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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 one (31) countries were
included in this evaluation.

International genetic evaluations for milk, fat and protein yields of bulls from
Australia, Austria-Germany, Belgium, Canada, Czech Republic, Denmark-Finland-Sweden, Estonia,
France, Hungary, Ireland, Israel, Italy, Japan, Latvia,Lithuania, Netherlands,
New Zealand, Norway, Poland, Republic of South Africa, Slovak Republic,
Slovenia, Spain, Switzerland, the United Kingdom, the United States of America
,Portugal,Korea,Argentina and Urugay 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:

AUS ALL  For a number of traits there were slight reductions in the reliability.

ITA JER  As you will see there are some bulls who lost information, we are aware
         of this, and this depends on our data-flow.

ITA HOL  There is some bulls losing some info (herds..) this is due to the way we
         recive updates on our data-set and also due to pedigree corrections.

CAN ALL  Some bulls lost daughters/herds/EDCs which is related to pedigree changes in our database.

ESP HOL Update of genetic base was done for all traits

NOR RDC The rolling definition of hys is causing the daughters to distribute
        somewhat differently over hys-classes at each evaluation. Therefore some bulls
      occasionally may loose EDC although the number of daughters stay the same.
        Reliability changes is a function of the EDC changes.

HRV SIM/HOL Changes are result of updates in the pedigree of both breeds.

LTU HOL/RDC Rolling base it changes every year

JPN HOL Because we have corrected some cow's pedigree, number of daughters, number of herds, and
        EDC decreased in some bulls.

CHE SIM/HOL We merge raw data from two different databases. In this process discrepancies are
            corrected according to certain rules. Due to this procedure especially pedigree
          data can change a little bit from one evaluation to the next.


INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN
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1)     Data submission for pedigree, EBV/PTA, and parameters is
        possible only through uploading of the data to the Interbull
        Data Exchange Area (IDEA);
2)     Interbull Centre has moved to a completely new MACE evaluation
        software called "Dairy System for International Evaluation
        (DAISIE)", partly because of the extended use of IDEA for EBV/PTA,
        and partly because of our continuous efforts to make the system
        more effective than before;
3)     All trait groups (including conformation traits) are now evaluated
        in-house.
4)     The file containing heritability values now contain more decimal
        places for heritability, and one extra field for the definition of
        reference base population;
5)     The file containing genetic correlations has changed name from
        rG_columns_all to cor{RUNID}.csv, and also contains one extra field
        for the number of common bulls;
6)     The file containing sire genetic standard deviations has changed name
        from sire_std_columns_all to std{RUNID}.csv;
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7)   Sire-MGS based pedigree files are not distributed anymore;
8)   Parent averages in the "ipa" format are not distributed anymore;
9)   An import AI bull (type of proof = 21) with official publication
        status 'Y' from a given country is included in the distribution
        file if the bull has a first country proof included from a different
        country OR a second country proof is included with minimum required
        number of daughters or EDC (20, 10, 150, 20, 20, and 80) and herds
        (20, 10, 150, 20, 20, and 80) for different breeds (BSW, GUE, HOL,
        JER, RDC and SIM), respectively;
10)   Bulls with some missing pedigree information (sires and/or dam and/or
        birthdate) are excluded from evaluations;
11)   Standardization factors are not used anymore;
12)   Post-processing of genetic correlation are now applied to all trait groups.

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
in the 01x-proof file.

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

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NEXT ROUTINE INTERNATIONAL EVALUATION
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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 (August Routine Evaluation 2015).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
ARG			1313			
AUS	141	118	6836	1538	601	
BEL			1050			
CAN	205	93	10626	584	726	
CHE	2861		2759			2832
CZE			3766			
DEA	5523					21818
DEU			25364	122	393	
DFS			11985	1943	7132	
ESP			3024			
EST			914		380	
FRA	338		15633			377
FRM						4169
FRR			202			
GBR	127	311	6208	818	523	88
HUN			2838			195
IRL			2077	97	34	87
ISR			1170			
ITA	1923		9012	162		1413
JPN			5081			
KOR			1050			
LTU			623		385	
LVA			872		659	
NLD	156		13857	113	54	268
NOR					3730	
NZL	45	58	6520	4220	1211	
POL			8467			
PRT			2230			
SVK			994			531
SVN	311		392			513
URY			881			
USA	982	733	33549	3846	614	
ZAF		37	1191	638	137	
HRV			586			700
No.Records	12612	1350	181070	14081	16579	32991
Pub. Proofs	10331	1085	141359	11599	14960	30084

^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	592.75										
FRA	0.89	642.78									
USA	0.92	0.89	626.91								
CHE	0.90	0.91	0.88	478.63							
ITA	0.88	0.86	0.88	0.88	580.79						
DEA	0.86	0.86	0.86	0.93	0.90	462.38					
NLD	0.90	0.89	0.89	0.88	0.86	0.86	524.86				
SVN	0.87	0.86	0.87	0.86	0.86	0.86	0.86	10.52			
NZL	0.76	0.76	0.76	0.77	0.76	0.77	0.76	0.78	345.39		
GBR	0.86	0.87	0.86	0.88	0.86	0.86	0.88	0.87	0.76	248.23	
AUS	0.78	0.79	0.75	0.79	0.76	0.76	0.78	0.77	0.86	0.76	337.00

BSW   fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	25.49										
FRA	0.90	27.47									
USA	0.91	0.90	23.68								
CHE	0.86	0.89	0.86	19.08							
ITA	0.88	0.86	0.88	0.88	22.19						
DEA	0.87	0.86	0.85	0.93	0.89	17.53					
NLD	0.89	0.88	0.88	0.87	0.85	0.87	24.06				
SVN	0.87	0.86	0.87	0.86	0.86	0.86	0.86	10.55			
NZL	0.76	0.76	0.76	0.77	0.76	0.81	0.76	0.78	14.99		
GBR	0.86	0.88	0.87	0.87	0.86	0.86	0.88	0.87	0.76	9.44	
AUS	0.75	0.78	0.75	0.76	0.76	0.76	0.76	0.78	0.86	0.76	14.82

BSW   pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	21.58										
FRA	0.87	20.98									
USA	0.89	0.88	18.86								
CHE	0.86	0.88	0.85	14.97							
ITA	0.86	0.86	0.87	0.87	20.31						
DEA	0.86	0.85	0.85	0.91	0.89	14.42					
NLD	0.87	0.86	0.86	0.86	0.85	0.86	17.42				
SVN	0.87	0.86	0.87	0.86	0.86	0.86	0.86	10.51			
NZL	0.76	0.76	0.76	0.77	0.76	0.77	0.76	0.78	10.67		
GBR	0.85	0.87	0.85	0.87	0.86	0.86	0.87	0.87	0.76	7.22	
AUS	0.75	0.76	0.75	0.77	0.76	0.76	0.76	0.78	0.86	0.76	10.77

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GUE     mil
-------------------------------------------------------------------------------
          CAN      USA      AUS      GBR      ZAF      NZL
CAN     732.31
USA       0.94   687.56
AUS       0.85     0.77   488.67
GBR       0.86     0.86     0.78   234.24
ZAF       0.86     0.86     0.81     0.86   345.98
NZL       0.76     0.76     0.86     0.76     0.76   334.28
-------------------------------------------------------------------------------
GUE     fat
-------------------------------------------------------------------------------
          CAN      USA      AUS      GBR      ZAF      NZL
CAN      30.15
USA       0.94    25.13
AUS       0.83     0.77    18.02
GBR       0.87     0.87     0.77    10.01
ZAF       0.86     0.86     0.76     0.86    13.59
NZL       0.78     0.76     0.87     0.76     0.77    16.65
-------------------------------------------------------------------------------
GUE     pro
-------------------------------------------------------------------------------
          CAN      USA      AUS      GBR      ZAF      NZL
CAN      22.26
USA       0.92    19.04
AUS       0.78     0.75    14.10
GBR       0.86     0.86     0.76     6.38
ZAF       0.86     0.86     0.76     0.86    10.55
NZL       0.76     0.76     0.86     0.76     0.76    11.08
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HOL     mil
--------------------------------------------------------------------------------
         CAN     DEU     DFS     FRA     ITA     NLD     USA     CHE     GBR     NZL     AUS
BEL     IRL     ESP     CZE     SVN     EST     ISR     FRR     HUN     POL     ZAF     JPN     LVA
SVK     LTU     PRT     KOR     URY     ARG     HRV
CAN     760.79
DEU      0.91   623.51
DFS      0.93    0.93    11.13
FRA      0.91    0.89    0.93   670.39
ITA      0.89    0.88    0.90    0.89   574.96
NLD      0.92    0.92    0.94    0.91    0.87   652.35
USA      0.93    0.90    0.93    0.92    0.92    0.90   668.73
CHE      0.89    0.89    0.93    0.94    0.88    0.91    0.89   580.35
GBR      0.86    0.85    0.89    0.87    0.85    0.88    0.86    0.89   268.22
NZL      0.75    0.75    0.75    0.75    0.75    0.75    0.75    0.75    0.75   314.99
AUS      0.82    0.77    0.78    0.83    0.76    0.82    0.77    0.84    0.79    0.85   467.58
BEL      0.86    0.87    0.85    0.85    0.85    0.89    0.85    0.85    0.85    0.75    0.81
478.84
IRL      0.80    0.78    0.81    0.87    0.77    0.83    0.79    0.82    0.82    0.85    0.85
0.79  171.12
ESP      0.93    0.91    0.92    0.92    0.90    0.92    0.92    0.90    0.85    0.75    0.81
0.86    0.80   551.78
CZE      0.86    0.87    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85   537.37
SVN      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.76
0.85    0.76    0.85    0.85    11.84
EST      0.89    0.85    0.90    0.85    0.85    0.85    0.88    0.87    0.85    0.76    0.78
0.85    0.76    0.86    0.85    0.86   609.05
ISR      0.77    0.79    0.81    0.81    0.82    0.81    0.81    0.79    0.75    0.75    0.76
0.76    0.76    0.83    0.75    0.76    0.76   377.98
FRR      0.86    0.90    0.88    0.90    0.86    0.88    0.86    0.88    0.86    0.79    0.82
0.93    0.79    0.88    0.91    0.86    0.88    0.76   670.38
HUN      0.86    0.85    0.88    0.88    0.90    0.85    0.90    0.85    0.85    0.75    0.75
0.85    0.76    0.87    0.85    0.85    0.85    0.79    0.87   640.02
POL      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.85    0.85    0.76    0.87    0.85   432.61
ZAF      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.82
0.85    0.77    0.85    0.85    0.85    0.86    0.82    0.86    0.85    0.85   525.17
JPN      0.93    0.91    0.94    0.91    0.89    0.92    0.93    0.90    0.85    0.75    0.82
0.85    0.79    0.91    0.85    0.85    0.86    0.87    0.87    0.85    0.85    0.85   638.32
LVA      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.76    0.85    0.85    0.86    0.85    0.76    0.86    0.85    0.85    0.85    0.85
417.24
SVK      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.76    0.85    0.85    0.86    0.86    0.77    0.86    0.86    0.85    0.85    0.85
0.86  403.49
LTU      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.86    0.85    0.75    0.76
0.86    0.76    0.85    0.85    0.86    0.86    0.76    0.88    0.86    0.85    0.86    0.86
0.86    0.86  352.82
PRT      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.85    0.85    0.76    0.86    0.85    0.85    0.85    0.85
0.85    0.85    0.85  632.47
KOR      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.76
0.85    0.76    0.85    0.85    0.86    0.86    0.76    0.88    0.85    0.85    0.85    0.85
0.86    0.85    0.86    0.85   468.90
URY      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.76    0.78
0.85    0.76    0.85    0.85    0.86    0.86    0.76    0.88    0.85    0.85    0.85    0.85
0.86    0.85    0.86    0.85    0.85   168.38
ARG      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.76
0.85    0.75    0.85    0.85    0.86    0.86    0.76    0.88    0.85    0.85    0.85    0.85
0.85    0.86    0.86    0.85    0.85    0.85   181.01
HRV      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.76    0.85    0.85    0.86    0.86    0.76    0.86    0.85    0.85    0.85    0.85
0.85    0.86    0.85    0.85    0.86    0.86    0.85    12.22


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HOL   fat

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV
CAN	30.69																														
DEU	0.90	24.18																													
DFS	0.93	0.91	11.20																												
FRA	0.92	0.89	0.92	27.01																											
ITA	0.90	0.86	0.86	0.88	23.47																										
NLD	0.91	0.91	0.91	0.90	0.85	24.84																									
USA	0.94	0.90	0.91	0.92	0.92	0.89	24.82																								
CHE	0.88	0.88	0.92	0.91	0.85	0.89	0.88	23.21																							
GBR	0.86	0.86	0.89	0.89	0.85	0.88	0.87	0.89	9.70																						
NZL	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	12.71																					
AUS	0.79	0.75	0.76	0.81	0.75	0.77	0.76	0.77	0.76	0.85	18.35																				
BEL	0.85	0.87	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.79	19.83																			
IRL	0.78	0.76	0.81	0.85	0.75	0.81	0.77	0.81	0.78	0.85	0.85	0.83	6.15																		
ESP	0.91	0.90	0.88	0.91	0.90	0.89	0.92	0.87	0.85	0.75	0.78	0.85	0.79	21.95																	
CZE	0.87	0.87	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	0.85	0.75	0.86	21.70																
SVN	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.76	0.76	0.85	0.76	0.85	0.85	12.21															
EST	0.88	0.86	0.89	0.86	0.86	0.85	0.87	0.86	0.85	0.79	0.78	0.87	0.81	0.85	0.85	0.86	23.01														
ISR	0.76	0.76	0.76	0.78	0.77	0.77	0.84	0.76	0.76	0.76	0.76	0.76	0.76	0.82	0.76	0.77	0.76	14.34													
FRR	0.88	0.85	0.86	0.88	0.86	0.85	0.86	0.86	0.86	0.78	0.81	0.90	0.80	0.89	0.90	0.87	0.89	0.78	24.83												
HUN	0.86	0.86	0.85	0.89	0.91	0.85	0.91	0.85	0.85	0.75	0.75	0.85	0.75	0.88	0.85	0.86	0.86	0.80	0.87	23.18											
POL	0.87	0.87	0.85	0.86	0.86	0.85	0.86	0.85	0.85	0.75	0.75	0.85	0.75	0.90	0.87	0.85	0.86	0.76	0.88	0.85	16.58										
ZAF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	0.85	0.75	0.85	0.85	0.86	0.86	0.76	0.87	0.85	0.85	18.21									
JPN	0.93	0.89	0.92	0.90	0.85	0.89	0.90	0.89	0.85	0.75	0.76	0.85	0.78	0.86	0.85	0.86	0.88	0.76	0.86	0.85	0.85	0.85	24.29								
LVA	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.76	0.75	0.85	0.76	0.85	0.85	0.86	0.86	0.76	0.87	0.85	0.85	0.86	0.85	18.11							
SVK	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.85	0.75	0.75	0.85	0.76	0.85	0.85	0.86	0.86	0.77	0.87	0.85	0.85	0.86	0.85	0.86	15.12						
LTU	0.86	0.85	0.86	0.86	0.85	0.85	0.85	0.86	0.86	0.76	0.76	0.86	0.76	0.85	0.85	0.87	0.86	0.77	0.90	0.86	0.85	0.86	0.86	0.86	0.86	15.32					
PRT	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	0.85	0.75	0.85	0.85	0.85	0.86	0.76	0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.85	25.96				
KOR	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.77	0.85	0.75	0.85	0.85	0.86	0.86	0.77	0.90	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.85	19.01			
URY	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.77	0.79	0.85	0.78	0.85	0.85	0.86	0.86	0.77	0.89	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.85	0.85	6.06		
ARG	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.75	0.75	0.85	0.75	0.85	0.85	0.86	0.86	0.77	0.89	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.85	0.85	0.85	5.92	
HRV	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.76	0.75	0.85	0.76	0.85	0.85	0.86	0.86	0.76	0.87	0.85	0.85	0.86	0.85	0.85	0.85	0.86	0.86	0.85	0.86	0.86	12.70

```
HOL     pro
--------------------------------------------------------------------------------
          CAN     DEU     DFS     FRA     ITA     NLD     USA     CHE     GBR     NZL     AUS
BEL     IRL     ESP     CZE     SVN     EST     ISR     FRR     HUN     POL     ZAF     JPN     LVA
SVK     LTU     PRT     KOR     URY     ARG     HRV
CAN      21.04
DEU      0.87   17.85
DFS      0.92    0.92   10.79
FRA      0.87    0.85    0.91   18.46
ITA      0.86    0.85    0.89    0.86   17.68
NLD      0.87    0.89    0.90    0.86    0.85   18.09
USA      0.91    0.87    0.92    0.89    0.90    0.86   17.48
CHE      0.85    0.85    0.90    0.92    0.85    0.85    0.85   16.80
GBR      0.85    0.85    0.89    0.87    0.85    0.88    0.85    0.88    7.21
NZL      0.75    0.75    0.75    0.75    0.75    0.75    0.75    0.75    0.75    9.10
AUS      0.75    0.75    0.75    0.76    0.75    0.75    0.75    0.76    0.76    0.85   10.55
BEL      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
14.02
IRL      0.76    0.75    0.76    0.80    0.75    0.78    0.75    0.78    0.79    0.85    0.85
0.76    4.76
ESP      0.89    0.86    0.90    0.87    0.87    0.87    0.89    0.85    0.85    0.75    0.75
0.85    0.77   16.14
CZE      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85   16.45
SVN      0.86    0.85    0.85    0.86    0.85    0.85    0.86    0.86    0.85    0.76    0.76
0.86    0.76    0.85    0.86   11.29
EST      0.86    0.85    0.86    0.86    0.85    0.85    0.85    0.86    0.86    0.76    0.76
0.86    0.76    0.85    0.85    0.86   18.12
ISR      0.76    0.76    0.78    0.82    0.79    0.76    0.80    0.77    0.76    0.76    0.76
0.76    0.76    0.82    0.76    0.77    0.77    9.84
FRR      0.87    0.85    0.86    0.86    0.86    0.85    0.86    0.86    0.86    0.78    0.78
0.86    0.77    0.86    0.87    0.87    0.90    0.79   19.13
HUN      0.85    0.85    0.86    0.87    0.88    0.85    0.88    0.85    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.86    0.86    0.78    0.87   19.52
POL      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.85    0.85    0.76    0.86    0.85   11.93
ZAF      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.77
0.85    0.75    0.85    0.85    0.86    0.86    0.81    0.88    0.85    0.85   14.39
JPN      0.91    0.86    0.92    0.86    0.87    0.87    0.91    0.87    0.85    0.75    0.75
0.85    0.75    0.88    0.85    0.86    0.86    0.81    0.87    0.85    0.85    0.85   17.32
LVA      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.86    0.85    0.76    0.76
0.85    0.76    0.85    0.85    0.86    0.86    0.77    0.87    0.85    0.85    0.86    0.85
12.57
SVK      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.86    0.85    0.75    0.76
0.85    0.76    0.85    0.85    0.87    0.86    0.78    0.87    0.86    0.85    0.86    0.85
0.86   11.31
LTU      0.86    0.85    0.86    0.86    0.86    0.86    0.86    0.87    0.86    0.76    0.76
0.86    0.76    0.85    0.86    0.87    0.87    0.78    0.91    0.86    0.85    0.87    0.86
0.86    0.87   10.71
PRT      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.86    0.86    0.76    0.86    0.85    0.85    0.85    0.85
0.85    0.85    0.85   20.20
KOR      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.86    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.87    0.86    0.77    0.91    0.85    0.85    0.85    0.85
0.86    0.86    0.86    0.85   13.20
URY      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.86    0.85    0.75    0.75
0.86    0.76    0.85    0.86    0.87    0.87    0.78    0.91    0.85    0.86    0.85    0.85
0.87    0.86    0.87    0.85    0.86    4.94
ARG      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.75    0.75
0.85    0.75    0.85    0.85    0.87    0.86    0.77    0.90    0.85    0.85    0.85    0.85
0.86    0.86    0.86    0.85    0.85    0.85    5.40
HRV      0.85    0.85    0.85    0.85    0.85    0.85    0.85    0.86    0.85    0.76    0.75
0.85    0.76    0.85    0.85    0.86    0.86    0.76    0.87    0.85    0.85    0.86    0.86
0.85    0.86    0.86    0.85    0.86    0.87    0.86   11.77


--------------------------------------------------------------------------------
```

```
JER     mil
--------------------------------------------------------------------------------
          CAN       DFS       USA       NZL       AUS       GBR       NLD       ZAF       ITA       DEU       IRL
CAN     568.28
DFS       0.93      9.27
USA       0.92      0.93    609.54
NZL       0.79      0.76      0.75    280.72
AUS       0.86      0.78      0.78      0.86    485.05
GBR       0.86      0.87      0.85      0.75      0.76    209.21
NLD       0.92      0.93      0.89      0.76      0.80      0.87    591.19
ZAF       0.89      0.89      0.85      0.78      0.83      0.85      0.86    373.23
ITA       0.90      0.88      0.89      0.80      0.79      0.85      0.87      0.87    525.37
DEU       0.89      0.90      0.89      0.76      0.77      0.85      0.91      0.86      0.87    460.34
IRL       0.82      0.84      0.82      0.82      0.83      0.84      0.84      0.83      0.81      0.81    174.99


--------------------------------------------------------------------------------
JER     fat
--------------------------------------------------------------------------------
          CAN       DFS       USA       NZL       AUS       GBR       NLD       ZAF       ITA       DEU       IRL
CAN      25.24
DFS       0.91     11.64
USA       0.92      0.91     24.39
NZL       0.75      0.76      0.75     11.97
AUS       0.84      0.76      0.80      0.86     18.89
GBR       0.86      0.87      0.86      0.75      0.75      8.48
NLD       0.89      0.89      0.88      0.76      0.76      0.87     25.56
ZAF       0.85      0.86      0.85      0.75      0.75      0.85      0.86     14.49
ITA       0.89      0.86      0.89      0.76      0.76      0.85      0.86      0.86     25.63
DEU       0.89      0.90      0.88      0.76      0.76      0.86      0.90      0.86      0.86     20.78
IRL       0.80      0.83      0.82      0.79      0.81      0.82      0.82      0.82      0.79      0.79      6.12


--------------------------------------------------------------------------------
JER     pro
--------------------------------------------------------------------------------
          CAN       DFS       USA       NZL       AUS       GBR       NLD       ZAF       ITA       DEU       IRL
CAN      18.01
DFS       0.90     10.57
USA       0.89      0.92     18.25
NZL       0.75      0.76      0.75      8.44
AUS       0.80      0.76      0.75      0.85     11.87
GBR       0.86      0.87      0.85      0.75      0.75      5.96
NLD       0.87      0.89      0.86      0.76      0.76      0.87     19.11
ZAF       0.85      0.86      0.85      0.75      0.76      0.85      0.86     11.42
ITA       0.86      0.87      0.88      0.76      0.76      0.85      0.86      0.86     18.77
DEU       0.87      0.91      0.87      0.76      0.76      0.85      0.89      0.86      0.85     15.95
IRL       0.78      0.81      0.80      0.80      0.82      0.82      0.80      0.82      0.79      0.78      5.37


--------------------------------------------------------------------------------
RDC     mil
--------------------------------------------------------------------------------
          CAN       NOR       USA       NZL       AUS       GBR       DFS       DEU       ZAF       EST       LVA
LTU       IRL       NLD
CAN     592.56
NOR       0.91     10.02
USA       0.93      0.88    670.88
NZL       0.76      0.77      0.75    316.56
AUS       0.78      0.79      0.77      0.85    409.18
GBR       0.86      0.87      0.86      0.75      0.78    232.73
DFS       0.91      0.91      0.91      0.75      0.81      0.87     10.03
DEU       0.91      0.92      0.90      0.76      0.78      0.85      0.92    602.43
ZAF       0.86      0.91      0.86      0.76      0.78      0.86      0.86      0.85    538.51
EST       0.89      0.90      0.89      0.78      0.78      0.87      0.88      0.87      0.88    512.78
LVA       0.87      0.87      0.86      0.77      0.77      0.87      0.86      0.86      0.87      0.86    291.83
LTU       0.88      0.87      0.87      0.77      0.76      0.87      0.86      0.86      0.89      0.87      0.86
301.10
IRL       0.81      0.86      0.81      0.84      0.84      0.83      0.83      0.80      0.79      0.80      0.81
0.84    131.56
NLD       0.92      0.90      0.90      0.76      0.81      0.88      0.94      0.92      0.85      0.87      0.87
0.87      0.84    603.53
```

```
--------------------------------------------------------------------------------
RDC     fat
--------------------------------------------------------------------------------
          CAN     NOR     USA     NZL     AUS     GBR     DFS     DEU     ZAF     EST     LVA
LTU     IRL     NLD
CAN      22.60
NOR       0.91   10.08
USA       0.93    0.86   25.16
NZL       0.76    0.77    0.75   13.37
AUS       0.77    0.77    0.77    0.85   15.34
GBR       0.86    0.87    0.87    0.75    0.76    8.34
DFS       0.91    0.89    0.90    0.75    0.81    0.87    9.97
DEU       0.90    0.89    0.90    0.76    0.77    0.86    0.90   23.96
ZAF       0.86    0.91    0.87    0.76    0.76    0.86    0.86    0.85   18.74
EST       0.89    0.88    0.88    0.80    0.78    0.87    0.86    0.87    0.88   18.32
LVA       0.87    0.87    0.86    0.77    0.77    0.87    0.86    0.86    0.87    0.86   13.20
LTU       0.88    0.87    0.87    0.77    0.76    0.87    0.86    0.86    0.89    0.87    0.86
14.14
IRL       0.79    0.86    0.80    0.84    0.84    0.80    0.83    0.77    0.77    0.83    0.81
0.84    5.30
NLD       0.91    0.87    0.89    0.76    0.77    0.88    0.92    0.91    0.85    0.87    0.87
0.87    0.82   25.02


--------------------------------------------------------------------------------
RDC     pro
--------------------------------------------------------------------------------
          CAN     NOR     USA     NZL     AUS     GBR     DFS     DEU     ZAF     EST     LVA
LTU     IRL     NLD
CAN      17.88
NOR       0.90   10.00
USA       0.91    0.86   19.27
NZL       0.76    0.77    0.75    9.37
AUS       0.75    0.80    0.75    0.85   12.05
GBR       0.85    0.87    0.86    0.75    0.76    6.38
DFS       0.90    0.89    0.90    0.75    0.75    0.87   10.39
DEU       0.87    0.91    0.87    0.76    0.77    0.85    0.90   18.48
ZAF       0.86    0.91    0.86    0.76    0.76    0.86    0.86    0.85   15.34
EST       0.86    0.88    0.87    0.78    0.77    0.87    0.86    0.87    0.88   15.46
LVA       0.87    0.87    0.86    0.77    0.77    0.87    0.86    0.86    0.87    0.86    8.38
LTU       0.88    0.87    0.87    0.77    0.76    0.87    0.86    0.86    0.89    0.87    0.86
9.11
IRL       0.77    0.86    0.78    0.85    0.84    0.80    0.79    0.76    0.77    0.79    0.81
0.84    3.37
NLD       0.87    0.88    0.86    0.76    0.77    0.87    0.91    0.90    0.85    0.87    0.87
0.87    0.79   20.81


--------------------------------------------------------------------------------
SIM     mil
--------------------------------------------------------------------------------
          CHE     DEA     FRM     ITA     SVN     FRA     HUN     NLD     IRL     SVK     GBR
HRV
CHE     556.38
DEA       0.86  509.25
FRM       0.95    0.90  635.80
ITA       0.86    0.85    0.85  484.01
SVN       0.88    0.86    0.88    0.86    8.88
FRA       0.93    0.90    0.92    0.89    0.86  695.76
HUN       0.86    0.86    0.91    0.89    0.88    0.88  364.47
NLD       0.89    0.93    0.91    0.86    0.86    0.91    0.86  684.17
IRL       0.78    0.76    0.77    0.77    0.77    0.86    0.77    0.80  142.49
SVK       0.87    0.85    0.86    0.86    0.86    0.86    0.87    0.86    0.78  337.18
GBR       0.90    0.90    0.90    0.85    0.86    0.87    0.85    0.88    0.80    0.86  309.55
HRV       0.86    0.85    0.91    0.85    0.86    0.86    0.87    0.86    0.77    0.86    0.86
10.57


--------------------------------------------------------------------------------
```

```
SIM     fat
--------------------------------------------------------------------------------
        CHE     DEA     FRM     ITA     SVN     FRA     HUN     NLD     IRL     SVK     GBR
HRV
CHE     22.32
DEA      0.87   19.34
FRM      0.94    0.92   25.03
ITA      0.86    0.85    0.85   19.25
SVN      0.88    0.86    0.88    0.86    9.23
FRA      0.91    0.93    0.92    0.89    0.86   27.85
HUN      0.86    0.86    0.91    0.89    0.88    0.89   13.38
NLD      0.88    0.93    0.91    0.85    0.87    0.89    0.85   27.13
IRL      0.77    0.76    0.76    0.76    0.77    0.85    0.75    0.78    5.32
SVK      0.87    0.85    0.86    0.86    0.86    0.86    0.87    0.86    0.77   13.14
GBR      0.91    0.89    0.88    0.85    0.86    0.89    0.85    0.88    0.78    0.86   11.34
HRV      0.86    0.85    0.91    0.85    0.86    0.86    0.87    0.86    0.77    0.86    0.86
10.61


--------------------------------------------------------------------------------
SIM     pro
--------------------------------------------------------------------------------
        CHE     DEA     FRM     ITA     SVN     FRA     HUN     NLD     IRL     SVK     GBR
HRV
CHE     16.32
DEA      0.85   15.53
FRM      0.93    0.90   19.75
ITA      0.86    0.85    0.85   15.46
SVN      0.88    0.86    0.88    0.86    9.29
FRA      0.91    0.88    0.91    0.86    0.86   21.86
HUN      0.86    0.86    0.91    0.88    0.88    0.87   10.85
NLD      0.86    0.92    0.88    0.85    0.87    0.86    0.85   21.75
IRL      0.77    0.76    0.76    0.76    0.77    0.80    0.75    0.77    4.68
SVK      0.87    0.85    0.86    0.86    0.86    0.86    0.87    0.86    0.77   10.21
GBR      0.89    0.91    0.89    0.86    0.86    0.87    0.85    0.88    0.78    0.86    8.86
HRV      0.86    0.85    0.91    0.85    0.86    0.86    0.87    0.86    0.77    0.86    0.86
10.70


------------------------------------------------------------------------------------------
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^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   74  145  106  104  113   45   22   20   63   67
   FRA   66    0  114  140  162  184   74   44   17   51   45
   USA  140   75    0  286  214  289   70   30   24   83   90
   CHE   87  100  269    0  397  514   77   54   19   68   78
   ITA   91  128  148  342    0  607  107   71   22   72   77
   DEA   95  137  255  409  506    0  121   77   26   72   88
   NLD   41   61   61   68   87  113    0   33   18   36   38
   SVN   20   44   24   54   72   72   34    0    4   17   16
   NZL   20   13   21   15   16   21   11    3    0   17   20
   GBR   63   42   77   53   51   50   29   13   15    0   47
   AUS   66   34   81   48   49   57   28   12   15   39    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   74  145  106  104  113   45   22   20   63   67
   FRA   66    0  114  140  162  184   74   44   17   51   45
   USA  140   75    0  286  214  289   70   30   24   83   90
   CHE   87  100  269    0  397  514   77   54   19   68   78
   ITA   91  128  148  342    0  607  107   71   22   72   77
   DEA   95  137  255  409  506    0  121   77   26   72   88
   NLD   41   61   61   68   87  113    0   33   18   36   38
   SVN   20   44   24   54   72   72   34    0    4   17   16
   NZL   20   13   21   15   16   21   11    3    0   17   20
   GBR   63   42   77   53   51   50   29   13   15    0   47
   AUS   66   34   81   48   49   57   28   12   15   39    0
 ------------------------------------------------------------------------
```

```
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN   USA   AUS   GBR   ZAF   NZL
--------------------------------------------------------------------------------
   CAN     0    61    41    28     5    14
   USA    52     0    50    78    11    31
   AUS    38    45     0    33     6    27
   GBR    23    81    27     0     5    15
   ZAF     2     8     5     4     0     5
   NZL    11    29    27    13     3     0
--------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN   USA   AUS   GBR   ZAF   NZL
--------------------------------------------------------------------------------
   CAN     0    60    41    28     4    13
   USA    51     0    50    78    11    31
   AUS    38    45     0    33     6    27
   GBR    23    81    27     0     5    15
   ZAF     2     8     5     4     0     5
   NZL    11    29    27    13     3     0
--------------------------------------------------------------------------------

GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN   USA   AUS   GBR   ZAF   NZL
--------------------------------------------------------------------------------
   CAN     0    60    41    28     4    13
   USA    51     0    50    78    11    31
   AUS    38    45     0    33     6    27
   GBR    23    81    27     0     5    15
   ZAF     2     8     5     4     0     5
   NZL    11    29    27    13     3     0
--------------------------------------------------------------------------------
```

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

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	FRR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	ARG	HRV
CAN	0	1920	1042	1115	1266	1044	2430	584	1258	576	936	410	366	993	837	132	168	73	7	722	899	416	1051	314	343	150	813	497	375	503	198
DEU	1046	0	2381	2095	2201	2870	3033	871	1769	821	1243	686	641	1265	1635	213	310	117	111	1020	1761	523	1244	544	638	365	1099	482	398	530	458
DFS	711	1292	0	1365	1326	1650	1661	494	1255	685	926	493	543	817	1049	176	209	105	35	731	1165	437	788	352	352	218	818	377	333	410	283
FRA	611	892	581	0	1544	1596	2120	445	1277	672	946	537	536	901	1037	138	180	96	16	748	1169	411	1002	288	336	164	796	394	316	395	201
ITA	717	1162	796	655	0	1430	2186	512	1279	647	895	471	474	1016	1059	174	198	97	15	808	1157	444	994	360	337	200	871	458	364	462	261
NLD	837	2336	1226	824	946	0	1987	641	1397	858	1053	711	640	874	1216	177	274	111	72	777	1281	450	841	370	449	206	934	370	346	417	327
USA	2240	1726	1037	964	1085	1546	0	693	1732	900	1344	520	553	1223	1358	164	256	116	20	1025	1447	564	1605	435	450	228	1097	659	544	750	265
CHE	424	697	399	376	416	595	586	0	497	287	379	332	257	396	397	94	100	43	28	323	436	200	325	187	161	70	385	168	147	188	144
GBR	1353	1138	820	673	811	1091	1352	435	0	760	1005	493	666	867	864	153	183	96	14	693	974	448	840	302	307	182	838	386	353	429	244
NZL	567	596	444	351	428	759	819	238	622	0	908	306	526	437	516	97	106	81	5	418	509	324	457	174	212	121	504	243	273	276	158
AUS	779	688	486	495	438	755	1083	286	697	825	0	404	466	620	613	114	143	71	11	499	652	377	631	228	227	137	583	293	299	339	183
BEL	354	604	400	479	366	746	397	294	418	225	283	0	279	389	376	99	94	47	27	314	419	215	304	152	166	79	401	162	148	172	151
IRL	289	476	380	350	330	519	425	230	601	403	327	239	0	361	370	77	94	61	4	313	400	255	311	137	153	90	373	148	181	187	124
ESP	526	744	551	597	675	732	712	302	652	317	353	345	311	0	704	133	144	83	10	595	770	385	717	259	258	149	707	347	291	368	208
CZE	513	1175	599	567	640	992	945	263	538	334	292	261	232	450	0	157	198	93	28	751	1028	340	683	321	390	170	684	377	295	356	262
SVN	92	190	144	88	138	145	126	63	108	67	65	76	53	96	117	0	59	31	10	117	168	74	119	77	53	36	126	70	51	64	73
EST	88	209	121	73	104	195	167	54	98	56	48	58	45	65	123	38	0	39	14	143	225	81	145	136	90	55	150	77	77	77	83
ISR	44	96	83	50	65	91	96	28	67	69	42	27	44	55	67	24	26	0	1	77	96	53	72	46	35	30	89	43	46	42	47
FRR	3	85	22	11	14	38	10	19	10	4	7	22	4	6	20	9	13	1	0	4	70	6	2	20	19	0	13	1	1	0	12
HUN	611	780	543	470	645	623	949	249	591	333	307	244	249	470	653	91	87	62	4	0	715	338	565	229	268	139	609	350	303	372	185
POL	597	1350	824	600	777	1031	1142	328	691	348	327	339	269	504	766	147	151	73	74	600	0	342	717	412	344	219	800	411	309	397	322
ZAF	354	392	320	272	324	375	534	168	384	267	290	170	205	344	225	53	41	39	4	287	245	0	365	133	153	78	395	221	228	271	118
JPN	425	418	359	295	368	374	577	191	359	219	269	174	160	300	253	64	46	30	2	299	323	234	0	242	249	137	576	414	303	408	148
LVA	171	419	225	127	225	247	353	101	182	102	96	89	78	145	222	52	91	30	16	169	317	81	105	0	133	116	303	155	131	163	184
SVK	227	471	173	168	173	292	285	79	164	129	100	87	77	127	304	33	42	15	9	191	220	92	79	66	0	68	269	160	148	150	98
LTU	66	346	110	38	97	104	136	20	76	53	42	28	34	62	103	17	22	14	0	76	158	26	32	90	32	0	149	90	75	88	99
PRT	827	1035	716	692	804	976	1144	349	793	436	397	393	336	733	578	103	102	74	13	605	797	379	325	243	199	98	0	373	332	445	242
KOR	444	300	246	201	354	236	745	110	274	173	164	93	89	235	266	39	40	26	0	286	319	169	228	91	97	43	313	0	236	303	91
URY	356	274	238	180	264	270	684	111	299	215	212	109	137	248	227	32	43	24	0	260	256	201	179	84	107	40	323	196	0	322	93
ARG	422	306	252	197	306	277	821	119	315	180	189	105	115	282	240	30	44	21	0	293	304	249	216	114	88	40	421	259	340	0	116
HRV	97	471	215	116	192	287	197	95	173	91	96	127	82	163	198	59	62	35	12	139	280	83	71	157	51	70	207	38	52	69	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
FRR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  ARG  HRV
 ----------------------------------------------------------------------------
   CAN    0 1920 1042 1115 1266 1044 2430  584 1258  576  936  410  366  993  837  132  168   73
7  722  899  416 1049  314  343  150  813  497  234  503  198
   DEU 1045    0 2381 2095 2202 2870 3033  871 1769  821 1243  686  641 1265 1635  213  310  117
111 1020 1761  523 1243  544  638  365 1099  482  238  530  457
   DFS  710 1292    0 1365 1326 1650 1661  494 1255  685  926  493  543  817 1049  176  209  105
35  731 1165  437  787  352  352  218  818  377  201  410  282
   FRA  611  892  581    0 1545 1596 2120  445 1277  672  946  537  536  901 1037  138  180   96
16  748 1169  411 1001  288  336  164  796  394  194  395  200
   ITA  716 1165  796  656    0 1431 2187  512 1279  647  895  471  474 1016 1059  174  198   97
15  808 1157  444  992  360  337  200  871  458  214  462  261
   NLD  836 2336 1226  824  950    0 1987  641 1397  858 1053  711  640  874 1216  177  274  111
72  777 1281  450  840  370  449  206  934  370  199  417  326
   USA 2239 1726 1037  964 1088 1546    0  693 1732  900 1344  520  553 1223 1358  164  256  116
20 1025 1447  564 1603  435  450  228 1097  659  292  750  264
   CHE  424  697  399  376  417  595  586    0  497  287  379  332  257  396  397   94  100   43
28  323  436  200  325  187  161   70  385  168   98  188  144
   GBR 1352 1138  820  673  812 1091 1352  435    0  760 1005  493  666  867  864  153  183   96
14  693  974  448  839  302  307  182  838  386  208  429  244
   NZL  566  596  444  351  430  759  819  238  622    0  908  306  526  437  516   97  106   81
5  418  509  324  457  174  212  121  504  243  150  276  158
   AUS  779  688  486  495  438  755 1083  286  697  825    0  404  466  620  613  114  143   71
11  499  652  377  631  228  227  137  583  293  174  339  183
   BEL  354  604  400  479  366  746  397  294  418  225  283    0  279  389  376   99   94   47
27  314  419  215  304  152  166   79  401  162   99  172  150
   IRL  289  476  380  350  330  519  425  230  601  403  327  239    0  361  370   77   94   61
4  313  400  255  310  137  153   90  373  148  114  187  124
   ESP  525  744  551  597  675  732  712  302  652  317  353  345  311    0  704  133  144   83
10  595  770  385  715  259  258  149  707  347  173  368  208
   CZE  513 1174  598  567  640  991  945  263  538  334  292  261  232  449    0  157  198   93
28  751 1028  340  682  321  390  170  684  377  169  356  261
   SVN   92  190  144   88  138  145  126   63  108   67   65   76   53   96  117    0   59   31
10  117  168   74  118   77   53   36  126   70   30   64   73
   EST   88  209  121   73  104  195  167   54   98   56   48   58   45   65  123   38    0   39
14  143  225   81  144  136   90   55  150   77   41   77   83
   ISR   44   96   83   50   65   91   96   28   67   69   42   27   44   55   67   24   26    0
1   77   96   53   72   46   35   30   89   43   24   42   47
   FRR    3   85   22   11   14   38   10   19   10    4    7   22    4    6   20    9   13    1
0    4   70    6    2   20   19    0   13    1    0    0   12
   HUN  610  780  543  470  647  623  949  249  591  333  307  244  249  470  653   91   87   62
4    0  715  338  564  229  268  139  609  350  182  372  185
   POL  597 1350  824  600  778 1031 1142  328  691  348  327  339  269  504  765  147  151   73
74  600    0  342  715  412  344  219  800  411  171  397  321
   ZAF  353  392  320  272  324  375  534  168  384  267  290  170  205  344  225   53   41   39
4  287  245    0  364  133  153   78  395  221  148  271  118
   JPN  424  417  358  293  366  372  572  191  357  218  268  174  159  298  252   63   45   30
2  298  321  233    0  242  248  137  575  414  180  407  148
   LVA  171  419  225  127  225  247  353  101  182  102   96   89   78  145  222   52   91   30
16  169  317   81  105    0  133  116  303  155   87  163  184
   SVK  227  471  173  168  173  292  285   79  164  129  100   87   77  127  303   33   42   15
9  191  220   92   78   66    0   68  269  160   94  150   98
   LTU   66  346  110   38   97  104  136   20   76   53   42   28   34   62  103   17   22   14
0   76  158   26   32   90   32    0  149   90   43   88   99
   PRT  826 1035  716  692  804  976 1144  349  793  436  397  393  336  733  577  103  102   74
13  605  797  379  322  243  199   98    0  373  202  445  241
   KOR  444  300  246  201  354  236  744  110  274  173  164   93   89  235  266   39   40   26
0  286  319  169  227   91   97   43  313    0  147  303   91
   URY  211  167  150  115  163  156  343   71  176  117  124   76   91  150  121   23   22   13
0  154  130  133  109   52   57   23  192  117    0  214   56
   ARG  422  306  252  197  306  277  821  119  315  180  189  105  115  282  240   30   44   21
0  293  304  249  212  114   88   40  421  258  209    0  116
   HRV   97  470  214  116  192  286  197   95  173   91   96  126   82  163  197   59   62   35
12  139  279   83   71  157   51   70  206   38   29   69    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
FRR HUN POL ZAF JPN LVA SVK LTU PRT KOR URY ARG HRV
 --------------------------------------------------------------------------
   CAN    0 1920 1042 1115 1266 1044 2424  584 1258  576  936  410  366  993  837  132  168   73
7  722  899  416 1048  314  343  150  812  497  232  503  198
   DEU 1046    0 2381 2095 2202 2870 3029  871 1769  821 1243  686  641 1265 1635  213  310  117
111 1020 1761  523 1242  544  638  365 1098  482  237  530  458
   DFS  711 1292    0 1365 1326 1650 1659  494 1255  685  926  493  543  817 1049  176  209  105
35  731 1165  437  786  352  352  218  818  377  197  410  283
   FRA  611  892  581    0 1545 1596 2119  445 1277  672  946  537  536  901 1037  138  180   96
16  748 1169  411 1000  288  336  164  796  394  193  395  201
   ITA  717 1163  796  656    0 1431 2187  512 1279  647  895  471  474 1016 1059  174  198   97
15  808 1157  444  991  360  337  200  870  458  215  462  261
   NLD  837 2336 1226  824  947    0 1986  641 1397  858 1053  711  640  874 1216  177  274  111
72  777 1281  450  838  370  449  206  934  370  199  417  327
   USA 2237 1724 1037  964 1086 1546    0  693 1731  900 1341  519  553 1222 1358  164  256  116
20 1025 1447  564 1599  435  449  228 1096  660  289  749  265
   CHE  424  697  399  376  416  595  586    0  497  287  379  332  257  396  397   94  100   43
28  323  436  200  324  187  161   70  385  168   99  188  144
   GBR 1353 1138  820  673  811 1091 1352  435    0  760 1005  493  666  867  864  153  183   96
14  693  974  448  838  302  307  182  838  386  207  429  244
   NZL  567  596  444  351  428  759  819  238  622    0  908  306  526  437  516   97  106   81
5  418  509  324  457  174  212  121  504  243  153  276  158
   AUS  779  688  486  495  438  755 1083  286  697  825    0  404  466  620  613  114  143   71
11  499  652  377  630  228  227  137  583  293  177  339  183
   BEL  354  604  400  479  366  746  396  294  418  225  283    0  279  389  376   99   94   47
27  314  419  215  303  152  166   79  401  162   99  172  151
   IRL  289  476  380  350  330  519  425  230  601  403  327  239    0  361  370   77   94   61
4  313  400  255  310  137  153   90  373  148  115  187  124
   ESP  526  744  551  597  675  732  712  302  652  317  353  345  311    0  704  133  144   83
10  595  770  385  714  259  258  149  707  347  170  368  208
   CZE  513 1174  598  567  640  991  945  263  538  334  292  261  232  449    0  157  198   93
28  751 1028  340  681  321  390  170  684  377  170  356  262
   SVN   92  190  144   88  138  145  126   63  108   67   65   76   53   96  117    0   59   31
10  117  168   74  117   77   53   36  126   70   31   64   73
   EST   88  209  121   73  104  195  167   54   98   56   48   58   45   65  123   38    0   39
14  143  225   81  142  136   90   55  150   77   45   77   83
   ISR   44   96   83   50   65   91   96   28   67   69   42   27   44   55   67   24   26    0
1   77   96   53   72   46   35   30   89   43   24   42   47
   FRR    3   85   22   11   14   38   10   19   10    4    7   22    4    6   20    9   13    1
0    4   70    6    2   20   19    0   13    1    0    0   12
   HUN  611  780  543  470  645  623  949  249  591  333  307  244  249  470  653   91   87   62
4    0  715  338  563  229  268  139  609  350  185  372  185
   POL  597 1350  824  600  777 1031 1142  328  691  348  327  339  269  504  765  147  151   73
74  600    0  342  714  412  344  219  800  411  173  397  322
   ZAF  354  392  320  272  324  375  534  168  384  267  290  170  205  344  225   53   41   39
4  287  245    0  364  133  153   78  395  221  146  271  118
   JPN  423  416  357  292  364  370  570  191  356  218  267  173  159  297  251   62   43   30
2  297  320  233    0  241  248  136  574  414  178  407  147
   LVA  171  419  225  127  225  247  353  101  182  102   96   89   78  145  222   52   91   30
16  169  317   81  104    0  133  116  303  155   88  163  184
   SVK  227  471  173  168  173  292  284   79  164  129  100   87   77  127  303   33   42   15
9  191  220   92   78   68    0  269  160   92  150   98
   LTU   66  346  110   38   97  104  136   20   76   53   42   28   34   62  103   17   22   14
0   76  158   26   32   90   32    0  149   90   43   88   99
   PRT  826 1035  716  692  804  976 1144  349  793  436  397  393  336  733  577  103  102   74
13  605  797  379  321  243  199   98    0  373  201  445  242
   KOR  444  300  246  201  354  236  746  110  274  173  164   93   89  235  266   39   40   26
0  286  319  169  227   91   97   43  313    0  144  303   91
   URY  209  167  146  114  162  156  344   70  174  120  125   77   90  146  122   23   25   12
0  156  134  133  110   52   57   23  192  116    0  211   56
   ARG  422  306  252  197  306  277  821  119  315  180  189  105  115  282  240   30   44   21
0  293  304  249  212  114   88   40  421  259  207    0  116
   HRV   97  471  215  116  192  287  197   95  173   91   96  127   82  163  198   59   62   35
12  139  280   83   70  157   51   70  207   38   29   69    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
    ----------------------------------------------------------------------------
   CAN     0    65   304   139   183   127    28   114    64    45     5
   DFS    50     0   137   109    99   130    64   113    93    80    12
   USA   313   110     0   298   378   193    66   240    95    77    21
   NZL   153    85   374     0   342   170    56   170    81    60    59
   AUS   180    65   399   384     0   160    51   186    73    49    27
   GBR   126   115   207   172   153     0    64   140    98    68    30
   NLD    22    62    70    49    40    58     0    57    51    42     8
   ZAF   110    88   250   174   170   136    52     0    87    64    18
   ITA    61    90   102    80    68    99    48    82     0    60     8
   DEU    40    74    77    53    40    65    38    58    58     0     8
   IRL     3     9    22    64    22    31     8    18     9     8     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
    ----------------------------------------------------------------------------
   CAN     0    65   304   139   183   127    28   114    64    45     5
   DFS    50     0   137   109    99   130    64   113    93    80    13
   USA   313   110     0   298   378   193    66   240    95    77    23
   NZL   153    85   374     0   342   170    56   170    81    60    66
   AUS   180    65   399   384     0   160    51   186    73    49    28
   GBR   126   115   207   172   153     0    64   140    98    68    31
   NLD    22    62    70    49    40    58     0    57    51    42     9
   ZAF   110    88   250   174   170   136    52     0    87    64    19
   ITA    61    90   102    80    68    99    48    82     0    60     9
   DEU    40    74    77    53    40    65    38    58    58     0     9
   IRL     3    10    24    72    23    32     9    19    10     9     0
    ----------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN   DFS   USA   NZL   AUS   GBR   NLD   ZAF   ITA   DEU   IRL
    ----------------------------------------------------------------------------
   CAN     0    65   304   139   183   127    28   114    64    45     5
   DFS    50     0   137   109    99   130    64   113    93    80    13
   USA   313   110     0   298   378   193    66   240    95    77    23
   NZL   153    85   374     0   342   170    56   170    81    60    66
   AUS   180    65   399   384     0   160    51   186    73    49    28
   GBR   126   115   207   172   153     0    64   140    98    68    31
   NLD    22    62    70    49    40    58     0    57    51    42     9
   ZAF   110    88   250   174   170   136    52     0    87    64    19
   ITA    61    90   102    80    68    99    48    82     0    60     9
   DEU    40    74    77    53    40    65    38    58    58     0     9
   IRL     3    10    24    72    23    32     9    19    10     9     0
    ----------------------------------------------------------------------------
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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
    ----------------------------------------------------------------------------------
   CAN     0     4   169    69    76    63   110    11    71     1     9    14     2     4
   NOR     4     0    48    33    47    17    95    17     0    14    20    24    33    27
   USA   152    48     0    87    91    71   134    21    59    12    19    28    13    24
   NZL    69    32    86     0   112    47   142    14    33     4    14    23     3     8
   AUS    76    39    92   114     0    43   134    30    32    19    32    38     6    18
   GBR    61    18    64    44    43     0    50     5    35     1     9    12     7    13
   DFS   106    73   133   140   112    48     0    57    48    79   110   105     8    27
   DEU    10    17    21    14    29     5    48     0     1    22    31    31     3    13
   ZAF    73     0    54    29    32    30    45     1     0     0     2     5     0     2
   EST     1    14    11     3    18     1    68    21     0     0    44    22     0     8
   LVA     9    18    17    12    30     8    78    27     2    40     0    46     2    10
   LTU    13    19    22    19    34    11    89    29     5    21    41     0     2    11
   IRL     2    33    13     3     5     7     6     3     0     0     2     2     0     7
   NLD     4    26    22     8    16    13    26    13     2     7     9    10     6     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
    ----------------------------------------------------------------------------------
   CAN     0     4   169    69    76    63   110    11    71     1     9    14     2     4
   NOR     4     0    48    33    47    17    96    18     0    15    21    24    33    27
   USA   152    48     0    87    91    70   134    21    59    12    19    28    13    24
   NZL    69    32    86     0   112    47   142    14    33     4    14    23     3     8
   AUS    76    39    92   114     0    43   134    30    32    19    32    38     6    18
   GBR    61    18    64    44    43     0    50     5    35     1     9    12     7    13
   DFS   106    74   133   140   112    48     0    57    48    79   110   104     8    26
   DEU    10    18    21    14    29     5    48     0     1    22    31    31     3    13
   ZAF    73     0    54    29    32    30    45     1     0     0     2     5     0     2
   EST     1    15    11     3    18     1    68    21     0     0    44    22     0     8
   LVA     9    19    17    12    30     8    78    27     2    40     0    46     2    10
   LTU    13    19    22    19    34    11    88    29     5    21    41     0     2    11
   IRL     2    33    13     3     5     7     6     3     0     0     2     2     0     7
   NLD     4    26    22     8    16    13    26    13     2     7     9    10     6     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
    ----------------------------------------------------------------------------------
   CAN     0     4   169    69    76    63   110    11    71     1     9    14     2     4
   NOR     4     0    48    33    47    17    96    18     0    15    21    24    33    27
   USA   152    48     0    87    91    70   134    21    59    12    19    28    13    24
   NZL    69    32    86     0   112    47   142    14    33     4    14    23     3     8
   AUS    76    39    92   114     0    43   134    30    32    19    32    38     6    18
   GBR    61    18    64    44    43     0    50     5    35     1     9    12     7    13
   DFS   106    74   133   140   112    48     0    57    48    79   110   103     8    26
   DEU    10    18    21    14    29     5    48     0     1    22    31    31     3    13
   ZAF    73     0    54    29    32    30    45     1     0     0     2     5     0     2
   EST     1    15    11     3    18     1    68    21     0     0    44    22     0     8
   LVA     9    19    17    12    30     8    78    27     2    40     0    46     2    10
   LTU    13    19    22    19    34    11    88    29     5    21    41     0     2    11
   IRL     2    33    13     3     5     7     6     3     0     0     2     2     0     7
   NLD     4    26    22     8    16    13    26    13     2     7     9    10     6     0
    ----------------------------------------------------------------------------------
```

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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
   -------------------------------------------------------------------------
   CHE     0   260   143    70     5    10     1    68    48    27    52     0
   DEA   228     0   217   701   141   182    44   183    49   329    50   413
   FRM   184   261     0   143    17     2     3   100    62    52    69     2
   ITA    74   604   173     0    77   102    16   133    50   120    44   184
   SVN     5   127    17    73     0    40     9    35     1    39     0    59
   FRA     8   143     1    93    37     0    10    39     0    43     0    67
   HUN     0    29     1    14     7     7     0     3     1    12     0    16
   NLD    71   189   121   128    33    39     3     0    45    46    50    69
   IRL    45    42    67    47     1     0     1    40     0    10    36     2
   SVK    19   336    52   102    39    37    10    39     3     0     8    74
   GBR    60    50    88    49     0     0     0    50    32     3     0     0
   HRV     0   433     1   177    49    61    16    67     1    58     0     0
   -------------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CHE   DEA   FRM   ITA   SVN   FRA   HUN   NLD   IRL   SVK   GBR   HRV
   -------------------------------------------------------------------------
   CHE     0   260   143    70     5    10     1    68    48    27    52     0
   DEA   228     0   217   703   141   182    44   183    49   329    50   411
   FRM   184   261     0   143    17     2     3   100    62    52    69     2
   ITA    74   606   173     0    77   102    16   133    50   120    44   182
   SVN     5   127    17    73     0    40     9    35     1    39     0    59
   FRA     8   143     1    93    37     0    10    39     0    43     0    67
   HUN     0    29     1    14     7     7     0     3     1    12     0    16
   NLD    71   189   121   128    33    39     3     0    45    46    50    69
   IRL    45    42    67    47     1     0     1    40     0    10    36     2
   SVK    19   336    52   102    39    37    10    39     3     0     8    72
   GBR    60    50    88    49     0     0     0    50    32     3     0     0
   HRV     0   431     1   175    49    61    16    67     1    56     0     0
   -------------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CHE   DEA   FRM   ITA   SVN   FRA   HUN   NLD   IRL   SVK   GBR   HRV
   -------------------------------------------------------------------------
   CHE     0   260   143    70     5    10     1    68    48    27    52     0
   DEA   228     0   217   701   141   182    44   183    49   329    50   412
   FRM   184   261     0   143    17     2     3   100    62    52    69     2
   ITA    74   604   173     0    77   102    16   133    50   120    44   183
   SVN     5   127    17    73     0    40     9    35     1    39     0    59
   FRA     8   143     1    93    37     0    10    39     0    43     0    67
   HUN     0    29     1    14     7     7     0     3     1    12     0    16
   NLD    71   189   121   128    33    39     3     0    45    46    50    69
   IRL    45    42    67    47     1     0     1    40     0    10    36     2
   SVK    19   336    52   102    39    37    10    39     3     0     8    73
   GBR    60    50    88    49     0     0     0    50    32     3     0     0
   HRV     0   432     1   176    49    61    16    67     1    57     0     0
   -------------------------------------------------------------------------
```