

## Introduction

The latest international evaluation for dairy production traits took place as scheduled at the Interbull Centre. Data from thirty-three (33) 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, 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 conformation traits are as follows:

AUS (ALL)	Drops in information due to data clean up such as pedigree changes, status change of a bull which leads to a good number of bulls no longer qualifying. Base change for RDC.
EST (HOL,RDC)	Base change from cows born in years 2012-2016 to cows born in years 2014-2018.
SVN (ALL)	Reduced the performance data to 2010-2022 and estimated variance components for all traits
DEA (BSW,SIM)	Base change. Bug correction causing changes in the ToP declaration for young bulls being previously wrongly assigned ToP 12 and now corrected to 11. Pedigree corrections for SIM.
ITA (SIM)	Some decrease in information due to pedigree correction
JPN (HOL)	Some decrease in information due to pedigree correction
NZL (ALL)	Continuous DNA parentage testing affecting numbers of daughters, herds and EDCs. EDCs are also affected by changes in phenotype records
CHE (ALL)	Drops in information due to manual edits in database. The change of herd-year-season assignment of certain data records might also explain small changes in EDC and reliabilities for some bulls.
GBR (ALL)	Minor changes in data due re-extraction at each run and changes introduced by data providers
PRT (HOL)	Migration of system and database into a new set of programs.
BEL (HOL)	Inclusion of inbreeding effect in the model

## INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

### Post-processing Windows:

According to the decision taken by ITC in Orlando (2015) to review the post-processing windows every 5 years, during the 2020 the relative working group has been re-activated and new windows have been identified.

As before, the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while the lower values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the real estimated ones. Over the past five years, in fact, the previous adopted lower value (25th percentile) had been found too high causing estimated and post-processed correlations to differ significantly from each other. The new lower values have been applied to all breeds and traits.

The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more in consideration the value of the new estimated ones even when no changes are applied by the countries.

The new weights are as follows:

No changes :: 2  
Small changes:: 1  
Big changes :: 0

More information can be read on [https://interbull.org/ib/rg\\_procedure](https://interbull.org/ib/rg_procedure)

#### 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 ROUTINE RUN

Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honor the agreed code of practice, decided by the Interbull Steering Committee, and only publish international evaluations on their own country scale. Evaluations expressed on another country scale are confidential and may only be used internally for research and review purposes.

PUBLICATION OF INTERBULL TEST RUN

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

^LTable 1. National evaluation data considered in the Interbull evaluation for dairy production traits (December Routine Evaluation 2022). Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	225	146	8811	1878	837	
BEL			2263			
CAN	274	109	13690	863	872	
CHE	3159		3329	98		3543
CZE			5079			
DEA	6341					25975
DEU			23894	227	295	
DFS			14082	2320	8004	
ESP			4450			
EST			1349		485	
FRA	486		18417			477
FRM						5044
GBR	187	373	8003	979	696	95
HUN			3615			237
IRL			3138	163	62	102
ISR			1670			
ITA	2328		9202	173		1948
JPN			6736			
KOR			1725			
LTU			1353		438	
LVA			1486		712	
NLD	222		16730	242	95	490
NOR					4313	
NZL	82	63	8951	5474	1525	
POL			12164			
PRT			2522			
SVK			1185			
SVN	330		643			647
URY			1160			
USA	1199	820	41848	5284	799	94
ZAF			1316	745	144	
HRV			932			1039
CAM					46	
No. Records	14833	1511	219743	18446	19323	39691
Pub. Proofs	11814	1196	158673	14673	17081	35712

^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	652.03										
FRA	0.88	641.64									
USA	0.92	0.88	628.31								
CHE	0.90	0.88	0.87	493.30							
ITA	0.87	0.79	0.88	0.87	610.57						
DEA	0.84	0.81	0.85	0.94	0.89	465.41					
NLD	0.88	0.85	0.87	0.85	0.86	0.86	655.84				
SVN	0.69	0.73	0.72	0.71	0.63	0.73	0.68	10.29			
NZL	0.67	0.74	0.69	0.70	0.65	0.69	0.70	0.65	453.80		
GBR	0.85	0.86	0.84	0.86	0.79	0.78	0.84	0.67	0.71	293.04	
AUS	0.73	0.74	0.69	0.68	0.65	0.63	0.71	0.65	0.82	0.70	388.51

-----

BSW fat

-----

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.90										
FRA	0.87	26.71									
USA	0.90	0.89	23.41								
CHE	0.85	0.86	0.84	19.46							
ITA	0.87	0.82	0.86	0.86	23.21						
DEA	0.82	0.83	0.84	0.94	0.87	17.30					
NLD	0.86	0.84	0.85	0.83	0.84	0.86	25.56				
SVN	0.76	0.77	0.72	0.74	0.68	0.78	0.67	10.92			
NZL	0.70	0.75	0.72	0.77	0.66	0.77	0.68	0.66	21.28		
GBR	0.84	0.87	0.84	0.85	0.78	0.78	0.85	0.67	0.71	10.73	
AUS	0.73	0.71	0.72	0.64	0.65	0.65	0.68	0.61	0.79	0.68	15.54

-----

BSW pro

-----

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.44										
FRA	0.83	20.44									
USA	0.89	0.86	18.62								
CHE	0.84	0.82	0.83	15.74							
ITA	0.83	0.77	0.83	0.84	21.29						
DEA	0.79	0.75	0.82	0.93	0.87	14.50					
NLD	0.84	0.81	0.83	0.81	0.82	0.84	21.52				
SVN	0.66	0.69	0.68	0.66	0.62	0.69	0.64	10.13			
NZL	0.60	0.66	0.63	0.68	0.61	0.71	0.63	0.62	15.41		
GBR	0.84	0.84	0.82	0.82	0.76	0.72	0.83	0.65	0.64	8.74	
AUS	0.69	0.64	0.66	0.60	0.58	0.59	0.64	0.55	0.78	0.65	12.14

-----

GUE mil

-----

	CAN	USA	AUS	GBR	NZL
CAN	766.97				
USA	0.93	778.76			
AUS	0.78	0.74	474.45		
GBR	0.86	0.82	0.72	249.55	
NZL	0.71	0.68	0.82	0.70	373.39

-----

GUE fat

-----

	CAN	USA	AUS	GBR	NZL
CAN	29.86				
USA	0.92	27.22			
AUS	0.77	0.74	17.53		







RDC	pro														
	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.36														
NOR	0.83	12.28													
USA	0.89	0.87	20.10												
NZL	0.57	0.67	0.64	11.29											
AUS	0.63	0.66	0.67	0.77	12.14										
GBR	0.81	0.82	0.82	0.60	0.68	6.80									
DFS	0.88	0.88	0.86	0.64	0.63	0.79	10.53								
DEU	0.91	0.82	0.89	0.58	0.62	0.85	0.92	20.06							
ZAF	0.77	0.78	0.78	0.64	0.72	0.68	0.72	0.73	17.19						
EST	0.80	0.69	0.81	0.57	0.55	0.73	0.77	0.79	0.67	15.69					
LVA	0.73	0.69	0.74	0.56	0.55	0.70	0.67	0.73	0.71	0.69	9.63				
LTU	0.66	0.66	0.64	0.53	0.54	0.65	0.62	0.65	0.69	0.62	0.71	9.53			
IRL	0.75	0.75	0.76	0.79	0.77	0.75	0.75	0.75	0.68	0.63	0.66	0.63	5.36		
NLD	0.87	0.91	0.84	0.60	0.64	0.84	0.89	0.92	0.71	0.72	0.70	0.65	26.31		
CAM	0.80	0.79	0.90	0.66	0.69	0.79	0.80	0.79	0.80	0.77	0.78	0.78	0.75	0.79	10.76

SIM	mil											
	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	565.91											
DEA	0.87	507.14										
FRM	0.95	0.85	612.05									
ITA	0.78	0.72	0.72	510.58								
SVN	0.75	0.73	0.78	0.71	9.68							
FRA	0.90	0.87	0.82	0.84	0.78	674.91						
NLD	0.88	0.92	0.88	0.77	0.73	0.87	748.98					
IRL	0.83	0.73	0.85	0.68	0.71	0.86	0.80	179.19				
GBR	0.87	0.86	0.87	0.78	0.69	0.85	0.85	0.78	230.12			
HRV	0.67	0.67	0.77	0.64	0.62	0.65	0.65	0.66	0.65	10.68		
USA	0.86	0.81	0.82	0.87	0.78	0.90	0.89	0.79	0.83	0.66	608.84	
HUN	0.84	0.81	0.87	0.85	0.85	0.86	0.85	0.85	0.85	0.84	0.86	417.09

SIM	fat											
	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	22.55											
DEA	0.87	19.09										
FRM	0.93	0.89	24.10									
ITA	0.78	0.78	0.75	19.95								
SVN	0.72	0.77	0.79	0.73	9.67							
FRA	0.88	0.90	0.82	0.83	0.75	27.39						
NLD	0.87	0.93	0.88	0.76	0.75	0.86	27.86					
IRL	0.78	0.73	0.81	0.65	0.70	0.83	0.78	7.77				
GBR	0.91	0.86	0.86	0.80	0.68	0.88	0.86	0.75	8.16			
HRV	0.66	0.63	0.77	0.62	0.61	0.64	0.63	0.66	0.65	10.63		
USA	0.85	0.85	0.81	0.88	0.73	0.91	0.87	0.76	0.85	0.69	20.78	
HUN	0.84	0.82	0.87	0.85	0.85	0.86	0.85	0.85	0.85	0.84	0.86	16.57

SIM	pro											
	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	16.90											
DEA	0.86	15.48										
FRM	0.92	0.84	19.02									
ITA	0.72	0.70	0.70	16.05								
SVN	0.70	0.69	0.75	0.68	9.77							
FRA	0.87	0.84	0.79	0.72	0.79	21.49						
NLD	0.83	0.91	0.86	0.72	0.69	0.83	23.25					
IRL	0.75	0.73	0.80	0.60	0.65	0.78	0.73	6.29				
GBR	0.84	0.85	0.85	0.76	0.65	0.84	0.85	0.73	7.08			
HRV	0.65	0.62	0.76	0.61	0.59	0.63	0.62	0.60	0.64	10.79		
USA	0.82	0.76	0.76	0.84	0.74	0.87	0.85	0.71	0.82	0.63	17.68	
HUN	0.83	0.81	0.87	0.84	0.84	0.86	0.84	0.84	0.84	0.83	0.86	13.47



^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	98	189	146	143	159	57	32	36	76	102
FRA	89	0	135	194	230	259	93	50	35	73	79
USA	184	99	0	328	255	348	90	40	45	109	132
CHE	125	151	305	0	502	631	107	76	42	86	125
ITA	127	191	180	444	0	787	139	94	46	96	132
DEA	141	208	312	524	687	0	160	100	58	94	139
NLD	53	79	82	99	116	153	0	45	34	45	64
SVN	29	49	32	71	91	92	46	0	13	22	27
NZL	35	26	38	31	38	52	27	11	0	29	40
GBR	75	62	102	66	71	65	39	17	25	0	68
AUS	105	62	124	85	97	101	48	20	32	62	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	98	189	146	143	159	57	32	36	76	102
FRA	89	0	135	194	230	259	93	50	35	73	79
USA	184	99	0	328	255	348	90	40	45	109	132
CHE	125	151	305	0	502	632	107	76	42	86	125
ITA	127	191	180	444	0	788	139	94	46	96	132
DEA	141	208	312	524	688	0	160	100	58	94	139
NLD	53	79	82	99	116	153	0	45	34	45	64
SVN	29	49	32	71	91	92	46	0	13	22	27
NZL	35	26	38	31	38	52	27	11	0	29	40
GBR	75	62	102	66	71	65	39	17	25	0	68
AUS	105	62	124	85	97	101	48	20	32	62	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	98	189	146	143	159	57	32	36	76	102
FRA	89	0	135	194	230	259	93	50	35	73	79
USA	184	99	0	328	255	348	90	40	45	109	132
CHE	125	151	305	0	502	631	107	76	42	86	125
ITA	127	191	180	444	0	787	139	94	46	96	132
DEA	141	208	312	524	687	0	160	100	58	94	139
NLD	53	79	82	99	116	153	0	45	34	45	64
SVN	29	49	32	71	91	92	46	0	13	22	27
NZL	35	26	38	31	38	52	27	11	0	29	40
GBR	75	62	102	66	71	65	39	17	25	0	68
AUS	105	62	124	85	97	101	48	20	32	62	0

-----

GUE

-----

common bulls below diagonal

common three quarter	sib group		above diagonal		
CAN	USA	AUS	GBR	NZL	
CAN	0	77	52	38	14
USA	69	0	69	99	32
AUS	49	66	0	43	27
GBR	32	101	37	0	16
NZL	11	29	27	14	0

-----

GUE

-----

common bulls below diagonal  
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	77	52	38	14
USA	69	0	69	99	32
AUS	49	66	0	43	27
GBR	32	101	37	0	16
NZL	11	29	27	14	0

-----

GUE

-----

common bulls below diagonal  
common three quarter sib group above diagonal

	CAN	USA	AUS	GBR	NZL
CAN	0	77	52	38	14
USA	69	0	69	99	32
AUS	49	66	0	43	27
GBR	32	101	37	0	16
NZL	11	29	27	14	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
CAN	0	2595	1665	1682	1829	1753	3922	926	1883	851	1596	901	614	1423	1309	219	314	156	1110	1694	515	1435	577	461	351	1089	803	529	337
DEU	2036	0	2861	2691	2561	3579	3759	1180	2242	1072	1780	1324	911	1642	2080	348	491	184	1305	2895	560	1476	905	713	689	1265	709	504	694
DFS	1474	2168	0	1865	1574	2368	2348	763	1706	937	1416	959	776	1136	1453	260	365	171	988	1875	515	1044	559	431	413	972	568	445	462
FRA	1234	1646	1159	0	1699	2252	2717	770	1709	897	1419	1089	787	1353	1476	225	313	143	1037	2015	512	1289	516	470	349	1027	617	451	373
ITA	1513	1701	1226	1002	0	1762	2662	740	1594	711	1203	814	597	1285	1309	245	313	146	1018	1798	418	1151	566	392	371	963	646	420	398
NLD	1709	3378	2123	1583	1428	0	2782	965	1953	1185	1597	1395	932	1249	1750	278	430	182	1051	2187	523	1146	626	571	461	1096	572	456	493
USA	4454	2819	1875	1591	1947	2490	0	1059	2487	1208	2132	1059	851	1690	1919	251	413	231	1430	2487	647	2056	773	576	470	1361	976	721	427
CHE	847	1116	719	712	671	964	993	0	758	449	672	653	423	602	571	139	189	70	451	750	260	490	321	247	196	510	300	224	214
GBR	2130	1730	1331	1162	1212	1731	2282	724	0	1030	1552	941	1016	1176	1226	210	309	164	939	1575	519	1107	494	398	367	992	569	479	367
NZL	846	827	675	584	513	1080	1157	379	893	0	1307	569	770	595	732	128	165	130	545	767	376	613	289	278	215	605	356	394	245
AUS	1629	1358	1049	1012	891	1412	2192	596	1362	1315	0	811	766	974	977	174	251	128	790	1198	487	961	448	329	297	829	523	469	319
BEL	899	1364	902	1120	790	1606	948	665	931	465	718	0	544	738	768	174	225	88	588	926	342	584	342	315	235	697	345	268	297
IRL	574	789	638	662	490	872	765	432	1038	665	661	532	0	528	586	106	152	109	465	656	330	457	237	219	173	507	261	287	198
ESP	969	1080	878	1123	907	1122	1144	499	924	452	705	725	500	0	988	192	240	120	837	1225	455	960	419	337	265	871	550	381	311
CZE	1013	1681	1011	1025	950	1613	1576	443	893	550	670	634	458	735	0	230	316	145	1038	1582	439	939	509	542	373	875	556	429	409
SVN	165	340	209	169	203	242	201	101	152	87	121	135	79	138	168	0	96	49	160	286	74	166	136	76	84	153	114	62	120
EST	201	358	240	171	180	316	296	110	183	85	133	144	81	117	200	57	0	56	228	402	114	228	222	130	137	214	141	121	143
ISR	111	139	125	88	92	137	219	40	115	104	82	56	83	70	112	34	33	0	123	167	67	120	84	55	61	114	75	76	72
HUN	1045	1047	799	765	869	891	1409	377	813	424	599	511	403	676	968	118	137	84	0	1070	404	767	389	336	258	747	517	394	286
POL	1523	2685	1584	1478	1446	2087	2473	641	1373	591	942	860	543	905	1361	256	295	130	972	0	427	1087	741	482	513	1069	655	452	531
ZAF	479	438	396	407	319	444	635	221	456	312	429	293	297	408	313	53	57	43	336	323	0	431	176	184	123	446	279	280	160
JPN	748	670	578	506	566	616	932	328	573	325	540	379	288	466	433	90	84	47	422	597	283	0	394	320	248	728	622	411	248
LVA	356	752	354	280	355	424	656	178	288	163	229	207	136	223	346	81	135	54	279	602	101	169	0	202	263	432	268	203	285
SVK	323	530	230	265	226	403	386	127	228	166	163	192	107	171	465	36	55	22	234	339	101	114	102	0	144	329	224	191	154
LTU	197	639	246	157	195	298	327	90	199	101	135	126	82	113	257	42	70	29	156	405	49	86	182	74	0	254	166	136	186
PRT	1125	1150	864	917	883	1093	1420	465	899	490	659	702	455	831	731	120	141	77	736	1065	398	433	327	224	160	0	504	410	335
KOR	787	495	422	388	524	420	1128	215	418	261	387	257	183	399	404	70	68	40	418	553	208	376	160	135	71	420	0	321	161
URY	525	380	325	310	315	367	901	178	406	317	367	208	233	312	333	36	70	41	336	387	240	254	120	123	78	369	261	0	150
HRV	204	722	369	272	290	452	328	142	266	146	204	243	138	234	314	99	103	51	213	483	108	114	221	78	134	274	75	97	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
CAN	0	2595	1665	1682	1837	1753	3920	926	1883	851	1596	901	614	1423	1309	220	314	156	1110	1694	514	1430	577	461	351	1089	803	529	336
DEU	2036	0	2861	2691	2569	3579	3756	1180	2242	1072	1780	1324	911	1642	2080	349	491	184	1305	2895	559	1471	905	713	689	1265	708	504	693

DFS	1474	2167	0	1865	1583	2368	2347	763	1706	937	1416	959	776	1136	1453	261	365	171	988	1875	514	1041	559	431	413	972	567	445	461
FRA	1234	1646	1159	0	1706	2252	2716	770	1709	897	1419	1089	788	1353	1476	226	313	143	1037	2015	511	1285	516	470	349	1027	617	451	372
ITA	1523	1711	1235	1010	0	1769	2672	742	1603	718	1210	819	601	1291	1316	246	314	146	1025	1802	423	1154	566	394	373	969	648	424	397
NLD	1709	3378	2123	1583	1439	0	2780	965	1953	1185	1597	1395	934	1249	1750	279	430	182	1051	2187	522	1141	626	571	461	1096	571	456	492
USA	4450	2814	1873	1590	1959	2489	0	1059	2486	1207	2132	1058	850	1689	1918	252	412	231	1429	2486	646	2051	772	576	470	1360	975	721	425
CHE	847	1116	719	712	675	964	993	0	758	449	672	653	423	602	571	140	189	70	451	750	259	486	321	247	196	510	300	224	213
GBR	2130	1730	1331	1162	1221	1731	2280	724	0	1030	1552	941	1017	1176	1226	211	309	164	939	1575	518	1103	494	398	367	992	569	479	367
NZL	846	827	675	584	520	1080	1156	379	893	0	1307	569	770	595	732	129	165	130	545	767	375	613	289	278	215	605	356	394	244
AUS	1629	1358	1049	1012	899	1412	2191	596	1362	1315	0	811	766	974	977	175	251	128	790	1198	486	959	448	329	297	829	523	469	319
BEL	899	1364	902	1120	795	1606	947	665	931	465	718	0	544	738	768	175	225	88	588	926	341	582	342	315	235	697	345	268	296
IRL	574	789	638	662	495	874	765	432	1039	665	661	532	0	528	586	107	152	109	465	657	330	456	237	219	173	507	261	287	197
ESP	969	1080	878	1123	916	1122	1143	499	924	452	705	725	500	0	988	193	240	120	837	1225	454	957	419	337	265	871	550	381	311
CZE	1013	1681	1011	1025	958	1613	1575	443	893	550	670	634	458	735	0	231	316	145	1038	1582	438	937	509	542	373	875	556	429	408
SVN	165	340	209	169	203	242	201	101	152	87	121	135	79	138	168	0	96	49	160	287	74	166	137	77	85	154	114	63	121
EST	201	358	240	171	181	316	295	110	183	85	133	144	81	117	200	57	0	56	228	402	114	225	222	130	137	214	141	121	143
ISR	111	139	125	88	92	137	219	40	115	104	82	56	83	70	112	34	33	0	123	167	66	119	84	55	61	114	75	76	72
HUN	1045	1047	799	765	877	891	1408	377	813	424	599	511	403	676	968	118	137	84	0	1070	403	765	389	336	258	747	517	394	286
POL	1523	2684	1583	1478	1450	2087	2470	641	1373	591	942	860	543	905	1361	256	295	130	972	0	426	1082	741	482	513	1069	655	452	530
ZAF	478	437	395	406	323	443	634	220	455	312	428	293	297	407	312	52	57	43	335	322	0	429	175	183	122	445	278	279	159
JPN	742	665	575	501	566	611	923	324	568	324	536	376	287	462	431	90	81	46	420	591	282	0	393	319	248	725	620	410	248
LVA	356	752	354	280	356	424	655	178	288	163	229	207	136	223	346	81	135	54	279	602	101	168	0	202	263	432	268	203	285
SVK	323	530	230	265	228	403	385	127	228	166	163	192	107	171	465	36	55	22	234	339	101	113	102	0	144	329	224	191	154
LTU	197	639	246	157	197	298	327	90	199	101	135	126	82	113	257	42	70	29	156	405	48	86	182	74	0	254	166	136	186
PRT	1125	1150	864	916	888	1093	1418	465	899	490	659	702	455	831	731	120	141	77	736	1065	397	430	327	224	160	0	504	410	334
KOR	787	495	422	388	526	420	1126	215	418	261	387	257	183	399	404	70	68	40	418	553	208	374	160	135	71	420	0	321	161
URY	525	380	325	310	319	367	901	178	406	317	367	208	233	312	333	36	70	41	336	387	240	251	120	123	78	369	261	0	150
HRV	202	720	367	270	288	450	325	140	265	145	203	242	136	234	312	98	103	50	212	481	108	114	221	78	133	272	74	97	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
CAN	0	2595	1665	1682	1829	1753	3914	926	1883	851	1596	901	614	1423	1309	219	314	156	1110	1694	514	1428	577	461	351	1089	803	529	337
DEU	2036	0	2861	2691	2561	3579	3754	1180	2242	1072	1780	1324	911	1642	2080	348	491	184	1305	2895	559	1470	905	713	689	1265	709	504	694
DFS	1474	2167	0	1865	1574	2368	2345	763	1706	937	1416	959	776	1136	1453	260	365	171	988	1875	514	1040	559	431	413	972	568	445	462
FRA	1234	1646	1159	0	1699	2252	2715	770	1709	897	1419	1089	788	1353	1476	225	313	143	1037	2015	511	1285	516	470	349	1027	617	451	373
ITA	1514	1702	1227	1003	0	1762	2661	740	1594	711	1203	814	597	1285	1309	245	313	146	1018	1798	417	1147	566	392	371	963	646	420	398
NLD	1709	3378	2123	1583	1429	0	2779	965	1953	1185	1597	1395	934	1249	1750	278	430	182	1051	2187	522	1139	626	571	461	1096	572	456	493
USA	4447	2814	1873	1590	1948	2489	0	1059	2485	1207	2129	1057	850	1688	1918	251	412	231	1429	2486	646	2047	772	575	470	1360	977	721	426
CHE	847	1116	719	712	672	964	992	0	758	449	672	653	423	602	571	139	189	70	451	750	259	484	321	247	196	510	300	224	214
GBR	2130	1730	1331	1162	1213	1731	2280	724	0	1030	1552	941	1017	1176	1226	210	309	164	939	1575	518	1102	494	398	367	992	569	479	367
NZL	846	827	675	584	513	1080	1156	379	893	0	1307	569	770	595	732	128	165	130	545	767	375	613	289	278	215	605	356	394	245
AUS	1629	1358	1049	1012	891	1412	2190	596	1362	1315	0	811	766	974	977	174	251	128	790	1198	486	958	448	329	297	829	523	469	319
BEL	899	1364	902	1120	790	1606	946	665	931	465	718	0	544	738	768	174	225	88	588	926	341	581	342	315	235	697	345	268	297
IRL	574	789	638	662	490	874	765	432	1039	665	661	532	0	528	586	106	152	109	465	657	330	455	237	219	173	507	261	287	198
ESP	969	1080	878	1123	908	1122	1143	499	924	452	705	725	500	0	988	192	240	120	837	1225	454	957	419	337	265	871	550	381	311
CZE	1013	1681	1011	1025	951	1613	1575	443	893	550	670	634	458	735	0	230	316	145	1038	1582	438	937	509	542	373	875	556	429	409
SVN	165	340	209	169	203	242	201	101	152	87	121	135	79	138	168	0	96	49	160	286	73	166	136	76	84	153	114	62	120
EST	201	358	240	171	180	316	295	110	183	85	133	144	81	117	200	57	0	56	228	402	114	224	222	130	137	214	141	121	143
ISR	111	139	125	88	92	137	219	40	115	104	82	56	83	70	112	34	33	0	123	167	66	119	84	55	61	114	75	76	72
HUN	1045	1047	799	765	870	891	1408	377	813	424	599	511	403	676	968	118	137	84	0	1070	403	765	389	336	258	747	517	394	286
POL	1523	2684	1583	1478	1446	2087	2470	641	1373	591	942	860	543	905	1361	256	295	130	972	0	426	1081	741	482	513	1069	655	452	531
ZAF	478	437	395	406	319	443	634	220	455	312	428	293	297	407	312	52	57	43	335	322	0	429	175	183	122	445	278	279	159
JPN	740	664	574	501	562	609	921	323	567	324	535	375	286	462	431	90	80	46	420	590	282	0	393	319	248	725	621	410	248

CAN	0	130	491	200	287	181	47	165	71	78	9	42
DFS	124	0	222	176	171	191	161	163	110	142	37	61
USA	519	204	0	406	531	264	107	318	101	145	39	72
NZL	208	153	481	0	482	244	93	218	86	93	106	57
AUS	291	141	573	533	0	247	82	253	85	92	53	59
GBR	180	182	284	246	245	0	101	180	105	106	65	77
NLD	42	163	114	89	73	93	0	81	56	94	27	41
ZAF	161	145	332	226	238	179	77	0	91	88	34	59
ITA	67	110	108	85	80	106	56	84	0	61	20	45
DEU	75	140	145	88	83	103	91	85	61	0	21	52
IRL	6	33	40	118	50	68	25	34	19	21	0	18
CHE	36	61	73	48	50	73	35	52	43	48	13	0

JER

common bulls below diagonal												
common	three	quarter	sib	group	above diagonal							
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	130	490	200	287	180	47	163	71	78	9	42
DFS	124	0	222	176	171	191	161	161	110	142	37	61
USA	518	204	0	405	531	263	107	314	101	145	39	72
NZL	208	153	480	0	482	243	93	217	86	93	106	58
AUS	291	141	573	533	0	246	82	252	85	92	53	59
GBR	180	182	284	246	245	0	101	178	105	106	65	76
NLD	42	163	114	89	73	93	0	80	56	94	27	41
ZAF	159	143	328	225	237	177	76	0	91	87	34	59
ITA	67	110	108	85	80	106	56	84	0	61	20	45
DEU	75	140	145	88	83	103	91	84	61	0	21	52
IRL	6	33	40	118	50	68	25	34	19	21	0	18
CHE	36	61	73	48	50	73	35	52	43	48	13	0

JER

common bulls below diagonal												
common	three	quarter	sib	group	above diagonal							
	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	130	490	200	287	180	47	163	71	78	9	42
DFS	124	0	222	176	171	191	161	161	110	142	37	61
USA	518	204	0	405	531	263	107	314	101	145	39	72
NZL	208	153	480	0	482	244	93	217	86	93	106	57
AUS	291	141	573	533	0	247	82	252	85	92	53	59
GBR	180	182	284	246	245	0	101	178	105	106	65	76
NLD	42	163	114	89	73	93	0	80	56	94	27	41
ZAF	159	143	328	225	237	177	76	0	91	87	34	59
ITA	67	110	108	85	80	106	56	84	0	61	20	45
DEU	75	140	145	88	83	103	91	84	61	0	21	52
IRL	6	33	40	118	50	68	25	34	19	21	0	18
CHE	36	61	73	48	50	73	35	52	43	48	13	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	CAM
CAN	0	7	229	95	105	90	190	14	75	3	10	17	3	6	0
NOR	6	0	85	48	75	68	138	15	0	29	19	25	49	49	0
USA	212	86	0	136	148	127	221	24	64	24	25	34	25	47	26
NZL	95	48	137	0	163	93	199	22	39	20	18	29	11	24	12
AUS	106	64	149	164	0	93	205	44	38	42	39	45	15	39	12
GBR	88	71	119	89	92	0	118	15	41	13	17	27	19	42	0
DFS	195	112	217	197	180	113	0	63	53	134	129	111	15	54	0
DEU	13	14	22	22	43	15	54	0	1	30	36	29	5	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	29	23	19	38	11	122	30	0	0	53	26	0	20	0
LVA	10	17	22	15	35	16	88	30	2	46	0	55	3	14	0

LTU	16	22	29	26	42	25	99	28	5	25	49	0	5	14	0
IRL	3	48	25	11	14	18	12	5	2	0	3	5	0	10	0
NLD	6	48	46	24	37	41	51	14	2	19	13	13	10	0	0
CAM	0	0	26	12	12	0	0	0	0	0	0	0	0	0	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	CAM
CAN	0	7	228	95	105	90	190	14	75	3	10	17	3	6	0
NOR	6	0	84	48	75	68	138	15	0	29	19	25	49	49	0
USA	211	85	0	136	148	126	218	24	64	24	25	34	25	47	26
NZL	95	48	137	0	163	93	199	22	39	20	18	29	11	24	12
AUS	106	64	149	164	0	93	205	44	38	42	39	45	15	39	12
GBR	88	71	118	89	92	0	118	15	41	13	17	27	19	42	0
DFS	195	112	214	197	180	113	0	63	53	134	129	111	15	54	0
DEU	13	14	22	22	43	15	54	0	1	30	36	29	5	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	29	23	19	38	11	122	30	0	0	53	26	0	20	0
LVA	10	17	22	15	35	16	88	30	2	46	0	55	3	14	0
LTU	16	22	29	26	42	25	99	28	5	25	49	0	5	14	0
IRL	3	48	25	11	14	18	12	5	2	0	3	5	0	10	0
NLD	6	48	46	24	37	41	51	14	2	19	13	13	10	0	0
CAM	0	0	26	12	12	0	0	0	0	0	0	0	0	0	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	CAM
CAN	0	7	228	95	105	90	190	14	75	3	10	17	3	6	0
NOR	6	0	84	48	75	68	138	15	0	29	19	25	49	49	0
USA	211	85	0	136	148	126	218	24	64	24	25	34	25	47	26
NZL	95	48	137	0	163	93	199	22	39	20	18	29	11	24	12
AUS	106	64	149	164	0	93	205	44	38	42	39	45	15	39	12
GBR	88	71	118	89	92	0	118	15	41	13	17	27	19	42	0
DFS	195	112	214	197	180	113	0	63	53	134	129	110	15	54	0
DEU	13	14	22	22	43	15	54	0	1	30	36	29	5	15	0
ZAF	77	0	58	34	39	36	50	1	0	0	2	5	2	2	0
EST	2	29	23	19	38	11	122	30	0	0	53	26	0	20	0
LVA	10	17	22	15	35	16	88	30	2	46	0	55	3	14	0
LTU	16	22	29	26	42	25	98	28	5	25	49	0	5	14	0
IRL	3	48	25	11	14	18	12	5	2	0	3	5	0	10	0
NLD	6	48	46	24	37	41	51	14	2	19	13	13	10	0	0
CAM	0	0	26	12	12	0	0	0	0	0	0	0	0	0	0

SIM

common bulls below diagonal  
common three quarter sib group above diagonal

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	0	376	234	99	2	10	92	57	56	2	32	2
DEA	342	0	285	1053	244	254	380	66	55	707	36	52
FRM	286	335	0	182	11	2	129	72	73	2	74	3
ITA	102	967	208	0	141	145	247	64	48	328	33	24
SVN	2	231	10	134	0	48	75	4	0	121	1	10
FRA	8	212	1	130	46	0	78	4	0	100	3	11
NLD	94	400	152	243	70	74	0	57	53	159	28	8
IRL	54	59	77	61	4	4	51	0	40	8	17	2
GBR	64	58	94	52	0	0	54	34	0	0	19	0
HRV	2	741	1	315	112	90	156	7	0	0	4	23
USA	31	42	89	40	1	3	30	16	27	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	0	0

SIM

```

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

```

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	0	375	234	99	2	10	92	57	56	2	32	2
DEA	342	0	285	1054	244	254	380	66	55	705	36	52
FRM	286	335	0	182	11	2	129	72	73	2	74	3
ITA	102	968	208	0	141	145	247	64	48	327	33	24
SVN	2	231	10	134	0	48	75	4	0	121	1	10
FRA	8	212	1	130	46	0	78	4	0	100	3	11
NLD	94	400	152	243	70	74	0	57	53	159	28	8
IRL	54	59	77	61	4	4	51	0	40	8	17	2
GBR	64	58	94	52	0	0	54	34	0	0	19	0
HRV	2	739	1	314	112	90	156	7	0	0	4	23
USA	31	42	89	40	1	3	30	16	27	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	0	0

```

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

```

	CHE	DEA	FRM	ITA	SVN	FRA	NLD	IRL	GBR	HRV	USA	HUN
CHE	0	375	234	99	2	10	92	57	56	2	32	2
DEA	342	0	285	1053	244	254	380	66	55	706	36	52
FRM	286	335	0	182	11	2	129	72	73	2	74	3
ITA	102	967	208	0	141	145	247	64	48	327	33	24
SVN	2	231	10	134	0	48	75	4	0	121	1	10
FRA	8	212	1	130	46	0	78	4	0	100	3	11
NLD	94	400	152	243	70	74	0	57	53	159	28	8
IRL	54	59	77	61	4	4	51	0	40	8	17	2
GBR	64	58	94	52	0	0	54	34	0	0	19	0
HRV	2	740	1	314	112	90	156	7	0	0	4	23
USA	31	42	89	40	1	3	30	16	27	4	0	0
HUN	1	36	1	20	9	8	8	2	0	21	0	0