

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 conformation traits are as follows:

AUS (ALL)	New EDC calculation, Base change, updated the status of bulls to better reflect their status as AI bull. As a result a good number no longer qualifies and were not submitted.
NOR (RDC)	The criterion for type of proof=12 was increased from 10 to 70 for 2nd batch daughters to make it more realistic. 99 bulls were then reversed to type=11.
DEA (ALL)	Base change
SVN (ALL)	Small decrease in information due to changes in data base related to the pedigree completeness as well as phenotypic data improvement.
DEU (JER)	Made some adjustments in defining the Fixed Lactation Curves
DFS (ALL)	Updated the pedigree program used for genetic evaluation. The effect is minor. Data from Norway has been included in the HOL evaluation
ISR (HOL)	Base change
ITA (SIM)	Changed the way to calculate the reliability and edc.
JPN (HOL)	Base change, now the cows born in 2015 are the base. Some changes in information due to pedigree verification.
BEL (HOL)	Base change now set to cows born in 2015
HUN (HOL,SIM)	Base change
GBR (ALL)	Changes in information due to changes from data recording agents
NZL (ALL)	Changes in information due to continuous pedigree verification
LVA (HOL,RDC)	Base change implemented in April but file301 updated only now.
PRT (HOL)	New variance components estimation, Base change.
EST (HOL)	For the next two years all breeding values are standardised within breed to a base with mean of 100 and a genetic standard deviation of 12 points for cows born 2012-2016.
ZAF (ALL)	Refining genetic groups. Changing from PEST software to MIX99 for estimation of breeding values and reliabilities. Base Year Change.

INTERBULL CHANGES COMPARED TO THE PREVIOUS 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 conformation 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.

The window so far applied for MAS evaluation have been found too high compared to the within-country genetic correlation between mastitis and SCS available from the literature. It has been an ITC recommendation to adjust the windows for MAS in the 2001t test run to make them more in line with the values available from the literature. The recommendation has been approved by the Steering committee. Also, according to the decision taken by ITC in Orlando (2015) to review all windows every five (5) years, an overall review of the windows for all traits will take place during the first half of 2020. Implementation of the reviewed windows is aimed for January 2021 test run.

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 2020).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	211	140	8457	1819	760	
BEL			2129			
CAN	252	102	13027	802	842	
CHE	3045		3561	92		3365
CZE			4824			
DEA	6131					24869
DEU			22789	189	276	
DFS			13506	2256	7849	
ESP			4110			
EST			1228		464	
FRA	415		17474			483
FRM						4827
GBR	171	352	7584	925	650	94
HUN			3480			226
IRL			2878	160	60	100
ISR			1549			
ITA	2196		9542	173		1832
JPN			6321			
KOR			1530			
LTU			1239		437	
LVA			1296		696	
NLD	200		16012	189	87	434
NOR					4213	
NZL	62	61	8316	5154	1445	
POL			11191			
PRT			2451			
SVK			1139			
SVN	400		620			681
URY			1095			
USA	1144	797	40073	4952	743	75

ZAF		1309	726	144		
HRV		771			854	
MEX		613				
CAM				44		

No. Records	14227	1452	210114	17437	18710	37840
Pub. Proofs	11492	1155	154837	13992	16682	34292

^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	656.34										
FRA	0.89	624.96									
USA	0.92	0.88	638.95								
CHE	0.91	0.88	0.87	488.01							
ITA	0.88	0.83	0.88	0.86	604.18						
DEA	0.88	0.82	0.86	0.94	0.90	463.53					
NLD	0.88	0.87	0.87	0.85	0.86	0.87	661.34				
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.28			
NZL	0.70	0.74	0.70	0.74	0.70	0.72	0.71	0.74	366.61		
GBR	0.86	0.88	0.86	0.87	0.82	0.82	0.86	0.82	0.70	278.83	
AUS	0.74	0.77	0.72	0.72	0.70	0.70	0.74	0.72	0.82	0.73	389.11

BSW fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	28.05										
FRA	0.89	26.54									
USA	0.90	0.89	23.58								
CHE	0.86	0.87	0.84	19.19							
ITA	0.89	0.83	0.86	0.86	23.03						
DEA	0.85	0.84	0.84	0.94	0.87	17.34					
NLD	0.87	0.85	0.86	0.84	0.85	0.86	26.53				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	9.63			
NZL	0.71	0.72	0.71	0.74	0.70	0.80	0.70	0.74	16.42		
GBR	0.86	0.89	0.86	0.88	0.82	0.82	0.86	0.82	0.71	10.34	
AUS	0.74	0.73	0.73	0.70	0.70	0.70	0.71	0.72	0.81	0.72	15.34

BSW pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.65										
FRA	0.84	20.05									
USA	0.89	0.86	18.89								
CHE	0.85	0.83	0.83	15.53							
ITA	0.85	0.81	0.83	0.84	21.26						
DEA	0.85	0.81	0.82	0.92	0.88	14.47					
NLD	0.85	0.83	0.84	0.83	0.82	0.84	21.90				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	9.11			
NZL	0.70	0.70	0.69	0.71	0.70	0.72	0.69	0.74	12.19		
GBR	0.84	0.85	0.83	0.85	0.81	0.82	0.85	0.82	0.70	8.05	
AUS	0.71	0.70	0.69	0.70	0.69	0.70	0.69	0.72	0.81	0.70	11.84

GUE mil

	CAN	USA	AUS	GBR	NZL
CAN	772.60				
USA	0.94	776.43			
AUS	0.80	0.76	469.55		
GBR	0.87	0.83	0.75	243.91	
NZL	0.71	0.70	0.83	0.70	299.62

DEA	0.86	15.48																		
FRM	0.93	0.86	19.01																	
ITA	0.82	0.80	0.81	15.90																
SVN	0.83	0.81	0.83	0.81	8.87															
FRA	0.89	0.86	0.88	0.82	0.81	21.27														
HUN	0.83	0.82	0.88	0.84	0.83	0.84	13.47													
NLD	0.84	0.92	0.87	0.81	0.81	0.85	0.81	23.47												
IRL	0.76	0.73	0.81	0.71	0.74	0.80	0.69	0.75	6.22											
GBR	0.85	0.85	0.86	0.81	0.81	0.86	0.80	0.85	0.74	7.06										
HRV	0.82	0.80	0.88	0.80	0.81	0.81	0.82	0.81	0.73	0.81	10.66									
USA	0.84	0.82	0.81	0.86	0.81	0.88	0.87	0.85	0.74	0.83	0.81	15.47								

^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	85	178	137	130	150	52	36	27	67	92
FRA	73	0	120	162	194	218	83	62	23	57	64
USA	166	81	0	320	243	329	82	44	32	95	126
CHE	113	118	297	0	467	596	96	87	28	74	116
ITA	112	152	172	405	0	725	128	107	33	80	121
DEA	128	159	295	492	619	0	148	116	41	78	129
NLD	49	68	74	89	109	143	0	49	28	42	57
SVN	32	60	36	82	106	107	50	0	13	25	30
NZL	25	18	28	21	25	35	21	12	0	21	28
GBR	59	44	79	53	53	51	31	18	18	0	58
AUS	91	48	118	77	88	92	41	23	21	49	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	85	178	137	130	150	52	36	27	67	92
FRA	73	0	120	162	194	218	83	62	23	57	64
USA	166	81	0	320	243	329	82	44	32	95	126
CHE	113	118	297	0	467	596	96	87	28	74	116
ITA	112	152	172	405	0	725	128	107	33	80	121
DEA	128	159	295	492	619	0	148	116	41	78	129
NLD	49	68	74	89	109	143	0	49	28	42	57
SVN	32	60	36	82	106	107	50	0	13	25	30
NZL	25	18	28	21	25	35	21	12	0	21	28
GBR	59	44	79	53	53	51	31	18	18	0	58
AUS	91	48	118	77	88	92	41	23	21	49	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	85	178	137	130	150	52	36	27	67	92
FRA	73	0	120	162	194	218	83	62	23	57	64
USA	166	81	0	320	243	329	82	44	32	95	126
CHE	113	118	297	0	467	596	96	87	28	74	116
ITA	112	152	172	405	0	725	128	107	33	80	121
DEA	128	159	295	492	619	0	148	116	41	78	129
NLD	49	68	74	89	109	143	0	49	28	42	57
SVN	32	60	36	82	106	107	50	0	13	25	30
NZL	25	18	28	21	25	35	21	12	0	21	28
GBR	59	44	79	53	53	51	31	18	18	0	58
AUS	91	48	118	77	88	92	41	23	21	49	0

GUE

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common bulls below diagonal
common three quarter sib group above diagonal
  CAN  USA  AUS  GBR  NZL
-----
CAN    0   71   48   34   14
USA   62    0   64   95   32
AUS   46   60    0   39   27
GBR   27   96   33    0   16
NZL   11   29   27   14    0
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GUE

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common bulls below diagonal
common three quarter sib group above diagonal
  CAN  USA  AUS  GBR  NZL
-----
CAN    0   71   48   34   14
USA   62    0   64   95   32
AUS   46   60    0   39   27
GBR   27   96   33    0   16
NZL   11   29   27   14    0
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GUE

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common bulls below diagonal
common three quarter sib group above diagonal
  CAN  USA  AUS  GBR  NZL
-----
CAN    0   71   48   34   14
USA   62    0   64   95   32
AUS   46   60    0   39   27
GBR   27   96   33    0   16
NZL   11   29   27   14    0
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HOL

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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 2353 1484 1496 1692 1552 3505  911 1716  771 1461  834  562 1329 1210 224 272 138 1057 1469  512 1344  503 435 307 1035  722  504  294  373
DEU 1752    0 2610 2361 2474 3226 3455 1158 2055  974 1650 1231  850 1532 1942 335 427 167 1246 2536  556 1382  787 686 618 1208  643 480 597 346
DFS 1270 1889    0 1650 1552 2137 2120  740 1574  851 1314  887  728 1053 1347 269 302 153  929 1655  509  969 499 411 372  932  505 423 390 286
FRA  985 1216  870    0 1646 1979 2506  694 1551  802 1289  942  727 1161 1334 213 267 125  959 1697  479 1193  430 425 300  923  539 408 280 296
ITA 1323 1547 1126  831    0 1668 2549  718 1546  713 1181  798  616 1245 1280 247 281 138 1012 1630  460 1149  508 386 334  968  599 428 355 323
NLD 1479 2957 1865 1205 1310    0 2523  913 1773 1066 1486 1306  873 1137 1630 283 376 162  994 1916  520 1058  554 542 401 1047  505 433 420 300
USA 3914 2426 1595 1306 1684 2193    0 1035 2282 1100 1961  991  784 1582 1784 260 358 195 1360 2157  643 1949  667 547 417 1301  887 685 366 447
CHE  775 1029  660  597  633  888  923    0  734  416  641  620  399  581  574 151 175  63  452  705  273  481  293 240  184  508  278 223 200 174
GBR 1949 1538 1178  931 1127 1535 2032  664    0  943 1433  879  950 1097 1152 226 264 150  894 1390  516 1043  442 382 317  948  518 453 321 319
NZL  777  747  605  471  505  972 1049  346  813    0 1217  533  708  553  679 138 144 112  517  682  368  571  257 264 190  569  328 368 213 196
AUS 1480 1224  955  851  835 1299 1958  556 1229 1224    0  765  721  914  920 188 224 116  747 1074  483  900  393 312 263  786  468 442 286 267
BEL  832 1268  832  918  763 1502  881  625  870  436  674    0  513  693  732 190 202  84  560  845  340  556  311 303 217  665  315 254 262 201
IRL  525  732  592  560  505  812  697  401  964  611  617  505    0  503  558 122 137  99  445  602  332  437  217 208 158 488  241 272 179 173
ESP  863  985  786  826  870 1014 1026  465  854  419  643  675 475    0  927 204 214 111  791 1102  452  917  382 320 239  828  498 368 273 281
CZE  919 1541  904  844  906 1496 1422  423  832  507  620  605 442  680    0  237 283 133  992 1435  434  886  467 520 339  844  510 413 356 277
SVN  163  322  216  144  206  244  197  107  164  95 131 152  90 148 176    0  98  48 172  277  101 177 130  88  83 171 106  78 108  67
EST  165  307  185  126  157  272  240  96 147  74 113 129  71  98 179  58    0  51 210 337 110 210 199 120 118 199 123 111 123  73
ISR   98  130  113  65  85 124 182  39 102  91  74  55  75  65 101  36 32    0 117 151  65 109  71  50  58 103  63  69  65  41
HUN  989  977  737  634  847  831 1323 362 768 406 562 484 390 626 920 127 129 81  0  996 400 734 351 322 231 718 473 378 253 287
POL 1259 2274 1340 1093 1227 1769 2042 575 1161 518 808 780 495 776 1204 250 243 115 880  0 420 1003 648 457 456 1019 588 428 444 314
ZAF  473  433  388  333  349  440  629 222 451 307 423 290 299 402 308 71 56 43 331 313  0 427 173 183 119 438 275 276 152 213
JPN  665  587  508  405  513  540  833 299 517 290 483 350 270 419 391 95 74 45 395 523 281  0 360 311 225 693 568 394 212 294
LVA  303  646  317  202  327  378  552 151 256 146 200 190 126 205 321 78 123 48 259 530  98 154  0 191 240 407 241 191 248 139
SVK  305  505  217  220  225  379  361 123 216 158 156 187 103 160 448 48 53 22 226 317 100 107  98  0 136 325 213 185 141 126
LTU  162  571  213  108  172  247  279  82 159  90 118 112  79  98 231 45 61 29 140 356  48  74 167  69  0 240 152 124 164  69
PRT 1083 1105 821  770  883 1053 1361 450 866 470 628 674 442 796 712 135 139 75 715 1022 394 406 316 225 153  0 471 399 310 336
KOR  691  432  360  307  474  357 1014 193 375 240 340 230 168 349 373 65 60 38 386 490 207 329 142 130  66 393  0 305 137 253
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URY	498	359	307	241	321	346	855	167	381	293	340	200	224	299	320	47	68	37	323	368	235	239	114	121	73	364	248	0	138	238
HRV	171	611	297	166	252	376	275	127	227	125	177	215	122	203	263	84	89	45	188	392	100	95	194	68	113	248	58	88	0	113
MEX	390	290	240	231	298	251	535	154	288	158	222	190	152	256	240	51	51	27	275	294	198	228	96	75	30	352	238	226	74	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	2353	1484	1496	1693	1552	3505	911	1716	771	1461	834	562	1329	1210	224	272	138	1057	1469	512	1341	503	435	307	1034	721	504	294	143
DEU	1752	0	2610	2361	2476	3226	3455	1158	2055	974	1650	1231	850	1532	1942	335	427	167	1246	2536	556	1378	787	686	618	1207	642	480	597	134
DFS	1270	1889	0	1650	1554	2137	2120	740	1574	851	1314	887	728	1053	1347	269	302	153	929	1655	509	966	499	411	372	932	505	423	390	122
FRA	985	1216	870	0	1648	1979	2506	694	1551	802	1289	942	728	1161	1334	213	267	125	959	1697	479	1189	430	425	300	922	539	408	280	125
ITA	1325	1552	1131	834	0	1671	2551	719	1549	715	1183	800	618	1248	1282	249	281	139	1012	1630	461	1147	509	387	334	970	599	428	356	120
NLD	1479	2957	1865	1205	1316	0	2523	913	1773	1066	1486	1306	875	1137	1630	283	376	162	994	1916	520	1053	554	542	401	1047	504	433	420	128
USA	3914	2426	1595	1306	1689	2193	0	1035	2282	1100	1961	991	784	1582	1784	260	358	195	1360	2157	643	1945	667	547	417	1300	886	685	366	149
CHE	775	1029	660	597	635	888	923	0	734	416	641	620	399	581	574	151	175	63	452	705	273	477	293	240	184	508	278	223	200	97
GBR	1949	1538	1178	931	1132	1535	2032	664	0	943	1433	879	951	1097	1152	226	264	150	894	1390	516	1039	442	382	317	947	518	453	321	132
NZL	777	747	605	471	508	972	1049	346	813	0	1217	533	708	553	679	138	144	112	517	682	368	571	257	264	190	569	328	368	213	102
AUS	1480	1224	955	851	840	1299	1958	556	1229	1224	0	765	721	914	920	188	224	116	747	1074	483	898	393	312	263	786	467	442	286	120
BEL	832	1268	832	918	766	1502	881	625	870	436	674	0	513	693	732	190	202	84	560	845	340	555	311	303	217	665	315	254	262	107
IRL	525	732	592	560	508	814	697	401	965	611	617	505	0	503	558	122	137	99	445	602	332	436	217	208	158	488	241	272	179	92
ESP	863	985	786	826	876	1014	1026	465	854	419	643	675	475	0	927	204	214	111	791	1102	452	915	382	320	239	828	498	368	273	121
CZE	919	1541	904	844	909	1496	1422	423	832	507	620	605	442	680	0	237	283	133	992	1435	434	883	467	520	339	844	510	413	356	99
SVN	163	322	216	144	208	244	197	107	164	95	131	152	90	148	176	0	98	48	172	277	101	176	130	88	83	171	106	78	108	36
EST	165	307	185	126	157	272	240	96	147	74	113	129	71	98	179	58	0	51	210	337	110	206	199	120	118	198	123	111	123	29
ISR	98	130	113	65	85	124	182	39	102	91	74	55	75	65	101	36	32	0	117	151	65	108	71	50	58	103	63	69	65	15
HUN	989	977	737	634	849	831	1323	362	768	406	562	484	390	626	920	127	129	81	0	996	400	732	351	322	231	717	473	378	253	112
POL	1259	2274	1340	1093	1229	1769	2042	575	1161	518	808	780	495	776	1204	250	243	115	880	0	420	998	648	457	456	1018	588	428	444	106
ZAF	473	433	388	333	351	439	628	222	450	307	423	290	299	402	308	71	56	43	331	313	0	426	173	183	119	437	275	276	152	105
JPN	661	582	505	401	512	534	826	295	512	289	478	347	269	417	389	94	70	44	393	516	280	0	358	309	224	690	567	393	212	129
LVA	303	646	317	202	328	378	552	151	256	146	200	190	126	205	321	78	123	48	259	530	98	153	0	191	240	407	241	191	248	45
SVK	305	505	217	220	226	379	361	123	216	158	156	187	103	160	448	48	53	22	226	317	100	106	98	0	136	324	213	185	141	59
LTU	162	571	213	108	172	247	279	82	159	90	118	112	79	98	231	45	61	29	140	356	48	73	167	69	0	240	152	124	164	26
PRT	1082	1103	821	767	887	1052	1360	449	865	469	627	673	442	795	711	135	138	75	713	1021	394	402	316	224	153	0	470	399	309	127
KOR	690	431	360	307	474	356	1012	193	375	240	339	230	168	349	373	65	60	38	386	490	207	327	142	130	66	392	0	305	137	99
URY	498	359	307	241	321	346	855	167	381	293	340	200	224	299	320	47	68	37	323	368	235	236	114	121	73	364	248	0	138	105
HRV	171	610	296	166	252	375	275	127	227	124	176	214	122	203	262	83	88	44	188	391	100	95	194	68	112	247	58	88	0	46
MEX	177	149	128	128	127	139	193	97	156	101	128	119	101	139	92	30	18	12	118	106	116	130	30	42	6	150	102	112	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	2353	1484	1496	1692	1552	3499	911	1716	771	1461	834	562	1329	1210	224	272	138	1057	1469	512	1338	503	435	307	1034	722	504	294	141
DEU	1752	0	2610	2361	2475	3226	3453	1158	2055	974	1650	1231	850	1532	1942	335	427	167	1246	2536	556	1376	787	686	618	1207	643	480	597	132
DFS	1270	1889	0	1650	1553	2137	2118	740	1574	851	1314	887	728	1053	1347	269	302	153	929	1655	509	965	499	411	372	932	505	423	390	120
FRA	985	1216	870	0	1647	1979	2505	694	1551	802	1289	942	728	1161	1334	213	267	125	959	1697	479	1188	430	425	300	922	539	408	280	123
ITA	1323	1548	1127	832	0	1670	2550	718	1548	714	1182	799	617	1247	1281	248	281	139	1012	1630	460	1146	509	387	334	969	599	428	355	118
NLD	1479	2957	1865	1205	1313	0	2522	913	1773	1066	1486	1306	875	1137	1630	283	376	162	994	1916	520	1051	554	542	401	1047	505	433	420	126
USA	3911	2426	1595	1306	1685	2193	0	1035	2281	1100	1958	990	784	1581	1784	260	358	195	1360	2157	643	1940	667	546	417	1300	888	685	366	147
CHE	775	1029	660	597	633	888	922	0	734	416	641	620	399	581	574	151	175	63	452	705	273	475	293	240	184	508	278	223	200	95
GBR	1949	1538	1178	931	1129	1535	2032	664	0	943	1433	879	951	1097	1152	226	264	150	894	1390	516	1038	442	382	317	947	518	453	321	130
NZL	777	747	605	471	506	972	1049	346	813	0	1217	533	708	553	679	138	144	112	517	682	368	571	257	264	190	569	328	368	213	101
AUS	1480	1224	955	851	836	1299	1957	556	1229	1224	0	765	721	914	920	188	224	116	747	1074	483	897	393	312	263	786	468	442	286	118
BEL	832	1268	832	918	764	1502	880	625	870	436	674	0	513	693	732	190	202	84	560	845	340	555	311	303	217	665	315	254	262	105
IRL	525	732	592	560	505	814	697	401	965	611	617	505	0	503	558	122	137	99	445	602	332	436	217	20						

LVA	303	646	317	202	328	378	552	151	256	146	200	190	126	205	321	78	123	48	259	530	98	152	0	191	240	407	241	191	248	44
SVK	305	505	217	220	226	379	360	123	216	158	156	187	103	160	448	48	53	22	226	317	100	105	98	0	136	324	213	185	141	59
LTU	162	571	213	108	172	247	279	82	159	90	118	112	79	98	231	45	61	29	140	356	48	73	167	69	0	240	152	124	164	25
PRT	1082	1104	821	768	885	1053	1359	450	866	470	627	674	442	796	712	135	138	75	714	1021	394	401	315	224	153	0	470	399	309	125
KOR	691	432	360	307	474	357	1015	193	375	240	340	230	168	349	373	65	60	38	386	490	207	326	142	130	66	392	0	305	137	99
URY	498	359	307	241	321	346	855	167	381	293	340	200	224	299	320	47	68	37	323	368	235	235	114	121	73	364	248	0	138	104
HRV	171	611	297	166	252	376	275	127	227	125	177	215	122	203	263	84	89	45	188	392	100	95	194	68	113	247	58	88	0	45
MEX	175	147	127	127	126	138	191	96	154	100	127	118	100	138	90	30	17	12	117	105	115	128	30	42	6	149	102	110	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	CHE
CAN	0	110	447	181	267	164	39	156	70	71	9	38
DFS	104	0	198	153	155	175	123	154	110	117	35	59
USA	472	179	0	366	500	240	87	302	101	122	37	66
NZL	186	132	439	0	453	221	76	204	85	79	103	50
AUS	272	125	541	503	0	227	74	239	85	85	50	53
GBR	160	162	254	217	220	0	88	170	104	96	61	68
NLD	35	125	94	70	65	79	0	74	57	74	25	40
ZAF	151	135	315	209	225	167	70	0	91	83	32	57
ITA	67	110	108	83	79	105	56	84	0	60	19	44
DEU	68	117	122	74	76	90	70	79	61	0	19	48
IRL	6	31	38	114	47	62	23	32	18	19	0	16
CHE	31	58	66	41	43	64	34	49	42	43	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	CHE
CAN	0	110	447	181	267	164	39	156	70	71	9	38
DFS	104	0	198	153	155	175	123	154	110	117	35	59
USA	472	179	0	366	500	240	87	301	101	122	37	66
NZL	186	132	439	0	453	220	76	204	85	79	103	51
AUS	272	125	541	503	0	226	74	238	85	85	50	53
GBR	160	162	254	217	220	0	88	170	104	96	61	68
NLD	35	125	94	70	65	79	0	74	57	74	25	40
ZAF	151	135	314	209	224	167	70	0	91	82	32	57
ITA	67	110	108	83	79	105	56	84	0	60	19	44
DEU	68	117	122	74	76	90	70	78	61	0	19	48
IRL	6	31	38	114	47	62	23	32	18	19	0	16
CHE	31	58	66	41	43	64	34	49	42	43	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	CHE
CAN	0	110	447	181	267	164	39	156	70	71	9	38
DFS	104	0	198	153	155	175	123	154	110	117	35	59
USA	472	179	0	366	500	240	87	301	101	122	37	66
NZL	186	132	439	0	453	220	76	204	85	79	103	50
AUS	272	125	541	503	0	226	74	238	85	85	50	53
GBR	160	162	254	217	220	0	88	170	104	96	61	68
NLD	35	125	94	70	65	79	0	74	57	74	25	40
ZAF	151	135	314	209	224	167	70	0	91	82	32	57
ITA	67	110	108	83	79	105	56	84	0	60	19	44
DEU	68	117	122	74	76	90	70	78	61	0	19	48
IRL	6	31	38	114	47	62	23	32	18	19	0	16
CHE	31	58	66	41	43	64	34	49	42	43	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	CAM
CAN	0	7	210	89	101	82	173	13	76	2	10	17	2	6	0
NOR	6	0	75	41	69	52	129	14	0	24	19	25	48	43	0
USA	194	77	0	124	132	109	193	20	65	19	23	34	24	42	24
NZL	88	41	125	0	143	83	174	17	40	11	17	27	9	19	12
AUS	101	59	133	142	0	82	187	38	39	34	35	42	14	32	12
GBR	78	55	99	77	81	0	100	14	41	8	17	26	18	34	0
DFS	176	103	189	172	160	92	0	50	53	115	121	104	14	49	0
DEU	12	13	20	17	38	14	41	0	1	22	34	29	4	14	0
ZAF	78	0	59	35	39	36	50	1	0	0	2	5	2	3	0
EST	2	24	18	10	31	7	103	22	0	0	50	25	0	18	0
LVA	10	17	20	14	33	16	82	28	2	43	0	52	2	13	0
LTU	16	22	29	25	42	24	99	28	5	25	48	0	4	14	0
IRL	2	47	24	9	13	17	11	4	2	0	2	4	0	9	0
NLD	6	43	41	19	30	33	46	14	3	17	12	13	9	0	0
CAM	0	0	24	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	210	89	101	82	173	13	76	2	10	17	2	6	0	
NOR	6	0	75	41	69	52	129	14	0	24	19	25	48	43	0	
USA	194	77	0	124	132	109	193	20	65	19	23	34	24	42	24	
NZL	88	41	125	0	143	83	174	17	40	11	17	27	9	19	12	
AUS	101	59	133	142	0	82	187	38	39	34	35	42	14	32	12	
GBR	78	55	99	77	81	0	100	14	41	8	17	26	18	34	0	
DFS	176	103	189	172	160	92	0	50	53	115	121	104	14	49	0	
DEU	12	13	20	17	38	14	41	0	1	22	34	29	4	14	0	
ZAF	78	0	59	35	39	36	50	1	0	0	2	5	2	3	0	
EST	2	24	18	10	31	7	103	22	0	0	50	25	0	18	0	
LVA	10	17	20	14	33	16	82	28	2	43	0	52	2	13	0	
LTU	16	22	29	25	42	24	99	28	5	25	48	0	4	14	0	
IRL	2	47	24	9	13	17	11	4	2	0	2	4	0	9	0	
NLD	6	43	41	19	30	33	46	14	3	17	12	13	9	0	0	
CAM	0	0	24	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	210	89	101	82	173	13	76	2	10	17	2	6	0	
NOR	6	0	75	41	69	52	129	14	0	24	19	25	48	43	0	
USA	194	77	0	124	132	109	193	20	65	19	23	34	24	42	24	
NZL	88	41	125	0	143	83	174	17	40	11	17	27	9	19	12	
AUS	101	59	133	142	0	82	187	38	39	34	35	42	14	32	12	
GBR	78	55	99	77	81	0	100	14	41	8	17	26	18	34	0	
DFS	176	103	189	172	160	92	0	50	53	115	121	103	14	49	0	
DEU	12	13	20	17	38	14	41	0	1	22	34	29	4	14	0	
ZAF	78	0	59	35	39	36	50	1	0	0	2	5	2	3	0	
EST	2	24	18	10	31	7	103	22	0	0	50	25	0	18	0	
LVA	10	17	20	14	33	16	82	28	2	43	0	52	2	13	0	
LTU	16	22	29	25	42	24	98	28	5	25	48	0	4	14	0	
IRL	2	47	24	9	13	17	11	4	2	0	2	4	0	9	0	
NLD	6	43	41	19	30	33	46	14	3	17	12	13	9	0	0	
CAM	0	0	24	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	HUN	NLD	IRL	GBR	HRV	USA

CHE	0	355	205	94	6	12	2	90	56	55	2	29
DEA	312	0	272	974	217	269	49	331	64	54	549	29
FRM	257	303	0	173	17	3	3	121	71	72	2	56
ITA	97	881	206	0	129	155	23	221	62	47	245	30
SVN	6	201	17	123	0	59	14	64	4	0	81	1
FRA	9	229	1	140	56	0	12	73	4	0	93	2
HUN	1	35	1	19	12	9	0	7	2	0	22	0
NLD	92	340	143	215	61	70	7	0	55	52	109	23
IRL	53	58	76	60	4	4	2	50	0	39	7	17
GBR	63	57	93	53	0	0	0	53	34	0	0	19
HRV	2	573	1	229	67	83	20	105	6	0	0	3
USA	28	30	71	35	1	2	0	25	16	27	3	0

SIM

common bulls below diagonal												
common three quarter sib group above diagonal												
	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
CHE	0	354	205	94	6	12	2	90	56	55	2	29
DEA	312	0	272	975	217	269	49	331	64	54	547	29
FRM	257	303	0	173	17	3	3	121	71	72	2	56
ITA	97	882	206	0	129	155	23	221	62	47	243	30
SVN	6	201	17	123	0	59	14	64	4	0	81	1
FRA	9	229	1	140	56	0	12	73	4	0	93	2
HUN	1	35	1	19	12	9	0	7	2	0	22	0
NLD	92	340	143	215	61	70	7	0	55	52	109	23
IRL	53	58	76	60	4	4	2	50	0	39	7	17
GBR	63	57	93	53	0	0	0	53	34	0	0	19
HRV	2	571	1	227	67	83	20	105	6	0	0	3
USA	28	30	71	35	1	2	0	25	16	27	3	0

SIM

common bulls below diagonal												
common three quarter sib group above diagonal												
	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	GBR	HRV	USA
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
CHE	0	354	205	94	6	12	2	90	56	55	2	29
DEA	312	0	272	974	217	269	49	331	64	54	548	29
FRM	257	303	0	173	17	3	3	121	71	72	2	56
ITA	97	881	206	0	129	155	23	221	62	47	244	30
SVN	6	201	17	123	0	59	14	64	4	0	81	1
FRA	9	229	1	140	56	0	12	73	4	0	93	2
HUN	1	35	1	19	12	9	0	7	2	0	22	0
NLD	92	340	143	215	61	70	7	0	55	52	109	23
IRL	53	58	76	60	4	4	2	50	0	39	7	17
GBR	63	57	93	53	0	0	0	53	34	0	0	19
HRV	2	572	1	228	67	83	20	105	6	0	0	3
USA	28	30	71	35	1	2	0	25	16	27	3	0