92	246	274	44	43	28	0
304	343	181	244	101	100	44	314	0	253	96									
URY	370	289	246	192	273	283	708	128	311	224	222	114	144	258	235	33	47	27	0
268	278	210	191	93	109	44	305	209	0	99									
HRV	97	478	217	116	195	289	203	102	176	88	95	125	81	163	199	61	63	34	12
144	288	82	68	157	51	73	190	41	55	0									

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR
HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV									
CAN	0	1975	1068	1159	1309	1083	2527	671	1293	591	982	424	373	1017	873	145	179	79	7
754	964	440	1075	330	355	162	836	524	396	203									
DEU	1113	0	2414	2149	2230	2925	3097	972	1812	838	1291	706	649	1286	1672	231	324	122	113
1049	1855	546	1269	566	652	390	1077	503	420	468									
DFS	746	1343	0	1390	1343	1691	1690	578	1287	703	951	511	549	837	1073	188	222	112	37
747	1222	458	803	361	358	234	798	390	352	290									
FRA	650	925	607	0	1555	1628	2167	512	1305	685	973	552	542	924	1072	151	189	102	19
778	1221	430	1016	304	347	174	781	410	333	204									
ITA	765	1193	821	669	0	1446	2223	590	1305	657	908	486	481	1039	1097	186	207	102	15
838	1220	460	1008	377	349	209	869	479	380	269									
NLD	885	2395	1276	861	969	0	2033	727	1431	873	1080	734	646	891	1250	185	284	116	75
797	1347	469	856	387	462	221	909	383	362	332									
USA	2396	1805	1071	1002	1134	1591	0	791	1774	919	1393	535	559	1250	1404	176	268	123	20
1062	1540	591	1633	458	464	245	1109	687	568	274									
CHE	510	805	492	433	504	691	687	0	568	326	435	367	284	450	460	110	124	47	28
369	523	235	373	213	193	91	437	200	172	156									
GBR	1400	1188	854	704	841	1135	1411	512	0	784	1038	508	680	884	889	168	192	102	16
714	1017	469	863	316	319	194	822	402	372	251									
NZL	583	616	467	365	436	778	842	268	651	0	921	319	533	445	528	103	112	89	5
427	531	341	467	183	218	126	486	252	286	159									
AUS	842	736	514	526	459	790	1147	333	735	845	0	418	473	632	637	120	150	75	11
513	678	395	646	238	238	147	581	310	314	187									
BEL	374	637	425	499	385	784	418	337	444	242	306	0	286	399	394	110	101	50	28
326	444	227	317	166	175	84	404	170	159	153									
IRL	297	486	393	360	341	534	435	259	620	413	338	251	0	365	375	79	97	64	4
316	413	268	316	143	156	96	356	150	191	124									
ESP	546	758	566	616	686	748	730	348	668	327	369	359	317	0	723	143	151	86	10
617	805	408	737	272	267	161	709	365	310	212									
CZE	547	1201	618	596	671	1031	993	315	560	346	313	280	240	463	0	166	211	97	29
777	1081	359	705	339	407	180	693	389	313	267									
SVN	101	211	154	99	146	154	134	78	119	71	69	84	55	101	123	0	65	33	10
128	181	82	127	85	59	39	133	75	55	77									
EST	94	221	128	79	111	205	177	69	106	57	51	62	47	69	134	41	0	42	14
154	239	84	153	144	96	58	156	83	83	87									
ISR	49	101	90	52	69	96	105	33	70	73	42	28	48	55	70	26	28	0	1
83	102	53	77	49	36	32	88	44	54	49									
FRR	3	85	22	14	14	39	10	19	10	4	7	23	4	6	21	9	13	1	0
4	76	6	2	22	19	0	9	1	1	12									
HUN	639	798	558	489	670	633	987	296	603	340	318	256	253	484	676	98	96	66	4
0	749	359	582	244	276	146	613	367	317	192									
POL	656	1450	879	644	824	1096	1256	414	749	371	359	369	288	528	805	157	166	81	80
630	0	367	756	435	364	237	833	437	339	332									
ZAF	378	411	339	289	336	391	564	189	401	277	309	181	215	360	234	57	42	39	4
301	265	0	383	139	159	85	390	237	244	121									
JPN	442	431	370	306	377	384	592	220	377	224	280	186	164	308	260	67	49	32	2
304	339	249	0	254	257	145	591	435	322	153									
LVA	182	438	231	135	239	256	374	115	193	108	100	98	81	153	236	57	96	32	16
184	344	86	111	0	141	124	311	165	145	189									
SVK	235	483	178	175	185	305	297	98	173	130	106	93	78	131	320	34	44	15	9
196	238	92	81	72	0	73	276	164	154	101									
LTU	71	368	114	39	98	110	148	31	82	54	44	30	38	64	113	17	24	14	0
81	174	31	33	94	33	0	157	99	82	106									
PRT	820	953	670	630	766	892	1119	373	730	392	378	380	294	659	555	102	102	66	9
584	815	346	328	242	188	97	0	389	336	239									
KOR	470	314	255	212	374	246	775	133	287	180	175	100	92	246	273	44	43	28	0
304	343	181	243	101	100	44	314	0	253	96									
URY	370	289	246	192	273	283	708	128	311	224	222	114	144	258	235	33	47	27	0
268	278	210	188	93	109	44	306	209	0	99									
HRV	97	478	217	116	195	289	203	102	176	88	95	125	81	163	199	61	63	34	12
144	288	82	68	157	51	73	190	41	55	0									

HOL

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR
HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV									
CAN	0	1974	1067	1157	1307	1083	2519	671	1293	591	982	424	373	1017	873	145	179	79	7
754	962	440	1071	330	355	162	836	525	396	203									
DEU	1111	0	2414	2149	2229	2925	3093	972	1812	838	1291	706	649	1286	1672	231	324	122	113
1049	1855	546	1269	566	652	390	1078	503	420	468									
DFS	744	1343	0	1390	1342	1691	1688	578	1287	703	951	511	549	837	1073	188	222	112	37
747	1222	458	803	361	358	234	799	390	352	290									
FRA	649	925	607	0	1554	1628	2166	512	1305	685	973	552	542	924	1072	151	189	102	19
778	1221	430	1016	304	347	174	781	410	333	204									
ITA	760	1190	819	667	0	1445	2222	590	1304	656	908	486	480	1038	1096	186	207	102	15
837	1220	459	1007	377	348	209	868	479	380	269									
NLD	884	2395	1276	861	966	0	2032	727	1431	873	1080	734	646	891	1250	185	284	116	75
797	1347	469	855	387	462	221	909	383	362	332									
USA	2390	1803	1071	1002	1130	1591	0	791	1773	919	1390	534	559	1249	1404	176	268	123	20
1062	1540	591	1629	458	463	245	1109	689	568	274									
CHE	509	805	492	433	503	691	687	0	568	326	435	367	284	450	460	110	124	47	28
369	523	235	372	213	193	91	437	200	172	156									
GBR	1399	1188	854	704	840	1135	1411	512	0	784	1038	508	680	884	889	168	192	102	16
714	1017	469	863	316	319	194	821	402	372	251									
NZL	582	616	467	365	434	778	842	268	651	0	921	319	533	445	528	103	112	89	5
427	531	341	467	183	218	126	486	252	286	159									
AUS	842	736	514	526	458	790	1147	333	735	845	0	418	473	632	637	120	150	75	11
513	678	395	646	238	238	147	581	310	314	187									
BEL	374	637	425	499	384	784	417	337	444	242	306	0	286	399	394	110	101	50	28
326	444	227	317	166	175	84	404	170	159	153									
IRL	297	486	393	360	340	534	435	259	620	413	338	251	0	365	375	79	97	64	4
316	413	268	316	143	156	96	356	150	191	124									
ESP	545	758	566	616	683	748	730	348	668	327	369	359	317	0	723	143	151	86	10
617	805	408	736	272	267	161	708	365	310	212									
CZE	547	1201	618	596	670	1031	993	315	560	346	313	280	240	463	0	166	211	97	29
777	1081	359	705	339	407	180	693	389	313	267									
SVN	101	211	154	99	146	154	134	78	119	71	69	84	55	101	123	0	65	33	10
128	181	82	127	85	59	39	133	75	55	77									
EST	94	221	128	79	111	205	177	69	106	57	51	62	47	69	134	41	0	42	14
154	239	84	152	144	96	58	156	83	83	87									
ISR	49	101	90	52	68	96	105	33	70	73	42	28	48	55	70	26	28	0	1
83	102	53	77	49	36	32	88	44	54	49									
FRR	3	85	22	14	14	39	10	19	10	4	7	23	4	6	21	9	13	1	0
4	76	6	2	22	19	0	9	1	1	12									
HUN	638	798	558	489	669	633	987	296	603	340	318	256	253	484	676	98	96	66	4
0	749	359	582	244	276	146	612	367	317	192									
POL	654	1450	879	644	823	1096	1256	414	749	371	359	369	288	528	805	157	166	81	80
630	0	367	755	435	364	237	833	438	339	332									
ZAF	377	411	339	289	333	391	564	189	401	277	309	181	215	360	234	57	42	39	4
301	265	0	383	139	159	85	390	237	244	121									
JPN	440	431	370	306	376	383	590	220	377	224	280	186	164	308	260	67	48	32	2
304	339	249	0	254	257	145	591	435	322	153									
LVA	182	438	231	135	239	256	374	115	193	108	100	98	81	153	236	57	96	32	16
184	344	86	111	0	141	124	311	165	145	189									
SVK	235	483	178	175	184	305	296	98	173	130	106	93	78	131	320	34	44	15	9
196	238	92	81	72	0	73	275	164	154	101									
LTU	71	368	114	39	98	110	148	31	82	54	44	30	38	64	113	17	24	14	0
81	174	31	33	94	33	0	157	99	82	106									
PRT	820	954	671	632	763	893	1118	373	730	392	378	380	294	659	555	102	102	66	9
584	815	347	329	242	188	98	0	388	335	239									
KOR	469	314	255	212	373	246	777	133	287	180	175	100	92	246	273	44	43	28	0
304	343	181	243	101	100	44	313	0	253	96									
URY	370	289	246	192	273	283	708	128	311	224	222	114	144	258	235	33	47	27	0
268	278	210	188	93	109	44	305	209	0	99									
HRV	97	478	217	116	195	289	203	102	176	88	95	125	81	163	199	61	63	34	12
144	288	82	68	157	51	73	190	41	55	0									

JER

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL
CAN	0	66	316	142	191	130	28	122	65	55	5
DFS	51	0	138	113	101	131	66	113	94	98	14
USA	324	111	0	307	393	198	66	251	96	95	25
NZL	155	87	381	0	353	176	58	175	82	75	69
AUS	189	65	414	392	0	165	51	191	73	63	31
GBR	128	115	212	179	154	0	65	142	100	82	33
NLD	22	64	71	51	40	59	0	57	51	49	11
ZAF	118	89	259	180	174	141	53	0	88	74	20
ITA	62	91	103	81	69	102	50	83	0	70	10
DEU	53	92	97	70	53	82	46	71	72	0	10
IRL	3	11	25	75	26	34	11	20	11	11	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	66	316	142	191	130	28	122	65	55	5
DFS	51	0	138	113	101	131	66	113	94	98	14
USA	324	111	0	307	393	198	66	251	96	95	25
NZL	155	87	381	0	353	176	58	175	82	75	69
AUS	189	65	414	392	0	165	51	191	73	63	31
GBR	128	115	212	179	154	0	65	142	100	82	33
NLD	22	64	71	51	40	59	0	57	51	49	11
ZAF	118	89	259	180	174	141	53	0	88	74	20
ITA	62	91	103	81	69	102	50	83	0	70	10
DEU	53	92	97	70	53	82	46	71	72	0	10
IRL	3	11	25	75	26	34	11	20	11	11	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	66	316	142	191	130	28	122	65	55	5
DFS	51	0	138	113	101	131	66	113	94	98	14
USA	324	111	0	307	393	198	66	251	96	95	25
NZL	155	87	381	0	353	176	58	175	82	75	69
AUS	189	65	414	392	0	165	51	191	73	63	31
GBR	128	115	212	179	154	0	65	142	100	82	33
NLD	22	64	71	51	40	59	0	57	51	49	11
ZAF	118	89	259	180	174	141	53	0	88	74	20
ITA	62	91	103	81	69	102	50	83	0	70	10
DEU	53	92	97	70	53	82	46	71	72	0	10
IRL	3	11	25	75	26	34	11	20	11	11	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	174	71	87	65	114	11	73	1	9	14	2	4
NOR	4	0	53	36	50	20	102	17	0	15	20	24	33	28
USA	157	54	0	97	104	75	142	21	61	12	19	29	13	26
NZL	70	35	96	0	118	49	147	15	36	5	14	24	3	11
AUS	86	41	104	120	0	48	143	34	35	20	32	41	6	20
GBR	63	21	68	46	48	0	56	5	35	1	9	12	7	15
DFS	111	75	139	144	121	53	0	58	49	83	115	107	8	30
DEU	10	17	21	15	33	5	49	0	2	23	33	32	3	14
ZAF	75	0	56	31	34	30	46	2	0	0	2	5	0	2
EST	1	15	11	4	19	1	72	22	0	0	46	23	0	9
LVA	9	18	17	12	30	8	79	28	2	41	0	47	2	11
LTU	13	19	23	20	37	11	91	30	5	22	42	0	2	11
IRL	2	33	13	3	5	7	6	3	0	0	2	2	0	7
NLD	4	27	25	11	18	15	29	14	2	8	10	10	6	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD
CAN	0	4	174	71	87	65	114	11	73	1	9	14	2	4
NOR	4	0	53	36	50	20	103	18	0	16	21	24	33	28
USA	157	54	0	97	104	74	142	21	61	12	19	29	13	26
NZL	70	35	96	0	118	49	147	15	36	5	14	24	3	11
AUS	86	41	104	120	0	48	143	34	35	20	32	41	6	20
GBR	63	21	68	46	48	0	56	5	35	1	9	12	7	15
DFS	111	76	139	144	121	53	0	58	49	83	115	106	8	29
DEU	10	18	21	15	33	5	49	0	2	23	33	32	3	14
ZAF	75	0	56	31	34	30	46	2	0	0	2	5	0	2
EST	1	16	11	4	19	1	72	22	0	0	46	23	0	9
LVA	9	19	17	12	30	8	79	28	2	41	0	47	2	11
LTU	13	19	23	20	37	11	90	30	5	22	42	0	2	11
IRL	2	33	13	3	5	7	6	3	0	0	2	2	0	7
NLD	4	27	25	11	18	15	29	14	2	8	10	10	6	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD
CAN	0	4	174	71	87	65	114	11	73	1	9	14	2	4
NOR	4	0	53	36	50	20	103	18	0	16	21	24	33	28
USA	157	54	0	97	104	74	142	21	61	12	19	29	13	26
NZL	70	35	96	0	118	49	147	15	36	5	14	24	3	11
AUS	86	41	104	120	0	48	143	34	35	20	32	41	6	20
GBR	63	21	68	46	48	0	56	5	35	1	9	12	7	15
DFS	111	76	139	144	121	53	0	58	49	83	115	106	8	29
DEU	10	18	21	15	33	5	49	0	2	23	33	32	3	14
ZAF	75	0	56	31	34	30	46	2	0	0	2	5	0	2
EST	1	16	11	4	19	1	72	22	0	0	46	23	0	9
LVA	9	19	17	12	30	8	79	28	2	41	0	47	2	11
LTU	13	19	23	20	37	11	90	30	5	22	42	0	2	11
IRL	2	33	13	3	5	7	6	3	0	0	2	2	0	7
NLD	4	27	25	11	18	15	29	14	2	8	10	10	6	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	0	277	158	76	6	11	2	72	48	30	53	0	17
DEA	248	0	224	726	155	189	44	197	52	339	51	419	15
FRM	207	270	0	146	17	2	3	102	62	54	69	2	23
ITA	78	633	178	0	85	107	18	142	52	125	45	189	18
SVN	6	141	17	79	0	41	9	39	1	42	0	61	0
FRA	9	149	1	96	38	0	10	41	1	44	0	71	0
HUN	1	29	1	14	7	7	0	3	1	12	0	13	0
NLD	73	204	123	137	37	41	3	0	46	49	50	69	14
IRL	45	47	67	48	1	1	1	41	0	11	36	3	12
SVK	22	346	54	106	41	38	10	41	4	0	9	73	3
GBR	61	52	88	51	0	0	0	50	32	4	0	0	17
HRV	0	440	1	178	49	64	13	66	2	56	0	0	0
USA	18	20	37	25	0	0	0	17	12	3	24	0	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	0	277	158	76	6	11	2	72	48	30	53	0	17
DEA	248	0	224	726	155	189	44	197	52	339	51	417	15
FRM	207	270	0	146	17	2	3	102	62	54	69	2	23
ITA	78	633	178	0	85	107	18	142	52	125	45	187	18
SVN	6	141	17	79	0	41	9	39	1	42	0	61	0
FRA	9	149	1	96	38	0	10	41	1	44	0	71	0
HUN	1	29	1	14	7	7	0	3	1	12	0	13	0
NLD	73	204	123	137	37	41	3	0	46	49	50	69	14
IRL	45	47	67	48	1	1	1	41	0	11	36	3	12
SVK	22	346	54	106	41	38	10	41	4	0	9	71	3
GBR	61	52	88	51	0	0	0	50	32	4	0	0	17
HRV	0	438	1	176	49	64	13	66	2	54	0	0	0
USA	18	20	37	25	0	0	0	17	12	3	24	0	0

SIM

common bulls below diagonal

common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	0	277	158	76	6	11	2	72	48	30	53	0	17
DEA	248	0	224	726	155	189	44	197	52	339	51	418	15
FRM	207	270	0	146	17	2	3	102	62	54	69	2	23
ITA	78	633	178	0	85	107	18	142	52	125	45	188	18
SVN	6	141	17	79	0	41	9	39	1	42	0	61	0
FRA	9	149	1	96	38	0	10	41	1	44	0	71	0
HUN	1	29	1	14	7	7	0	3	1	12	0	13	0
NLD	73	204	123	137	37	41	3	0	46	49	50	69	14
IRL	45	47	67	48	1	1	1	41	0	11	36	3	12
SVK	22	346	54	106	41	38	10	41	4	0	9	72	3
GBR	61	52	88	51	0	0	0	50	32	4	0	0	17
HRV	0	439	1	177	49	64	13	66	2	55	0	0	0
USA	18	20	37	25	0	0	0	17	12	3	24	0	0