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

DEA (BWS,SIM)  Base change
ITA (SIM)      Base change
DEU (ALL)      Change in heritabilities, they have been reduced compared to previous evaluations causing also a decrease in reliability.
AUS (ALL)      New database and procedures for data extraction. Mix99 software will be used for all traits. EBV expression is on the observable scale for a
               trait into consideration, (kg, days, log(scc), type scores, etc). Drop in reliabilities. The genetic parameters for all traits remain the same.
ITA (JER)      Base change
ITA (HOL)      Base change, editing and pedigree corrections
ITA (BSW)      Base change
BEL (HOL)      Up to 21 bulls missing in current data most of them are Montbeliard bulls erroneusly added before due to a bug in one of the programs preparing
               the file to be submitted. which has now been fixed.
NLD (ALL)      Minor data edit for the production traits, causing a minor decrease in number of herds and daughters for some bulls
FRA (ALL)      Base change
CAN (ALL)      Base change
SVN (ALL)      Base change
NOR (RDC)      A number of old bulls have lost one to two daughters due to editing rules in the database during extraction of daughters. 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.
NZL (ALL)      NZL has continuous DNA parentage testing so daughters, herds, EDC will always change. Small decrease in Reliability as consequence.
URY (HOL)      Covariance matrix for production slightly modified by introduction of SCC in the multiple trait analysis



INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN
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Subsetting:
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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:
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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.
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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

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Dates for the next test run can be found on
http://www.interbull.org/ib/servicecalendar.
PUBLICATION OF INTERBULL TEST RUN
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Test evaluation results are meant for review purposes only and should not be
published.
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^LTable 1. National evaluation data considered in the Interbull
evaluation for dairy production traits (April Routine Evaluation 2019).
Number of records for milk yield by breed
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Country       BSW          GUE          HOL          JER          RDC          SIM
-----------------------------------------------------------------------------------
AUS           212          139         8089         1751          735
BEL                                     1998
CAN           230          100        12460          741          808
CHE          2933                       3380           87                      3225
CZE                                     4293
DEA          5947                                                            23776
DEU                                    27650          204          429
DFS                                    12974         2137         7684
ESP                                     3761
EST                                     1132                       432
FRA           390                      17012                                   463
FRM                                                                           4631
GBR           156          333         7153          894          619           94
HUN                                     3262                                    218
IRL                                     2758          169           54           95
ISR                                     1421
ITA          2104                       9362          171                      1670
JPN                                     5890
KOR                                     1369
LTU                                     1161                       437
LVA                                     1153                       702
NLD           189                      15392          156           79          388
NOR                                                               4157
NZL            53           60         7706         4886         1385
POL                                    10385
PRT                                     2417
SVK                                     1111                                    579
SVN           373                        547                                    618
URY                                     1039
USA          1098          781        38364         4651          710           58
ZAF                                     1293          709          142
HRV                                      774                                    854
MEX                                      607
CAM                                                                40
===================================================================================
No.Records  13685         1413       205913        16556        18413        36669
Pub. Proofs 11083         1123       154987        13351        16489        32971
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW     mil
---------------------------------------------------------------------------------
          CAN     FRA     USA     CHE     ITA     DEA     NLD     SVN     NZL     GBR     AUS
CAN     644.42
FRA       0.89  636.45
USA       0.92    0.88  633.89
CHE       0.90    0.88    0.87  531.25
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ITA	0.88	0.83	0.88	0.87	597.07						
DEA	0.88	0.82	0.86	0.94	0.90	461.70					
NLD	0.88	0.87	0.87	0.85	0.85	0.87	639.65				
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.35			
NZL	0.70	0.76	0.71	0.75	0.70	0.73	0.72	0.74	333.27		
GBR	0.86	0.88	0.86	0.86	0.82	0.82	0.86	0.83	0.71	250.70	
AUS	0.73	0.75	0.71	0.72	0.70	0.70	0.74	0.72	0.82	0.73	419.00

BSW   fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.19										
FRA	0.89	27.24									
USA	0.90	0.89	23.56								
CHE	0.87	0.87	0.84	20.84							
ITA	0.89	0.83	0.86	0.87	22.85						
DEA	0.86	0.83	0.83	0.94	0.88	17.36					
NLD	0.87	0.86	0.86	0.84	0.85	0.86	25.79				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	9.86			
NZL	0.71	0.74	0.71	0.74	0.70	0.82	0.70	0.75	14.91		
GBR	0.86	0.89	0.86	0.88	0.82	0.82	0.87	0.83	0.71	8.94	
AUS	0.72	0.72	0.71	0.70	0.70	0.70	0.70	0.72	0.82	0.71	15.96

BSW   pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.16										
FRA	0.84	20.52									
USA	0.89	0.86	18.98								
CHE	0.86	0.84	0.83	17.20							
ITA	0.85	0.82	0.83	0.85	21.01						
DEA	0.86	0.81	0.82	0.92	0.89	14.38					
NLD	0.86	0.84	0.84	0.83	0.82	0.84	21.45				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	9.22			
NZL	0.70	0.70	0.70	0.71	0.70	0.76	0.70	0.75	10.59		
GBR	0.84	0.85	0.83	0.85	0.81	0.82	0.85	0.83	0.70	7.32	
AUS	0.70	0.70	0.69	0.70	0.69	0.70	0.70	0.72	0.81	0.70	12.40

GUE   mil

	CAN	USA	AUS	GBR	NZL
CAN	774.53				
USA	0.94	704.87			
AUS	0.80	0.75	491.88		
GBR	0.87	0.83	0.75	241.80	
NZL	0.71	0.70	0.83	0.71	326.90

GUE   fat

	CAN	USA	AUS	GBR	NZL
CAN	30.93				
USA	0.93	25.30			
AUS	0.78	0.74	18.76		
GBR	0.86	0.84	0.74	11.56	
NZL	0.72	0.72	0.84	0.70	16.42

GUE   pro

	CAN	USA	AUS	GBR	NZL
CAN	23.55				
USA	0.91	19.44			

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 AUS        0.71     0.69    14.01
 GBR        0.85     0.83     0.71    7.52
 NZL        0.70     0.69     0.83    0.69    10.85
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HOL   mil

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX
CAN	779.54																													
DEU	0.92	611.14																												
DFS	0.94	0.93	11.22																											
FRA	0.91	0.89	0.93	658.48																										
ITA	0.90	0.86	0.88	0.88	574.50																									
NLD	0.92	0.92	0.93	0.90	0.87	666.35																								
USA	0.93	0.90	0.92	0.91	0.91	0.90	671.05																							
CHE	0.89	0.90	0.91	0.94	0.88	0.91	0.89	612.82																						
GBR	0.87	0.83	0.86	0.87	0.82	0.87	0.85	0.89	269.98																					
NZL	0.69	0.69	0.71	0.77	0.69	0.71	0.70	0.77	0.70	313.68																				
AUS	0.75	0.74	0.71	0.77	0.71	0.75	0.73	0.77	0.74	0.82	467.40																			
BEL	0.85	0.87	0.82	0.83	0.80	0.83	0.81	0.81	0.81	0.69	0.76	494.92																		
IRL	0.83	0.82	0.84	0.89	0.80	0.87	0.82	0.88	0.82	0.85	0.81	0.80	183.46																	
ESP	0.93	0.91	0.91	0.92	0.89	0.91	0.93	0.90	0.84	0.69	0.75	0.86	0.84	543.60																
CZE	0.85	0.88	0.83	0.80	0.81	0.81	0.83	0.80	0.80	0.69	0.69	0.82	0.73	0.84	696.66															
SVN	0.82	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.70	0.70	0.81	0.70	0.81	0.81	11.36														
EST	0.89	0.86	0.90	0.86	0.84	0.86	0.88	0.87	0.81	0.72	0.75	0.81	0.78	0.86	0.84	0.82	531.96													
ISR	0.83	0.83	0.84	0.83	0.84	0.82	0.84	0.84	0.82	0.64	0.68	0.83	0.69	0.84	0.83	0.84	0.84	382.49												
HUN	0.86	0.84	0.87	0.88	0.90	0.85	0.90	0.85	0.82	0.69	0.69	0.80	0.79	0.86	0.82	0.81	0.84	0.84	667.41											
POL	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.84	0.82	0.69	0.73	0.82	0.81	0.90	0.85	0.81	0.87	0.83	0.88	416.22										
ZAF	0.84	0.80	0.81	0.83	0.81	0.81	0.83	0.81	0.81	0.69	0.77	0.81	0.78	0.83	0.80	0.81	0.82	0.84	0.81	0.81	527.37									
JPN	0.94	0.90	0.93	0.91	0.89	0.91	0.93	0.89	0.84	0.70	0.75	0.84	0.83	0.91	0.84	0.82	0.88	0.87	0.85	0.90	0.83	631.05								
LVA	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.71	0.81	0.80	0.81	0.81	0.83	0.81	0.80	0.81	0.81	439.58							
SVK	0.80	0.81	0.83	0.81	0.81	0.81	0.80	0.81	0.81	0.69	0.69	0.81	0.74	0.81	0.80	0.82	0.82	0.84	0.84	0.82	0.81	0.82	0.81	389.05						
LTU	0.81	0.80	0.81	0.81	0.81	0.81	0.80	0.82	0.81	0.70	0.70	0.81	0.71	0.81	0.81	0.81	0.83	0.82	0.84	0.81	0.80	0.82	0.81	0.82	358.23					
PRT	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.68	0.68	0.80	0.71	0.80	0.80	0.81	0.81	0.83	0.80	0.80	0.80	0.80	0.80	0.81	594.71				
KOR	0.86	0.80	0.84	0.82	0.81	0.81	0.85	0.81	0.81	0.72	0.72	0.81	0.74	0.84	0.80	0.82	0.84	0.83	0.80	0.80	0.81	0.86	0.81	0.81	0.82	0.80	487.49			
URY	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.80	0.78	0.73	0.80	0.74	0.80	0.80	0.82	0.81	0.84	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.80	166.91		
HRV	0.81	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.69	0.81	0.80	0.81	0.81	0.83	0.81	0.80	0.81	0.81	0.81	0.82	0.81	0.80	0.82	0.81	11.44	
MEX	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.80	0.69	0.69	0.80	0.69	0.80	0.80	0.82	0.82	0.84	0.80	0.80	0.80	0.80	0.81	0.81	0.82	0.80	0.80	0.80	0.81	379.98

HOL   fat

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX
CAN	31.09																													
DEU	0.92	22.94																												
DFS	0.93	0.92	11.11																											
FRA	0.91	0.89	0.91	26.69																										
ITA	0.89	0.87	0.86	0.89	23.83																									
NLD	0.90	0.92	0.91	0.89	0.85	25.29																								
USA	0.93	0.91	0.90	0.91	0.91	0.89	24.92																							
CHE	0.87	0.88	0.90	0.90	0.84	0.89	0.86	24.36																						
GBR	0.86	0.86	0.88	0.89	0.83	0.87	0.87	0.90	9.23																					
NZL	0.68	0.68	0.70	0.72	0.69	0.69	0.70	0.73	0.70	12.70																				
AUS	0.72	0.72	0.70	0.74	0.69	0.70	0.73	0.71	0.71	0.81	15.65																			
BEL	0.84	0.87	0.81	0.84	0.80	0.83	0.81	0.81	0.81	0.71	0.74	20.18																		
IRL	0.81	0.80	0.84	0.85	0.74	0.83	0.79	0.83	0.80	0.83	0.80	0.82	6.99																	
ESP	0.91	0.90	0.87	0.91	0.90	0.88	0.93	0.85	0.84	0.69	0.73	0.82	0.79	21.78																
CZE	0.85	0.87	0.84	0.81	0.81	0.81	0.84	0.81	0.81	0.69	0.69	0.80	0.69	0.84	22.05															
SVN	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.70	0.70	0.81	0.70	0.81	0.81	11.23														
EST	0.87	0.87	0.90	0.87	0.88	0.85	0.87	0.86	0.81	0.79	0.76	0.86	0.83	0.85	0.85	0.82	20.85													
ISR	0.83	0.82	0.82	0.82	0.82	0.82	0.84	0.83	0.82	0.64	0.65	0.82	0.63	0.83	0.83	0.84	0.84	14.59												
HUN	0.85	0.85	0.82	0.87	0.90	0.82	0.90	0.81	0.82	0.69	0.69	0.80	0.69	0.88	0.82	0.81	0.82	0.83	25.97											
POL	0.89	0.91	0.87	0.90	0.89	0.86	0.90	0.81	0.82	0.68	0.69	0.83	0.75	0.92	0.86	0.80	0.89	0.83	0.88	16.70										
ZAF	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.69	0.69	0.81	0.68	0.80	0.81	0.81	0.82	0.83	0.80	0.80	17.71									
JPN	0.92	0.90	0.92	0.90	0.86	0.89	0.90	0.88	0.84	0.70	0.70	0.83	0.82	0.86	0.82	0.81	0.88	0.83	0.80	0.88	0.80	24.20								
LVA	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.69	0.81	0.81	0.81	0.84	0.83	0.81	0.80	0.81	0.81	18.68							

SVK	0.80	0.80	0.81	0.81	0.82	0.81	0.80	0.81	0.81	0.69	0.69	0.81	0.69	0.81	0.81	0.82	0.85	0.84	0.83	0.81	0.81	0.81	0.81	14.99
LTU	0.81	0.80	0.81	0.81	0.81	0.81	0.80	0.82	0.81	0.70	0.70	0.81	0.70	0.81	0.81	0.83	0.82	0.84	0.81	0.80	0.82	0.81	0.82	0.82	15.80
PRT	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.68	0.68	0.80	0.68	0.80	0.80	0.81	0.81	0.83	0.80	0.80	0.80	0.80	0.80	0.80	0.81	23.59
KOR	0.84	0.81	0.81	0.81	0.81	0.81	0.86	0.81	0.81	0.69	0.74	0.81	0.70	0.85	0.84	0.82	0.83	0.83	0.80	0.83	0.81	0.84	0.81	0.81	0.82	0.80	19.63
URY	0.80	0.80	0.80	0.81	0.80	0.80	0.80	0.81	0.80	0.77	0.71	0.80	0.76	0.80	0.80	0.82	0.84	0.84	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.80	0.80	6.77
HRV	0.81	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.69	0.81	0.81	0.81	0.81	0.83	0.81	0.80	0.81	0.81	0.81	0.82	0.81	0.80	0.82	0.81	11.76
MEX	0.81	0.81	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.69	0.81	0.81	0.83	0.83	0.86	0.81	0.81	0.81	0.81	0.82	0.82	0.85	0.81	0.81	0.81	0.82	12.54

HOL   pro

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX
CAN	21.75																													
DEU	0.89	16.68																												
DFS	0.92	0.92	10.67																											
FRA	0.87	0.84	0.91	18.15																										
ITA	0.86	0.83	0.86	0.84	17.65																									
NLD	0.88	0.90	0.89	0.85	0.83	18.91																								
USA	0.91	0.88	0.91	0.88	0.88	0.86	17.45																							
CHE	0.85	0.84	0.87	0.91	0.84	0.85	0.85	18.04																						
GBR	0.85	0.82	0.86	0.86	0.81	0.86	0.84	0.87	7.13																					
NZL	0.68	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	9.02																				
AUS	0.68	0.69	0.69	0.69	0.68	0.69	0.68	0.69	0.70	0.80	12.05																			
BEL	0.80	0.83	0.81	0.81	0.80	0.81	0.80	0.81	0.81	0.69	0.69	14.56																		
IRL	0.74	0.73	0.77	0.81	0.72	0.79	0.75	0.80	0.78	0.80	0.80	0.72	5.56																	
ESP	0.90	0.88	0.89	0.88	0.86	0.87	0.90	0.85	0.84	0.69	0.69	0.81	0.76	15.70																
CZE	0.80	0.81	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.69	0.68	0.80	0.68	0.80	16.82															
SVN	0.81	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.70	0.70	0.81	0.70	0.81	0.81	10.67														
EST	0.82	0.85	0.86	0.81	0.81	0.82	0.82	0.84	0.81	0.71	0.70	0.81	0.70	0.81	0.81	0.82	15.71													
ISR	0.83	0.82	0.82	0.83	0.83	0.82	0.83	0.83	0.82	0.63	0.63	0.83	0.62	0.83	0.83	0.84	0.84	9.95												
HUN	0.82	0.81	0.83	0.85	0.87	0.81	0.87	0.82	0.80	0.69	0.68	0.80	0.68	0.82	0.80	0.81	0.81	0.83	21.10											
POL	0.85	0.85	0.86	0.83	0.83	0.83	0.84	0.80	0.80	0.68	0.68	0.80	0.72	0.86	0.80	0.81	0.85	0.83	0.84	11.18										
ZAF	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.69	0.71	0.81	0.69	0.80	0.80	0.82	0.82	0.83	0.80	0.80	13.37									
JPN	0.91	0.87	0.91	0.87	0.87	0.87	0.91	0.86	0.83	0.69	0.69	0.81	0.75	0.88	0.80	0.81	0.85	0.83	0.81	0.87	0.81	17.19								
LVA	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.69	0.81	0.81	0.82	0.81	0.83	0.81	0.80	0.81	0.81	13.13							
SVK	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.81	0.81	0.69	0.69	0.81	0.69	0.81	0.81	0.82	0.82	0.85	0.83	0.80	0.81	0.81	0.81	10.87						
LTU	0.81	0.80	0.81	0.81	0.81	0.81	0.81	0.82	0.81	0.70	0.70	0.82	0.70	0.81	0.81	0.83	0.82	0.85	0.81	0.80	0.82	0.81	0.81	0.82	10.73					
PRT	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.68	0.68	0.80	0.68	0.81	0.80	0.81	0.81	0.83	0.80	0.80	0.80	0.80	0.80	0.80	0.81	17.58				
KOR	0.83	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.69	0.69	0.81	0.69	0.83	0.81	0.82	0.82	0.84	0.80	0.80	0.80	0.82	0.81	0.81	0.82	0.80	13.47			
URY	0.80	0.80	0.80	0.80	0.81	0.80	0.80	0.81	0.80	0.72	0.69	0.80	0.69	0.80	0.80	0.82	0.82	0.84	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.80	0.80	5.19		
HRV	0.81	0.80	0.80	0.80	0.81	0.81	0.80	0.81	0.81	0.70	0.69	0.81	0.69	0.81	0.81	0.81	0.81	0.83	0.81	0.80	0.81	0.81	0.81	0.82	0.81	0.80	0.82	0.81	11.18	
MEX	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.70	0.69	0.81	0.70	0.81	0.81	0.83	0.84	0.87	0.81	0.81	0.81	0.81	0.83	0.82	0.85	0.81	0.81	0.81	0.83	11.31

JER   mil

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	584.97											
DFS	0.93	9.19										
USA	0.92	0.92	621.15									
NZL	0.74	0.70	0.70	283.46								
AUS	0.80	0.74	0.74	0.83	365.26							
GBR	0.84	0.83	0.82	0.69	0.72	213.35						
NLD	0.92	0.93	0.89	0.71	0.76	0.85	619.73					
ZAF	0.88	0.86	0.85	0.79	0.80	0.81	0.81	378.79				
ITA	0.89	0.87	0.88	0.74	0.78	0.82	0.85	0.87	545.63			
DEU	0.90	0.91	0.89	0.70	0.76	0.82	0.91	0.83	0.88	488.83		
IRL	0.81	0.79	0.77	0.87	0.82	0.76	0.82	0.78	0.79	0.80	181.98	
CHE	0.88	0.88	0.85	0.73	0.80	0.84	0.90	0.81	0.86	0.89	0.84	324.41

JER   fat

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	26.45											
DFS	0.90	11.27										

```
USA       0.90    0.90   24.59
NZL       0.69    0.70    0.74   12.10
AUS       0.77    0.71    0.75    0.83   13.68
GBR       0.83    0.84    0.82    0.69    0.70   11.50
NLD       0.88    0.86    0.86    0.70    0.71    0.85   24.73
ZAF       0.81    0.81    0.80    0.69    0.70    0.81    0.81   14.31
ITA       0.89    0.84    0.86    0.70    0.72    0.82    0.84    0.82   25.72
DEU       0.90    0.90    0.87    0.70    0.75    0.84    0.89    0.81    0.86   21.53
IRL       0.80    0.78    0.76    0.82    0.81    0.76    0.80    0.71    0.74    0.79    6.43
CHE       0.87    0.85    0.84    0.72    0.76    0.85    0.86    0.81    0.84    0.89    0.80   15.38

---------------------------------------------------------------------------
JER    pro
---------------------------------------------------------------------------
           CAN     DFS     USA     NZL     AUS     GBR     NLD     ZAF     ITA     DEU     IRL     CHE
CAN      18.80
DFS       0.90   10.53
USA       0.89    0.92   18.62
NZL       0.69    0.70    0.69    8.49
AUS       0.71    0.70    0.69    0.80   10.16
GBR       0.83    0.85    0.81    0.69    0.69    6.65
NLD       0.88    0.88    0.85    0.70    0.70    0.84   19.43
ZAF       0.82    0.81    0.80    0.69    0.70    0.81    0.81   11.39
ITA       0.85    0.83    0.85    0.70    0.70    0.81    0.83    0.84   19.48
DEU       0.87    0.91    0.87    0.70    0.70    0.82    0.88    0.81    0.85   15.44
IRL       0.75    0.75    0.73    0.84    0.81    0.74    0.77    0.71    0.72    0.75    5.72
CHE       0.84    0.84    0.83    0.70    0.70    0.83    0.84    0.81    0.83    0.84    0.78   10.47

---------------------------------------------------------------------------
RDC    mil
---------------------------------------------------------------------------
           CAN     NOR     USA     NZL     AUS     GBR     DFS     DEU     ZAF     EST     LVA     LTU     IRL     NLD     CAM
CAN     594.83
NOR       0.90   12.72
USA       0.91    0.91  665.55
NZL       0.69    0.72    0.69  319.09
AUS       0.74    0.75    0.75    0.83  422.71
GBR       0.84    0.83    0.83    0.70    0.77  269.99
DFS       0.91    0.91    0.89    0.69    0.76    0.83   10.26
DEU       0.92    0.91    0.89    0.70    0.75    0.83    0.91  580.53
ZAF       0.82    0.88    0.84    0.70    0.75    0.81    0.81    0.81  613.05
EST       0.88    0.87    0.89    0.75    0.75    0.83    0.86    0.84    0.83  486.47
LVA       0.82    0.83    0.81    0.73    0.72    0.82    0.82    0.81    0.83    0.82  314.58
LTU       0.83    0.83    0.82    0.72    0.71    0.82    0.81    0.81    0.84    0.83    0.82  312.04
IRL       0.83    0.74    0.81    0.85    0.82    0.81    0.82    0.82    0.78    0.79    0.74    0.75  168.79
NLD       0.92    0.92    0.89    0.72    0.77    0.86    0.93    0.92    0.81    0.85    0.82    0.83    0.85  787.37
CAM       0.89    0.90    0.95    0.76    0.77    0.88    0.89    0.89    0.89    0.90    0.89    0.89    0.84    0.89  482.44

---------------------------------------------------------------------------
RDC    fat
---------------------------------------------------------------------------
           CAN     NOR     USA     NZL     AUS     GBR     DFS     DEU     ZAF     EST     LVA     LTU     IRL     NLD     CAM
CAN      22.85
NOR       0.88   11.83
USA       0.91    0.84   24.79
NZL       0.69    0.75    0.70   13.46
AUS       0.73    0.74    0.77    0.85   15.76
GBR       0.84    0.82    0.84    0.69    0.73    9.30
DFS       0.90    0.88    0.89    0.70    0.76    0.84   10.29
DEU       0.91    0.90    0.89    0.70    0.75    0.86    0.90   23.07
ZAF       0.81    0.88    0.84    0.70    0.70    0.81    0.81    0.81   19.41
EST       0.87    0.84    0.87    0.78    0.74    0.83    0.85    0.85    0.83   18.79
LVA       0.82    0.83    0.81    0.73    0.72    0.82    0.82    0.82    0.83    0.83   13.62
LTU       0.83    0.83    0.82    0.72    0.72    0.82    0.81    0.81    0.85    0.83    0.82   14.79
IRL       0.81    0.74    0.80    0.83    0.81    0.79    0.82    0.79    0.70    0.82    0.73    0.75    7.32
NLD       0.90    0.88    0.88    0.70    0.73    0.87    0.91    0.91    0.81    0.85    0.82    0.83    0.82   27.86
```

```
CAM       0.90    0.89    0.95    0.76    0.79    0.89    0.89    0.89    0.89    0.89    0.89    0.89    0.83    0.89   22.89
```

RDC   pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	17.82														
NOR	0.88	11.73													
USA	0.89	0.87	19.02												
NZL	0.69	0.72	0.69	9.53											
AUS	0.69	0.76	0.70	0.80	12.41										
GBR	0.83	0.82	0.83	0.69	0.72	7.39									
DFS	0.89	0.88	0.88	0.69	0.71	0.83	10.36								
DEU	0.89	0.91	0.87	0.70	0.71	0.83	0.89	17.17							
ZAF	0.81	0.88	0.81	0.70	0.72	0.81	0.81	0.81	16.27						
EST	0.83	0.83	0.85	0.75	0.73	0.83	0.82	0.84	0.83	14.84					
LVA	0.82	0.83	0.81	0.73	0.72	0.82	0.81	0.81	0.83	0.82	9.20				
LTU	0.83	0.83	0.82	0.73	0.71	0.82	0.81	0.81	0.85	0.83	0.82	9.38			
IRL	0.75	0.76	0.76	0.82	0.82	0.77	0.76	0.74	0.71	0.74	0.73	0.75	5.37		
NLD	0.88	0.91	0.85	0.70	0.72	0.85	0.89	0.90	0.81	0.83	0.82	0.83	0.78	26.48	
CAM	0.89	0.89	0.92	0.76	0.78	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.84	0.89	12.02

SIM   mil

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	592.30												
DEA	0.87	510.66											
FRM	0.96	0.87	618.42										
ITA	0.84	0.80	0.81	495.79									
SVN	0.83	0.81	0.84	0.81	8.61								
FRA	0.93	0.89	0.89	0.85	0.82	676.49							
HUN	0.85	0.82	0.89	0.88	0.83	0.87	406.59						
NLD	0.89	0.94	0.89	0.83	0.82	0.89	0.85	735.11					
IRL	0.83	0.73	0.84	0.74	0.73	0.89	0.79	0.80	181.32				
SVK	0.83	0.81	0.82	0.81	0.82	0.82	0.85	0.82	0.75	318.93			
GBR	0.88	0.87	0.87	0.82	0.81	0.87	0.83	0.86	0.79	0.82	214.21		
HRV	0.82	0.81	0.89	0.81	0.82	0.81	0.83	0.81	0.73	0.82	0.81	10.79	
USA	0.89	0.84	0.88	0.90	0.81	0.91	0.89	0.90	0.82	0.81	0.84	0.81	562.31

SIM   fat

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	23.64												
DEA	0.88	19.32											
FRM	0.94	0.90	24.28										
ITA	0.82	0.81	0.81	19.47									
SVN	0.83	0.81	0.83	0.81	8.94								
FRA	0.90	0.91	0.89	0.85	0.82	27.31							
HUN	0.81	0.82	0.89	0.88	0.83	0.86	15.39						
NLD	0.88	0.93	0.90	0.82	0.82	0.88	0.82	27.76					
IRL	0.74	0.71	0.78	0.72	0.73	0.84	0.70	0.79	7.64				
SVK	0.82	0.81	0.82	0.81	0.82	0.82	0.84	0.82	0.73	12.78			
GBR	0.91	0.86	0.87	0.82	0.81	0.89	0.82	0.87	0.77	0.82	8.21		
HRV	0.82	0.81	0.88	0.81	0.82	0.81	0.83	0.81	0.74	0.82	0.81	10.79	
USA	0.86	0.83	0.84	0.90	0.81	0.91	0.90	0.88	0.78	0.81	0.86	0.81	18.17

SIM   pro

	CHE	DEA	FRM	ITA	SVN	FRA	HUN	NLD	IRL	SVK	GBR	HRV	USA
CHE	17.75												
DEA	0.85	15.53											
FRM	0.93	0.87	19.18										
ITA	0.82	0.80	0.81	15.64									

```
SVN      0.83    0.81    0.83    0.81    8.73
FRA      0.89    0.86    0.89    0.82    0.82   21.48
HUN      0.82    0.82    0.88    0.85    0.83    0.85   13.13
NLD      0.85    0.93    0.87    0.82    0.82    0.85    0.81   23.13
IRL      0.77    0.71    0.81    0.71    0.73    0.81    0.69    0.74    6.30
SVK      0.82    0.81    0.82    0.81    0.82    0.82    0.84    0.82    0.73    9.85
GBR      0.85    0.86    0.86    0.81    0.81    0.86    0.81    0.86    0.75    0.82    6.68
HRV      0.82    0.81    0.88    0.81    0.82    0.81    0.83    0.81    0.73    0.82    0.81   10.66
USA      0.85    0.83    0.83    0.87    0.81    0.88    0.87    0.86    0.75    0.81    0.84    0.81   15.28
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^LAPPENDIX II. Number of common bulls

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

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	0	80	167	124	117	132	51	32	24	66	89
FRA	70	0	119	158	185	208	80	54	22	58	62
USA	153	80	0	312	234	317	77	41	30	94	127
CHE	99	116	291	0	438	572	92	77	25	74	114
ITA	98	145	164	379	0	687	122	96	27	81	118
DEA	108	154	280	471	583	0	140	102	33	79	127
NLD	48	66	68	85	104	135	0	43	24	43	56
SVN	28	53	33	73	95	94	44	0	10	25	28
NZL	22	18	26	20	20	28	17	9	0	20	26
GBR	59	45	80	53	54	52	32	18	17	0	58
AUS	89	47	120	75	87	89	41	22	20	50	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	80	167	124	117	132	51	32	24	66	89
FRA	70	0	119	158	185	208	80	54	22	58	62
USA	153	80	0	312	234	317	77	41	30	94	127
CHE	99	116	291	0	438	572	92	77	25	74	114
ITA	98	145	164	379	0	687	122	96	27	81	118
DEA	108	154	280	471	583	0	140	102	33	79	127
NLD	48	66	68	85	104	135	0	43	24	43	56
SVN	28	53	33	73	95	94	44	0	10	25	28
NZL	22	18	26	20	20	28	17	9	0	20	26
GBR	59	45	80	53	54	52	32	18	17	0	58
AUS	89	47	120	75	87	89	41	22	20	50	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	80	167	124	117	132	51	32	24	66	89
FRA	70	0	119	158	185	208	80	54	22	58	62
USA	153	80	0	312	234	317	77	41	30	94	127
CHE	99	116	291	0	438	572	92	77	25	74	114
ITA	98	145	164	379	0	687	122	96	27	81	118
DEA	108	154	280	471	583	0	140	102	33	79	127
NLD	48	66	68	85	104	135	0	43	24	43	56
SVN	28	53	33	73	95	94	44	0	10	25	28
NZL	22	18	26	20	20	28	17	9	0	20	26
GBR	59	45	80	53	54	52	32	18	17	0	58
AUS	89	47	120	75	87	89	41	22	20	50	0

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

  CAN    0   69   48   31   14
  USA   60    0   62   91   31
  AUS   46   57    0   40   27
  GBR   26   93   34    0   15
  NZL   11   29   27   13    0
       ------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  USA  AUS  GBR  NZL
       ------------------------------------------------------------------------

  CAN    0   69   48   31   14
  USA   60    0   62   91   31
  AUS   46   57    0   40   27
  GBR   26   93   34    0   15
  NZL   11   29   27   13    0
       ------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  USA  AUS  GBR  NZL
       ------------------------------------------------------------------------

  CAN    0   69   48   31   14
  USA   60    0   62   91   31
  AUS   46   57    0   40   27
  GBR   26   93   34    0   15
  NZL   11   29   27   13    0
       ------------------------------------------------------------------------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  FRA  ITA  NLD  USA  CHE  GBR  NZL  AUS  BEL  IRL  ESP  CZE  SVN  EST  ISR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  HRV  MEX
       ------------------------------------------------------------------------

  CAN    0 2386 1341 1406 1575 1408 3194  841 1570  720 1345  767  555 1231 1068  195  237  116  963 1284  501 1261  454  420  280 1016  656  483  294  373
  DEU 1648    0 2673 2494 2417 3371 3580 1134 2069  959 1655 1225  895 1492 1852  299  390  153 1211 2292  585 1410  710  718  603 1230  600  489  603  352
  DFS 1096 1699    0 1563 1473 1949 1938  685 1467  788 1216  815  728  960 1190  236  267  136  860 1465  497  901  446  396  347  906  458  406  386  286
  FRA  890 1231  769    0 1637 1885 2406  636 1471  770 1224  882  724 1086 1202  193  238  121  905 1550  470 1143  392  411  273  906  492  391  281  296
  ITA 1166 1429 1004  785    0 1589 2438  676 1461  706 1128  760  634 1175 1208  223  249  124  952 1453  467 1093  467  380  310  972  552  421  354  326
  NLD 1308 3017 1628 1091 1195    0 2342  848 1649  993 1402 1222  872 1040 1420  242  331  144  923 1677  510  988  487  517  367 1024  454  411  419  298
  USA 3443 2350 1375 1207 1482 1979    0  958 2079 1026 1806  924  767 1466 1588  225  318  165 1240 1905  631 1824  592  526  380 1278  812  654  366  447
  CHE  700  979  595  545  589  819  843    0  668  384  590  575  394  536  516  135  152   58  426  641  264  439  268  226  165  496  250  207  199  174
  GBR 1780 1472 1054  852 1020 1392 1787  600    0  885 1330  826  923 1023 1012  199  235  127  831 1246  505  977  398  362  288  935  472  428  320  319
  NZL  723  737  545  436  488  901  965  321  751    0 1174  494  697  512  593  123  129  104  486  625  364  533  238  249  171  554  304  339  211  195
  AUS 1336 1180  840  794  773 1210 1762  514 1119 1169    0  725  717  848  821  169  200  100  691  971  474  833  354  305  237  776  422  416  287  266
  BEL  755 1262  744  847  706 1398  807  584  809  405  627    0  514  641  640  167  178   79  523  769  327  512  284  290  198  649  280  242  259  199
  IRL  526  783  592  562  523  822  686  392  946  603  621  510    0  498  520  121  135   95  439  602  331  430  215  207  156  494  233  263  185  175
  ESP  759  917  686  751  806  904  910  429  788  386  592  619  473    0  820  181  188  105  728  988  441  844  343  308  223  811  450  353  272  279
  CZE  762 1403  746  710  808 1236 1196  360  667  413  520  498  381  553    0  208  242  120  880 1267  391  787  415  460  307  788  456  369  352  272
  SVN  140  286  194  131  183  208  169   97  144   87  120  138   91  133  156    0   87   43  151  237   96  155  111   78   72  160   91   71  108   64
  EST  137  269  156  107  134  235  207   85  128   65   99  112   71   88  152   52    0   46  184  288  105  187  174  109  106  183  105   99  119   70
  ISR   84  125  105   63   78  115  150   36   86   87   66   52   72   61   88   32   28    0  103  130   61   96   64   47   50   99   55   65   65   42
  HUN  890  938  657  579  780  747 1186  336  712  380  512  448  387  566  780  115  112   76    0  901  390  675  310  309  210  701  432  359  251  285
  POL 1047 1986 1137  941 1053 1502 1751  518 1004  470  715  701  498  672 1020  213  203  101  775    0  409  914  572  431  408  992  538  406  443  313
  ZAF  459  450  378  326  349  427  613  216  438  303  413  279  296  390  259   66   54   42  319  303    0  416  165  179  113  426  263  270  150  211
  JPN  585  529  441  370  456  473  736  268  463  267  433  311  265  374  323   84   62   39  357  454  272    0  323  292  199  673  514  374  209  291
  LVA  271  571  278  177  296  329  482  135  233  137  177  174  132  188  286   73  111   45  235  465   96  137    0  176  216  392  210  179  243  138
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SVK   290  539  200  211  215  352  340  115  202  148  152  177  107  153  376   46   50   19  217  295   99  101   89    0  127  315  201  177  139  123
LTU   145  567  193   87  156  218  249   72  142   76  102  100   74   92  204   41   55   25  126  315   46   59  155   66    0  229  133  114  161   68
PRT  1061 1129  795  752  881 1027 1331  433  852  454  614  656  451  767  648  127  128   74  691  991  384  388  310  216  147    0  448  387  309  333
KOR   620  392  312  273  434  312  923  172  340  220  306  203  165  313  321   56   50   33  355  446  199  292  121  122   55  378    0  286  134  252
URY   473  349  290  227  312  325  816  156  356  267  312  189  210  282  274   43   62   34  306  343  229  222  109  116   66  350  233    0  136  235
HRV   169  616  291  166  252  372  274  127  224  123  176  214  128  202  254   84   86   45  185  390   99   95  192   69  112  247   57   85    0  112
MEX   384  286  236  227  295  244  531  151  284  152  222  185  150  250  222   47   49   26  270  290  196  218   91   75   29  344  234  219   74    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 2386 1341 1406 1578 1408 3194  841 1570  720 1345  767  545 1231 1068  195  237  116  963 1284  501 1258  454  420  280 1016  655  483  294  141
DEU   1648    0 2673 2494 2420 3371 3580 1134 2068  959 1655 1225  886 1492 1852  299  390  153 1211 2292  585 1408  710  718  603 1230  599  489  603  134
DFS   1096 1699    0 1563 1476 1949 1938  685 1466  788 1216  815  719  960 1190  236  267  136  860 1465  497  900  446  396  347  906  457  406  386  120
FRA    890 1231  769    0 1639 1885 2406  636 1470  770 1224  882  719 1086 1202  193  238  121  905 1550  470 1140  392  411  273  906  491  391  281  123
ITA   1172 1434 1009  790    0 1592 2442  677 1463  709 1130  762  625 1178 1209  223  249  125  954 1454  469 1092  467  381  310  974  551  422  354  122
NLD   1308 3017 1628 1091 1200    0 2342  848 1648  993 1402 1222  862 1040 1420  242  331  144  923 1677  510  984  487  517  367 1024  453  411  419  125
USA   3443 2350 1375 1207 1489 1979    0  958 2079 1026 1806  924  753 1466 1588  225  318  165 1240 1905  631 1821  592  526  380 1277  811  654  366  147
CHE    700  979  595  545  590  819  843    0  667  384  590  575  390  536  516  135  152   58  426  641  264  437  268  226  165  496  249  207  199   94
GBR   1780 1472 1054  852 1026 1392 1787  600    0  884 1329  825  914 1023 1011  199  235  127  831 1245  505  975  397  362  288  934  471  428  319  129
NZL    723  737  545  436  494  901  965  321  751    0 1174  494  692  512  593  123  129  104  486  625  364  533  238  249  171  554  303  339  211  100
AUS   1336 1180  840  794  777 1210 1762  514 1119 1169    0  725  707  848  821  169  200  100  691  971  474  831  354  305  237  776  421  416  287  118
BEL    755 1262  744  847  709 1398  807  584  809  405  627    0  508  641  640  167  178   79  523  769  327  511  284  290  198  649  279  242  259  104
IRL    515  776  586  557  519  812  672  389  935  598  611  503    0  493  517  119  134   94  436  595  331  425  215  207  155  493  233  263  185   91
ESP    759  917  686  751  810  904  910  429  788  386  592  619  470    0  820  181  188  105  728  988  441  843  343  308  223  811  449  353  272  120
CZE    762 1402  745  710  811 1235 1196  360  667  413  520  497  380  552    0  208  242  120  880 1267  391  785  415  460  307  788  455  369  352   95
SVN    140  286  194  131  183  208  169   97  144   87  120  138   91  133  156    0   87   43  151  237   96  154  111   78   72  160   91   71  108   33
EST    137  269  156  107  134  235  207   85  128   65   99  112   71   88  152   52    0   46  184  288  105  185  174  109  106  183  105   99  119   27
ISR     84  125  105   63   80  115  150   36   86   87   66   52   71   61   88   32   28    0  103  130   61   96   64   47   50   99   55   65   65   15
HUN    890  938  657  579  784  747 1186  336  712  380  512  448  385  566  780  115  112   76    0  901  390  674  310  309  210  701  431  359  251  110
POL   1047 1986 1137  941 1056 1502 1751  518 1004  470  715  701  492  672 1019  213  203  101  775    0  409  910  572  431  408  992  537  406  443  102
ZAF    459  450  378  326  352  427  613  216  438  303  413  279  296  390  259   66   54   42  319  303    0  415  165  179  113  426  263  270  150  104
JPN    581  527  440  367  454  469  730  266  460  266  429  309  262  372  321   83   60   39  356  449  271    0  321  291  198  671  513  372  209  127
LVA    271  571  278  177  296  329  482  135  233  137  177  174  131  188  286   73  111   45  235  465   96  136    0  176  216  391  210  179  243   45
SVK    290  539  200  211  217  352  340  115  202  148  152  177  107  153  375   46   50   19  217  295   99  100   89    0  127  315  201  177  139   57
LTU    145  567  193   87  156  218  249   72  142   76  102  100   73   92  204   41   55   25  126  315   46   59  155   66    0  229  133  114  161   26
PRT   1061 1129  795  751  884 1027 1330  433  852  454  614  656  449  767  648  127  128   74  691  991  384  386  310  216  147    0  447  387  309  125
KOR    619  391  311  272  433  311  921  171  339  219  305  202  165  312  320   56   50   33  354  446  199  290  121  122   55  377    0  286  134   98
URY    473  349  290  227  314  325  816  156  356  267  312  189  210  282  274   43   62   34  306  343  229  218  109  116   66  350  233    0  136  102
HRV    169  615  290  166  251  371  274  127  224  122  175  213  128  202  253   83   86   44  185  389   99   95  192   69  111  247   57   85    0   46
MEX    170  143  123  123  125  132  185   93  150   96  123  114   99  132   74   26   16   10  113  100  113  121   27   42    7  144   98  106   30    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 2386 1341 1406 1575 1408 3188  841 1570  720 1345  767  545 1231 1068  195  237  116  963 1284  501 1257  454  420  280 1016  655  483  294  139
DEU   1648    0 2673 2494 2417 3371 3576 1134 2068  959 1655 1225  886 1492 1852  299  390  153 1211 2292  585 1408  710  718  603 1230  599  489  603  132
DFS   1096 1699    0 1563 1473 1949 1936  685 1466  788 1216  815  719  960 1190  236  267  136  860 1465  497  900  446  396  347  906  457  406  386  118
FRA    890 1231  769    0 1637 1885 2405  636 1470  770 1224  882  719 1086 1202  193  238  121  905 1550  470 1140  392  411  273  906  491  391  281  121
ITA   1166 1429 1004  785    0 1589 2438  676 1460  706 1128  760  623 1175 1208  223  249  124  952 1453  467 1091  467  380  310  972  551  421  354  119
NLD   1308 3017 1628 1091 1195    0 2341  848 1648  993 1402 1222  862 1040 1420  242  331  144  923 1677  510  983  487  517  367 1024  453  411  419  123
USA   3440 2348 1375 1207 1482 1979    0  958 2078 1026 1803  923  753 1465 1588  225  318  165 1240 1905  631 1818  592  525  380 1277  812  654  366  145
CHE    700  979  595  545  589  819  843    0  667  384  590  575  390  536  516  135  152   58  426  641  264  436  268  226  165  496  249  207  199   92
GBR   1780 1472 1054  852 1020 1392 1787  600    0  884 1329  825  914 1023 1011  199  235  127  831 1245  505  975  397  362  288  934  471  428  319  127
NZL    723  737  545  436  488  901  965  321  751    0 1174  494  692  512  593  123  129  104  486  625  364  533  238  249  171  554  303  339  211   99
AUS   1336 1180  840  794  773 1210 1760  514 1119 1169    0  725  707  848  821  169  200  100  691  971  474  831  354  305  237  776  421  416  287  116
BEL    755 1262  744  847  706 1398  806  584  809  405  627    0  508  641  640  167  178   79  523  769  327  511  284  290  198  649  279  242  259  102
IRL    515  776  586  557  514  812  672  389  935  598  611  503    0  493  517  119  134   94  436  595  331  425  215  207  155  493  233  263  185   89
ESP    759  917  686  751  806  904  910  429  788  386  592  619  470    0  820  181  188  105  728  988  441  843  343  308  223  811  449  353  272  118
CZE    762 1402  745  710  808 1235 1196  360  667  413  520  497  380  552    0  208  242  120  880 1267  391  785  415  460  307  788  455  369  352   93
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SVN  140  286  194  131  183  208  169   97  144   87  120  138   91  133  156    0   87   43  151  237   96  154  111   78   72  160   91   71  108   33
EST  137  269  156  107  134  235  207   85  128   65   99  112   71   88  152   52    0   46  184  288  105  184  174  109  106  183  105   99  119   27
ISR   84  125  105   63   78  115  150   36   86   87   66   52   71   61   88   32   28    0  103  130   61   96   64   47   50   99   55   65   65   15
HUN  890  938  657  579  780  747 1186  336  712  380  512  448  385  566  780  115  112   76    0  901  390  674  310  309  210  701  431  359  251  108
POL 1047 1986 1137  941 1053 1502 1751  518 1004  470  715  701  492  672 1019  213  203  101  775    0  409  910  572  431  408  992  537  406  443  100
ZAF  459  450  378  326  349  427  613  216  438  303  413  279  296  390  259   66   54   42  319  303    0  415  165  179  113  426  263  270  150  102
JPN  580  527  440  367  453  468  729  266  460  266  429  309  262  372  321   83   59   39  356  449  271    0  321  291  198  671  513  372  209  125
LVA  271  571  278  177  296  329  482  135  233  137  177  174  131  188  286   73  111   45  235  465   96  136    0  176  216  391  210  179  243   44
SVK  290  539  200  211  215  352  339  115  202  148  152  177  107  153  375   46   50   19  217  295   99  100   89    0  127  315  201  177  139   57
LTU  145  567  193   87  156  218  249   72  142   76  102  100   73   92  204   41   55   25  126  315   46   59  155   66    0  229  133  114  161   25
PRT 1061 1129  795  751  881 1027 1329  433  852  454  614  656  449  767  648  127  128   74  691  991  384  386  309  216  147    0  447  387  309  123
KOR  619  391  311  272  433  311  923  171  339  219  305  202  165  312  320   56   50   33  354  446  199  290  121  122   55  377    0  286  134   98
URY  473  349  290  227  312  325  816  156  356  267  312  189  210  282  274   43   62   34  306  343  229  218  109  116   66  350  233    0  136  101
HRV  169  616  291  166  252  372  274  127  224  123  176  214  128  202  254   84   86   45  185  390   99   95  192   69  112  247   57   85    0   45
MEX  168  141  122  122  123  131  183   92  148   95  121  113   98  131   72   26   15   10  112   99  112  119   27   42    7  143   98  104   29    0
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JER
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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	79	407	165	249	148	35	151	70	73	12	36
DFS	64	0	151	124	122	144	92	128	97	120	38	54
USA	425	120	0	342	472	220	79	289	100	126	42	61
NZL	173	97	415	0	431	201	71	195	84	89	107	49
AUS	256	87	512	481	0	201	65	229	84	90	52	50
GBR	148	126	236	203	202	0	74	160	104	99	65	65
NLD	30	89	84	64	57	67	0	69	55	67	29	38
ZAF	146	103	300	202	215	158	64	0	90	90	36	54
ITA	67	94	107	82	79	105	55	83	0	74	19	45
DEU	70	111	128	83	79	95	62	85	76	0	27	47
IRL	8	31	42	118	48	64	27	35	18	27	0	18
CHE	29	50	61	40	41	62	32	48	42	43	14	0

JER
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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	79	407	165	249	147	35	151	70	73	12	36
DFS	64	0	151	124	122	143	92	128	97	120	38	54
USA	425	120	0	342	472	219	79	289	100	126	42	61
NZL	173	97	415	0	431	200	71	195	84	89	107	50
AUS	256	87	512	481	0	200	65	229	84	90	52	50
GBR	148	126	236	203	202	0	74	160	103	99	65	65
NLD	30	89	84	64	57	67	0	69	55	67	29	38
ZAF	146	103	300	202	215	158	64	0	90	90	36	54
ITA	67	94	107	82	79	105	55	83	0	74	19	45
DEU	70	111	128	83	79	95	62	85	76	0	27	47
IRL	8	31	42	118	48	64	27	35	18	27	0	18
CHE	29	50	61	40	41	62	32	48	42	43	14	0

JER
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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	79	407	165	249	147	35	151	70	73	12	36
DFS	64	0	151	124	122	143	92	128	97	120	38	54
USA	425	120	0	342	472	219	79	289	100	126	42	61
NZL	173	97	415	0	431	200	71	195	84	89	107	49
AUS	256	87	512	481	0	200	65	229	84	90	52	50
GBR	148	126	236	203	202	0	74	160	103	99	65	65

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 NLD    30    89    84    64    57    67     0    69    55    67    29    38
 ZAF   146   103   300   202   215   158    64     0    90    90    36    54
 ITA    67    94   107    82    79   105    55    83     0    74    19    45
 DEU    70   111   128    83    79    95    62    85    76     0    27    47
 IRL     8    31    42   118    48    64    27    35    18    27     0    18
 CHE    29    50    61    40    41    62    32    48    42    43    14     0
      ----------------------------------------------------------------------
RDC
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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     5   197    80   100    79   148    15    74     2    10    17     2     5     0
 NOR     5     0    68    40    63    45   122    20     0    19    19    25    48    40     0
 USA   182    70     0   114   128   104   172    29    63    19    24    35    24    37    21
 NZL    78    39   113     0   139    73   165    22    37     8    17    26     9    18    11
 AUS   100    53   129   140     0    78   174    44    37    29    35    43    14    27    12
 GBR    77    47    96    68    77     0    94    19    38     7    17    25    18    30     0
 DFS   149    95   167   160   148    88     0    69    51    98   120   104    14    44     0
 DEU    14    19    29    21    43    18    58     0     2    26    35    38     5    16     0
 ZAF    76     0    57    32    38    33    48     2     0     0     2     5     2     2     0
 EST     2    19    18     7    26     6    86    25     0     0    48    25     0    14     0
 LVA    10    17    21    14    32    16    81    30     2    42     0    52     2    11     0
 LTU    16    22    30    24    42    24    99    35     5    25    48     0     4    15     0
 IRL     2    47    24     9    13    17    11     5     2     0     2     4     0     9     0
 NLD     5    40    36    17    25    29    42    16     2    13    10    13     9     0     0
 CAM     0     0    21    11    12     0     0     0     0     0     0     0     0     0     0
      ------------------------------------------------------------------------------------------
RDC
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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     5   197    80   100    79   148    15    74     2    10    17     2     5     0
 NOR     5     0    68    40    63    45   122    20     0    19    19    25    48    40     0
 USA   182    70     0   114   128   104   172    29    63    19    24    35    24    37    21
 NZL    78    39   113     0   139    73   165    22    37     8    17    26     9    18    11
 AUS   100    53   129   140     0    78   174    44    37    29    35    43    14    27    12
 GBR    77    47    96    68    77     0    94    19    38     7    17    25    18    30     0
 DFS   149    95   167   160   148    88     0    69    51    98   120   104    14    44     0
 DEU    14    19    29    21    43    18    58     0     2    26    35    38     5    16     0
 ZAF    76     0    57    32    38    33    48     2     0     0     2     5     2     2     0
 EST     2    19    18     7    26     6    86    25     0     0    48    25     0    14     0
 LVA    10    17    21    14    32    16    81    30     2    42     0    52     2    11     0
 LTU    16    22    30    24    42    24    99    35     5    25    48     0     4    15     0
 IRL     2    47    24     9    13    17    11     5     2     0     2     4     0     9     0
 NLD     5    40    36    17    25    29    42    16     2    13    10    13     9     0     0
 CAM     0     0    21    11    12     0     0     0     0     0     0     0     0     0     0
      ------------------------------------------------------------------------------------------
RDC
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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     5   197    80   100    79   148    15    74     2    10    17     2     5     0
 NOR     5     0    68    40    63    45   122    20     0    19    19    25    48    40     0
 USA   182    70     0   114   128   104   172    29    63    19    24    35    24    37    21
 NZL    78    39   113     0   139    73   165    22    37     8    17    26     9    18    11
 AUS   100    53   129   140     0    78   174    44    37    29    35    43    14    27    12
 GBR    77    47    96    68    77     0    94    19    38     7    17    25    18    30     0
 DFS   149    95   167   160   148    88     0    69    51    98   120   103    14    44     0
 DEU    14    19    29    21    43    18    58     0     2    26    35    38     5    16     0
 ZAF    76     0    57    32    38    33    48     2     0     0     2     5     2     2     0
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EST	2	19	18	7	26	6	86	25	0	0	48	25	0	14	0
LVA	10	17	21	14	32	16	81	30	2	42	0	52	2	11	0
LTU	16	22	30	24	42	24	98	35	5	25	48	0	4	15	0
IRL	2	47	24	9	13	17	11	5	2	0	2	4	0	9	0
NLD	5	40	36	17	25	29	42	16	2	13	10	13	9	0	0
CAM	0	0	21	11	12	0	0	0	0	0	0	0	0	0	0

SIM
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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	323	188	85	6	12	2	82	56	31	55	2	21
DEA	288	0	250	865	182	254	47	289	60	371	53	549	22
FRM	239	293	0	160	17	3	3	112	70	57	72	2	41
ITA	87	768	193	0	104	143	21	189	59	139	47	234	23
SVN	6	168	17	97	0	55	12	49	2	46	0	75	0
FRA	9	214	1	128	52	0	12	62	1	54	0	90	1
HUN	1	33	1	17	10	9	0	6	2	13	0	20	0
NLD	84	302	136	184	47	60	6	0	52	63	52	103	18
IRL	52	54	75	57	2	1	2	47	0	12	39	4	16
SVK	26	378	57	116	45	45	11	54	4	0	11	95	5
GBR	63	56	93	53	0	0	0	53	34	6	0	0	19
HRV	2	572	1	218	63	82	18	97	3	75	0	0	2
USA	20	27	56	29	0	1	0	20	15	5	27	2	0

SIM
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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	323	188	85	6	12	2	82	56	31	55	2	21
DEA	288	0	250	865	182	254	47	289	60	371	53	547	22
FRM	239	293	0	160	17	3	3	112	70	57	72	2	41
ITA	87	768	193	0	104	143	21	189	59	139	47	232	23
SVN	6	168	17	97	0	55	12	49	2	46	0	75	0
FRA	9	214	1	128	52	0	12	62	1	54	0	90	1
HUN	1	33	1	17	10	9	0	6	2	13	0	20	0
NLD	84	302	136	184	47	60	6	0	52	63	52	103	18
IRL	52	54	75	57	2	1	2	47	0	12	39	4	16
SVK	26	378	57	116	45	45	11	54	4	0	11	93	5
GBR	63	56	93	53	0	0	0	53	34	6	0	0	19
HRV	2	570	1	216	63	82	18	97	3	73	0	0	2
USA	20	27	56	29	0	1	0	20	15	5	27	2	0

SIM
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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	323	188	85	6	12	2	82	56	31	55	2	21
DEA	288	0	250	865	182	254	47	289	60	371	53	548	22
FRM	239	293	0	160	17	3	3	112	70	57	72	2	41
ITA	87	768	193	0	104	143	21	189	59	139	47	233	23
SVN	6	168	17	97	0	55	12	49	2	46	0	75	0
FRA	9	214	1	128	52	0	12	62	1	54	0	90	1
HUN	1	33	1	17	10	9	0	6	2	13	0	20	0
NLD	84	302	136	184	47	60	6	0	52	63	52	103	18
IRL	52	54	75	57	2	1	2	47	0	12	39	4	16
SVK	26	378	57	116	45	45	11	54	4	0	11	94	5
GBR	63	56	93	53	0	0	0	53	34	6	0	0	19
HRV	2	571	1	217	63	82	18	97	3	74	0	0	2
USA	20	27	56	29	0	1	0	20	15	5	27	2	0