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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-three (33) countries were
included in this evaluation.

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


BEL  (HOL) Drop in daughters, herds, EDC and reliabilities due to corrections in pedigree.
           Missing bulls because the pedigree correction removed number of herds and daughters.
CHE  (ALL) Change in number of herds, EDC and reliabilities due to manual data edits and hYS assignment.
DEU  (HOL) Overall base change. From this routine run onwards cow base is adjusted with each routine run, four months (birth month) forwards.
DFS  (HOL,JER,RDC) Drop in EDC mostly cause by rounding effect.
ESP  (HOL) Base changed. Drop in information due to new checks in data editing.
FRA  (HOL) Drop in information due to the pedigree update.
IRL  (HOL,JER,RDC,SIM)  Drop in information due to correction in the pedigree based on genomic information.
ITA  (HOL) Increase in the threshold of reliability and daughters per herd meant that many bulls no longer achieved the requirements for submission.
ITA  (SIM) Drop in information due to pedigree editing.
JPN  (HOL) Changes in EDC due to pedigree editing.
LVA  (HOL,RDC)  Implementation of a new recording system that caused decrease in information and led to some bulls changing from official to unofficial.
NLD  (ALL) Drop in information due to pedigree corrections.
POL  (HOL) The Polish Federation of Cattle Breeders and Milk Producers replaced the milk recording system SYMLEK by the FEDINFO system.
           Due to this change, a marginal number of animals have been assigned to a native breed instead of Holstein-Friesian.
           These bulls were removed from the evaluation. Drop in information due to data editing.
USA  (ALL) Drop in information due to pedigree corrections and herd-year edits.
           Implementation of the 305-AA (Average Age) system on the CDCB genetic evaluations which replace the 305-ME (Mature Equivalent).
           This change enables fairer phenotypic comparisons of standardized records for cows of different ages, parities, and seasons of calving.


INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN
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In 2020 new post-processing windowsâ\200\231 correlations for all breeds and traits have been applied: the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while
the lower values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the real estimated ones. The previoulsy lower value adopted (based on
the 25th percentile) had been found too high causing estimated and post-processed correlations to differ significantly from each other. It is a recommendation from the Interbull Technical Committee to
review such windows every 5 years. The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more
in consideration the value of the new estimated ones even when no changes are applied by the countries. More information can be read on https://interbull.org/ib/rg_procedure

Since 2021 a new trait group has been added to the MACE evaluation, called stcm (SNP Training for clinical mastitis) evaluating the trait cma (pure clinical mastitis). New trait group codes have been
issued as follows: 041 for international ebv files (.itb), 071 for parent average (ipr).


DATA AND METHOD OF ANALYSIS
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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
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national evaluation.

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

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

SCIENTIFIC LITERATURE

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

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

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

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

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

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

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

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

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

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for the next routine evaluation can be found on
http://www.interbull.org/ib/servicecalendar.

NEXT TEST INTERNATIONAL EVALUATION

Dates for the next test run can be found on
http://www.interbull.org/ib/servicecalendar.

PUBLICATION OF INTERBULL ROUTINE RUN

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

At the same time, all recipients of Interbull results are expected to honor
the agreed code of practice, decided by the Interbull Steering Committee,
and only publish international evaluations on their own country scale.

PUBLICATION OF INTERBULL TEST RUN

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

^LTable 1. National evaluation data considered in the Interbull
evaluation for dairy production traits (August Routine Evaluation 2024).
Number of records for milk yield by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS	233	151	9036	1919	869	
BEL			2370			
CAN	290	112	14186	918	896	
CHE	3273		3462	106		3716
CZE			5312			
DEA	6516					26996
DEU			24759	296	312	
DFS			14588	2391	8114	
ESP			4723			
EST			1453		500	
FRA	506		18761			507
FRM						5244
GBR	203	383	8361	1032	749	122
HUN			3611			
IRL			3446	163	62	105
ISR			1787			
ITA	2433		7408	170		2077
JPN			7065			
KOR			1783			
LTU			897		374	
LVA			1568		727	
NLD	250		17260	280	107	531
NOR					4393	
NZL	90	63	9268	5662	1568	
POL			13076			
PRT			2964			
SVK			1214			
SVN	353		728			722
URY			1200			
USA	1245	835	43176	5546	825	118
ZAF			1317	754	144	
HRV			987			1072
CAM					50	
No.Records	15392	1544	225766	19237	19690	41210
Pub. Proofs	12172	1217	161811	15156	17284	36973

^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	653.86										
FRA	0.90	654.88									
USA	0.91	0.89	653.52								
CHE	0.90	0.90	0.85	488.61							
ITA	0.87	0.83	0.86	0.87	614.82						
DEA	0.82	0.85	0.82	0.94	0.89	468.11					
NLD	0.88	0.87	0.86	0.85	0.85	0.86	671.56				

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SVN      0.69    0.74    0.70    0.71    0.63    0.72    0.68   10.52
NZL      0.68    0.76    0.70    0.73    0.68    0.72    0.71    0.65  475.67
GBR      0.84    0.86    0.82    0.85    0.77    0.76    0.83    0.68    0.72  286.58
AUS      0.72    0.76    0.70    0.69    0.64    0.63    0.71    0.65    0.83    0.69  368.42
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BSW   fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.28										
FRA	0.88	27.46									
USA	0.89	0.89	24.07								
CHE	0.85	0.89	0.82	19.28							
ITA	0.87	0.87	0.85	0.87	23.32						
DEA	0.80	0.87	0.81	0.94	0.87	17.37					
NLD	0.86	0.84	0.83	0.83	0.83	0.85	25.35				
SVN	0.77	0.79	0.72	0.73	0.70	0.78	0.67	10.72			
NZL	0.70	0.79	0.74	0.78	0.68	0.78	0.68	0.67	23.52		
GBR	0.83	0.86	0.82	0.83	0.78	0.76	0.83	0.68	0.72	9.97	
AUS	0.73	0.72	0.74	0.63	0.65	0.65	0.67	0.62	0.80	0.67	15.40

BSW   pro

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	23.40										
FRA	0.86	21.45									
USA	0.88	0.86	20.03								
CHE	0.83	0.85	0.81	15.58							
ITA	0.82	0.81	0.82	0.85	21.45						
DEA	0.77	0.80	0.79	0.93	0.87	14.55					
NLD	0.84	0.82	0.82	0.81	0.81	0.84	21.76				
SVN	0.66	0.72	0.68	0.65	0.64	0.69	0.64	10.15			
NZL	0.61	0.71	0.64	0.68	0.63	0.68	0.63	0.62	16.72		
GBR	0.83	0.82	0.79	0.80	0.74	0.70	0.82	0.65	0.65	8.26	
AUS	0.68	0.68	0.67	0.60	0.57	0.57	0.62	0.56	0.78	0.63	11.79

GUE   mil

	CAN	USA	AUS	GBR	NZL
CAN	806.89				
USA	0.93	800.71			
AUS	0.76	0.73	478.74		
GBR	0.86	0.81	0.71	266.66	
NZL	0.71	0.69	0.83	0.71	377.13

GUE   fat

	CAN	USA	AUS	GBR	NZL
CAN	30.87				
USA	0.92	27.41			
AUS	0.76	0.74	17.39		
GBR	0.86	0.81	0.71	10.34	
NZL	0.71	0.73	0.82	0.72	18.47

GUE   pro

	CAN	USA	AUS	GBR	NZL
CAN	23.99				
USA	0.90	21.72			
AUS	0.66	0.62	13.75		
GBR	0.84	0.79	0.65	7.74	
NZL	0.62	0.60	0.79	0.63	12.73

HOL   mil

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        CAN     DEU     DFS     FRA     ITA     NLD     USA     CHE     GBR     NZL     AUS     BEL     IRL     ESP     CZE     SVN     EST     ISR     HUN     POL     ZAF     JPN     LVA     SVK     LTU     PRT     KOR     URY     HRV
CAN   800.09
DEU     0.94  646.59
DFS     0.92    0.93   11.17
FRA     0.91    0.92    0.90  620.97
ITA     0.89    0.88    0.87    0.88  589.68
NLD     0.92    0.94    0.92    0.89    0.88  666.48
USA     0.93    0.91    0.89    0.90    0.90    0.89  712.86
CHE     0.90    0.93    0.88    0.93    0.88    0.91    0.88  569.65
GBR     0.86    0.84    0.83    0.85    0.82    0.85    0.83    0.89  276.33
NZL     0.70    0.69    0.69    0.76    0.68    0.72    0.70    0.75    0.70  388.04
AUS     0.77    0.74    0.71    0.78    0.70    0.75    0.74    0.77    0.73    0.83  421.84
BEL     0.86    0.87    0.81    0.82    0.78    0.84    0.81    0.81    0.76    0.67    0.77  503.86
IRL     0.83    0.84    0.82    0.90    0.79    0.85    0.81    0.87    0.81    0.82    0.81    0.78  181.86
ESP     0.93    0.92    0.89    0.92    0.89    0.90    0.92    0.89    0.82    0.68    0.76    0.86    0.83  530.51
CZE     0.87    0.88    0.84    0.81    0.81    0.82    0.84    0.77    0.73    0.64    0.71    0.84    0.73    0.84  712.78
SVN     0.81    0.84    0.81    0.83    0.72    0.80    0.79    0.75    0.69    0.60    0.67    0.75    0.67    0.82    0.76   11.94
EST     0.87    0.87    0.89    0.85    0.83    0.84    0.87    0.85    0.78    0.67    0.72    0.79    0.75    0.83    0.82    0.72  579.42
ISR     0.81    0.82    0.83    0.82    0.84    0.80    0.86    0.81    0.79    0.63    0.66    0.79    0.70    0.83    0.79    0.78    0.80  404.43
HUN     0.85    0.86    0.83    0.87    0.88    0.85    0.89    0.85    0.81    0.66    0.65    0.74    0.77    0.85    0.83    0.72    0.83    0.83  684.19
POL     0.89    0.90    0.87    0.89    0.86    0.88    0.88    0.86    0.81    0.68    0.75    0.83    0.81    0.89    0.87    0.81    0.86    0.80    0.87  412.98
ZAF     0.83    0.78    0.77    0.82    0.79    0.75    0.82    0.78    0.74    0.66    0.76    0.75    0.75    0.82    0.78    0.67    0.72    0.80    0.79    0.80  539.75
JPN     0.93    0.91    0.92    0.91    0.89    0.90    0.92    0.89    0.83    0.68    0.76    0.84    0.81    0.91    0.85    0.86    0.84    0.85    0.84    0.89    0.83  623.90
LVA     0.74    0.75    0.71    0.76    0.68    0.70    0.75    0.74    0.69    0.63    0.64    0.68    0.73    0.72    0.66    0.65    0.76    0.79    0.72    0.74    0.71    0.72  511.57
SVK     0.77    0.79    0.79    0.79    0.75    0.72    0.78    0.76    0.73    0.62    0.64    0.76    0.69    0.79    0.80    0.74    0.79    0.81    0.80    0.70    0.80    0.68  383.20
LTU     0.74    0.73    0.71    0.76    0.66    0.67    0.70    0.71    0.66    0.60    0.63    0.70    0.65    0.73    0.69    0.77    0.63    0.78    0.68    0.70    0.63    0.73    0.68    0.72  398.16
PRT     0.76    0.76    0.77    0.78    0.74    0.74    0.77    0.75    0.69    0.60    0.60    0.67    0.71    0.77    0.65    0.76    0.67    0.79    0.72    0.74    0.61    0.75    0.66    0.68    0.61  588.76
KOR     0.85    0.79    0.80    0.80    0.78    0.77    0.85    0.78    0.71    0.70    0.74    0.82    0.73    0.84    0.80    0.75    0.78    0.79    0.74    0.78    0.78    0.85    0.73    0.77    0.67    0.68  481.55
URY     0.71    0.70    0.67    0.75    0.69    0.69    0.70    0.71    0.64    0.76    0.73    0.70    0.71    0.70    0.67    0.64    0.66    0.78    0.68    0.72    0.74    0.67    0.70    0.62    0.68    0.61    0.70  166.00
HRV     0.64    0.65    0.66    0.65    0.64    0.68    0.63    0.62    0.62    0.59    0.59    0.66    0.60    0.65    0.62    0.62    0.65    0.79    0.66    0.66    0.70    0.67    0.62    0.65    0.61    0.61    0.63    0.63   11.18

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HOL    fat
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        CAN     DEU     DFS     FRA     ITA     NLD     USA     CHE     GBR     NZL     AUS     BEL     IRL     ESP     CZE     SVN     EST     ISR     HUN     POL     ZAF     JPN     LVA     SVK     LTU     PRT     KOR     URY     HRV
CAN    32.00
DEU     0.93   24.16
DFS     0.90    0.91   10.91
FRA     0.91    0.92    0.90   25.22
ITA     0.88    0.88    0.84    0.90   24.92
NLD     0.90    0.94    0.90    0.88    0.85   25.39
USA     0.92    0.92    0.87    0.91    0.90    0.87   26.60
CHE     0.87    0.90    0.86    0.91    0.84    0.88    0.85   22.64
GBR     0.85    0.87    0.83    0.87    0.83    0.86    0.85    0.88    9.51
NZL     0.67    0.68    0.69    0.75    0.66    0.68    0.72    0.74    0.71   15.29
AUS     0.73    0.72    0.67    0.75    0.70    0.70    0.74    0.70    0.71    0.79   14.80
BEL     0.86    0.86    0.81    0.84    0.79    0.83    0.82    0.80    0.79    0.69    0.75   20.27
IRL     0.81    0.80    0.82    0.84    0.73    0.82    0.79    0.83    0.78    0.80    0.78    0.81    6.81
ESP     0.91    0.90    0.86    0.91    0.89    0.87    0.92    0.85    0.83    0.65    0.74    0.82    0.78   21.05
CZE     0.83    0.85    0.81    0.79    0.80    0.78    0.84    0.71    0.74    0.57    0.66    0.80    0.67    0.82   22.37
SVN     0.78    0.79    0.78    0.77    0.73    0.78    0.74    0.73    0.68    0.61    0.59    0.79    0.65    0.76    0.72   12.37
EST     0.87    0.89    0.88    0.86    0.85    0.86    0.87    0.86    0.78    0.73    0.75    0.85    0.79    0.83    0.82    0.79   23.52
ISR     0.77    0.80    0.73    0.76    0.79    0.76    0.84    0.76    0.71    0.63    0.60    0.64    0.60    0.77    0.72    0.62    0.77   14.97
HUN     0.83    0.86    0.78    0.86    0.88    0.81    0.89    0.81    0.78    0.64    0.65    0.72    0.69    0.86    0.79    0.64    0.80    0.84   27.29
POL     0.88    0.90    0.84    0.88    0.86    0.84    0.89    0.81    0.80    0.66    0.70    0.83    0.74    0.89    0.84    0.77    0.88    0.78    0.86   17.26
ZAF     0.71    0.69    0.61    0.73    0.70    0.67    0.75    0.69    0.67    0.57    0.65    0.64    0.64    0.75    0.69    0.62    0.72    0.71    0.71    0.74   19.26
JPN     0.92    0.91    0.92    0.90    0.87    0.89    0.89    0.87    0.83    0.68    0.69    0.84    0.80    0.87    0.80    0.85    0.85    0.75    0.78    0.86    0.67   24.05
LVA     0.78    0.79    0.73    0.80    0.76    0.73    0.79    0.75    0.71    0.66    0.69    0.79    0.64    0.79    0.73    0.67    0.84    0.76    0.75    0.81    0.73    0.75   20.22
SVK     0.73    0.75    0.72    0.75    0.78    0.67    0.77    0.70    0.70    0.58    0.61    0.74    0.60    0.76    0.78    0.72    0.80    0.68    0.76    0.80    0.64    0.72    0.73   15.27
LTU     0.69    0.70    0.65    0.71    0.67    0.61    0.70    0.68    0.64    0.57    0.57    0.70    0.57    0.68    0.64    0.74    0.66    0.65    0.63    0.70    0.62    0.67    0.78    0.69   17.83
PRT     0.73    0.75    0.71    0.77    0.75    0.71    0.77    0.73    0.72    0.60    0.59    0.63    0.63    0.76    0.62    0.68    0.68    0.62    0.74    0.74    0.60    0.73    0.70    0.61    0.61   23.64
KOR     0.84    0.81    0.78    0.82    0.80    0.78    0.86    0.79    0.76    0.72    0.74    0.84    0.71    0.84    0.77    0.74    0.80    0.75    0.76    0.83    0.70    0.85    0.76    0.73    0.69    0.66   19.69
URY     0.75    0.73    0.70    0.79    0.71    0.68    0.75    0.70    0.70    0.73    0.70    0.70    0.70    0.71    0.68    0.67    0.78    0.66    0.69    0.76    0.69    0.70    0.77    0.63    0.61    0.60    0.70    6.70
HRV     0.62    0.66    0.67    0.67    0.68    0.66    0.68    0.62    0.63    0.56    0.57    0.62    0.57    0.67    0.64    0.61    0.65    0.68    0.65    0.65    0.65    0.67    0.61    0.62    0.61    0.63    0.75    0.62   11.73

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HOL    pro
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	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV
CAN	22.46																												
DEU	0.91	17.88																											
DFS	0.90	0.92	10.52																										
FRA	0.87	0.89	0.89	17.00																									
ITA	0.85	0.85	0.84	0.84	18.33																								
NLD	0.88	0.93	0.89	0.84	0.83	19.03																							
USA	0.90	0.90	0.88	0.87	0.86	0.85	18.56																						
CHE	0.85	0.89	0.84	0.91	0.83	0.85	0.84	16.29																					
GBR	0.84	0.84	0.82	0.83	0.80	0.84	0.82	0.86	7.39																				
NZL	0.60	0.59	0.61	0.69	0.57	0.62	0.62	0.65	0.63	11.43																			
AUS	0.66	0.63	0.63	0.68	0.59	0.64	0.65	0.65	0.66	0.78	10.87																		
BEL	0.81	0.82	0.76	0.74	0.72	0.78	0.76	0.74	0.75	0.58	0.68	14.73																	
IRL	0.75	0.75	0.76	0.81	0.71	0.77	0.75	0.80	0.75	0.76	0.75	0.72	5.45																
ESP	0.90	0.89	0.87	0.88	0.86	0.85	0.89	0.84	0.82	0.58	0.67	0.79	0.76	15.23															
CZE	0.78	0.81	0.76	0.69	0.71	0.72	0.76	0.64	0.66	0.47	0.55	0.76	0.57	0.75	17.14														
SVN	0.76	0.79	0.76	0.80	0.70	0.75	0.75	0.70	0.64	0.51	0.57	0.70	0.60	0.79	0.67	11.38													
EST	0.81	0.84	0.83	0.79	0.77	0.80	0.82	0.83	0.73	0.58	0.61	0.75	0.62	0.75	0.73	0.65	17.56												
ISR	0.77	0.78	0.78	0.80	0.80	0.76	0.82	0.80	0.73	0.50	0.52	0.60	0.59	0.79	0.63	0.69	0.72	10.43											
HUN	0.80	0.83	0.79	0.84	0.84	0.80	0.86	0.82	0.77	0.54	0.52	0.66	0.66	0.80	0.71	0.65	0.77	0.80	21.95										
POL	0.84	0.87	0.84	0.84	0.80	0.82	0.84	0.80	0.77	0.56	0.62	0.78	0.73	0.85	0.79	0.75	0.82	0.73	0.82	11.27									
ZAF	0.77	0.71	0.69	0.75	0.69	0.68	0.75	0.71	0.71	0.61	0.70	0.67	0.67	0.73	0.66	0.60	0.66	0.76	0.70	0.75	14.79								
JPN	0.90	0.89	0.90	0.87	0.87	0.86	0.90	0.85	0.81	0.59	0.65	0.77	0.74	0.89	0.74	0.82	0.79	0.79	0.79	0.84	0.74	17.02							
LVA	0.73	0.73	0.68	0.73	0.67	0.67	0.73	0.71	0.68	0.58	0.57	0.70	0.63	0.71	0.61	0.60	0.74	0.71	0.68	0.73	0.68	0.70	14.66						
SVK	0.74	0.75	0.74	0.75	0.72	0.66	0.74	0.71	0.68	0.52	0.55	0.71	0.59	0.74	0.75	0.69	0.73	0.74	0.76	0.74	0.66	0.76	0.67	10.54					
LTU	0.66	0.66	0.63	0.71	0.61	0.59	0.63	0.64	0.59	0.51	0.49	0.65	0.50	0.65	0.59	0.74	0.60	0.67	0.61	0.62	0.61	0.65	0.69	0.67	11.88				
PRT	0.71	0.72	0.74	0.74	0.70	0.68	0.72	0.69	0.66	0.52	0.51	0.58	0.64	0.73	0.58	0.73	0.61	0.68	0.69	0.68	0.58	0.72	0.66	0.61	0.58	17.87			
KOR	0.82	0.76	0.76	0.75	0.77	0.73	0.82	0.75	0.68	0.60	0.63	0.80	0.64	0.82	0.72	0.71	0.72	0.74	0.69	0.76	0.69	0.81	0.67	0.72	0.61	0.63	13.41		
URY	0.64	0.64	0.63	0.73	0.61	0.60	0.64	0.65	0.58	0.72	0.66	0.59	0.64	0.64	0.59	0.62	0.60	0.61	0.59	0.63	0.67	0.59	0.70	0.60	0.63	0.58	0.60	5.16	
HRV	0.61	0.65	0.61	0.64	0.61	0.64	0.61	0.59	0.59	0.59	0.49	0.66	0.49	0.63	0.59	0.59	0.61	0.61	0.63	0.63	0.63	0.64	0.59	0.61	0.59	0.58	0.61	0.60	11.07

JER   mil

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	606.70											
DFS	0.90	9.10										
USA	0.91	0.89	687.04									
NZL	0.73	0.75	0.74	306.31								
AUS	0.79	0.71	0.74	0.81	385.59							
GBR	0.83	0.80	0.77	0.67	0.71	220.55						
NLD	0.91	0.90	0.88	0.71	0.74	0.80	602.86					
ZAF	0.87	0.83	0.84	0.77	0.80	0.73	0.76	367.66				
ITA	0.89	0.87	0.89	0.75	0.79	0.80	0.85	0.88	544.12			
DEU	0.91	0.94	0.91	0.69	0.69	0.82	0.93	0.79	0.86	603.03		
IRL	0.80	0.80	0.78	0.90	0.82	0.71	0.82	0.76	0.78	0.80	174.05	
CHE	0.87	0.87	0.82	0.73	0.75	0.84	0.88	0.78	0.83	0.91	0.82	387.90

JER   fat

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	27.29											
DFS	0.88	11.01										
USA	0.89	0.87	25.38									
NZL	0.67	0.68	0.71	14.31								
AUS	0.77	0.69	0.75	0.79	13.89							
GBR	0.81	0.78	0.80	0.67	0.71	9.16						
NLD	0.86	0.85	0.83	0.67	0.66	0.77	25.37					
ZAF	0.76	0.74	0.74	0.63	0.69	0.64	0.66	14.43				
ITA	0.87	0.83	0.86	0.67	0.72	0.75	0.79	0.76	25.72			
DEU	0.92	0.92	0.89	0.68	0.72	0.84	0.90	0.75	0.87	23.90		
IRL	0.77	0.76	0.74	0.83	0.79	0.74	0.78	0.62	0.70	0.76	6.10	
CHE	0.84	0.82	0.80	0.73	0.70	0.78	0.79	0.70	0.81	0.89	0.77	17.76

JER   pro

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

```
CAN     19.71
DFS      0.88  10.39
USA      0.88   0.88  19.35
NZL      0.63   0.67   0.67  10.21
AUS      0.69   0.64   0.66   0.76  10.57
GBR      0.82   0.80   0.76   0.65   0.68   7.04
NLD      0.86   0.86   0.84   0.64   0.65   0.77  19.69
ZAF      0.80   0.77   0.77   0.67   0.68   0.69   0.70  11.41
ITA      0.85   0.83   0.86   0.61   0.67   0.77   0.81   0.84  19.45
DEU      0.89   0.93   0.89   0.62   0.62   0.82   0.91   0.73   0.84  18.98
IRL      0.73   0.75   0.72   0.84   0.77   0.72   0.76   0.67   0.70   0.75   5.55
CHE      0.79   0.82   0.74   0.65   0.59   0.76   0.81   0.65   0.74   0.87   0.76  13.14

---------------------------------------------------------------------------------
RDC    mil
---------------------------------------------------------------------------------
        CAN    NOR    USA    NZL    AUS    GBR    DFS    DEU    ZAF    EST    LVA    LTU    IRL    NLD    CAM
CAN   615.61
NOR     0.85  12.64
USA     0.91   0.89 733.76
NZL     0.67   0.69   0.68 368.29
AUS     0.74   0.69   0.72   0.82 419.51
GBR     0.82   0.79   0.81   0.68   0.75 261.05
DFS     0.89   0.91   0.87   0.69   0.70   0.79  10.08
DEU     0.93   0.84   0.89   0.69   0.70   0.84   0.92 659.93
ZAF     0.82   0.78   0.83   0.72   0.78   0.70   0.78   0.78 619.02
EST     0.85   0.81   0.84   0.67   0.69   0.77   0.83   0.80   0.72 526.17
LVA     0.74   0.74   0.75   0.65   0.66   0.71   0.73   0.74   0.72   0.77 332.27
LTU     0.74   0.75   0.72   0.64   0.62   0.72   0.63   0.73   0.68   0.65   0.75 368.25
IRL     0.82   0.76   0.80   0.84   0.82   0.78   0.80   0.83   0.75   0.74   0.73   0.72 178.75
NLD     0.91   0.91   0.87   0.70   0.72   0.84   0.91   0.93   0.75   0.82   0.72   0.69   0.83 777.12
CAM     0.80   0.81   0.92   0.67   0.73   0.78   0.78   0.79   0.79   0.78   0.78   0.76   0.77   0.78 427.44

---------------------------------------------------------------------------------
RDC    fat
---------------------------------------------------------------------------------
        CAN    NOR    USA    NZL    AUS    GBR    DFS    DEU    ZAF    EST    LVA    LTU    IRL    NLD    CAM
CAN    23.59
NOR     0.84  12.09
USA     0.90   0.80  25.85
NZL     0.66   0.73   0.70  15.87
AUS     0.69   0.63   0.74   0.81  15.67
GBR     0.82   0.71   0.82   0.68   0.73   8.62
DFS     0.89   0.88   0.86   0.70   0.69   0.79  10.69
DEU     0.92   0.84   0.91   0.68   0.69   0.87   0.91  26.83
ZAF     0.76   0.78   0.80   0.63   0.66   0.66   0.71   0.70  20.72
EST     0.86   0.67   0.87   0.65   0.71   0.78   0.81   0.85   0.73  20.81
LVA     0.75   0.67   0.77   0.65   0.63   0.70   0.69   0.78   0.73   0.81  14.77
LTU     0.70   0.73   0.74   0.62   0.65   0.68   0.66   0.73   0.69   0.72   0.80  16.96
IRL     0.80   0.72   0.79   0.82   0.80   0.77   0.80   0.79   0.65   0.78   0.66   0.66   7.35
NLD     0.90   0.86   0.86   0.66   0.68   0.84   0.90   0.93   0.67   0.81   0.74   0.67   0.81  29.01
CAM     0.80   0.79   0.93   0.65   0.69   0.79   0.80   0.79   0.80   0.80   0.78   0.78   0.77   0.80  22.09

---------------------------------------------------------------------------------
RDC    pro
---------------------------------------------------------------------------------
        CAN    NOR    USA    NZL    AUS    GBR    DFS    DEU    ZAF    EST    LVA    LTU    IRL    NLD    CAM
CAN    18.64
NOR     0.83  12.11
USA     0.89   0.87  20.64
NZL     0.58   0.66   0.63  11.42
AUS     0.62   0.65   0.66   0.78  12.07
GBR     0.80   0.77   0.80   0.59   0.66   7.01
DFS     0.88   0.88   0.85   0.64   0.61   0.75  10.59
DEU     0.90   0.82   0.88   0.60   0.61   0.84   0.92  20.18
ZAF     0.76   0.77   0.77   0.66   0.73   0.65   0.70   0.71  17.57
EST     0.80   0.69   0.78   0.57   0.57   0.74   0.77   0.80   0.67  16.35
LVA     0.71   0.68   0.73   0.57   0.55   0.68   0.64   0.72   0.69   0.69   9.89
LTU     0.66   0.65   0.65   0.56   0.51   0.67   0.59   0.66   0.67   0.63   0.71  10.80
```

```
IRL     0.74    0.74    0.76    0.79    0.77    0.74    0.74    0.75    0.68    0.63    0.64    0.62    5.40
NLD     0.88    0.90    0.84    0.60    0.62    0.81    0.89    0.92    0.69    0.74    0.68    0.62    0.76   25.87
CAM     0.79    0.78    0.88    0.66    0.69    0.78    0.78    0.78    0.79    0.76    0.76    0.75    0.73    0.77   10.25
```

SIM   mil

```
          CHE     DEA     FRM     ITA     SVN     FRA     NLD     IRL     GBR     HRV     USA
CHE    563.12
DEA     0.87  507.12
FRM     0.95    0.86  621.12
ITA     0.77    0.68    0.66  513.28
SVN     0.75    0.75    0.76    0.71    9.19
FRA     0.90    0.93    0.84    0.81    0.79  743.72
NLD     0.88    0.92    0.89    0.75    0.77    0.88  762.20
IRL     0.84    0.74    0.84    0.67    0.71    0.87    0.79  180.95
GBR     0.86    0.85    0.85    0.76    0.68    0.85    0.85    0.77  229.19
HRV     0.64    0.62    0.76    0.61    0.61    0.62    0.62    0.64    0.62   10.52
USA     0.87    0.82    0.82    0.87    0.78    0.90    0.89    0.80    0.82    0.64  623.43
```

SIM   fat

```
          CHE     DEA     FRM     ITA     SVN     FRA     NLD     IRL     GBR     HRV     USA
CHE     22.42
DEA     0.87   19.05
FRM     0.94    0.89   24.19
ITA     0.77    0.75    0.69   19.72
SVN     0.73    0.81    0.75    0.73    9.22
FRA     0.89    0.94    0.84    0.81    0.77   29.93
NLD     0.86    0.91    0.89    0.73    0.78    0.87   28.73
IRL     0.79    0.72    0.79    0.63    0.70    0.83    0.78    7.60
GBR     0.89    0.84    0.85    0.79    0.68    0.87    0.85    0.75    7.95
HRV     0.64    0.59    0.75    0.61    0.60    0.61    0.61    0.64    0.63   10.54
USA     0.85    0.84    0.82    0.88    0.74    0.91    0.88    0.76    0.84    0.68   20.69
```

SIM   pro

```
          CHE     DEA     FRM     ITA     SVN     FRA     NLD     IRL     GBR     HRV     USA
CHE     16.76
DEA     0.85   15.49
FRM     0.94    0.85   19.99
ITA     0.70    0.64    0.64   16.06
SVN     0.71    0.71    0.73    0.66    9.18
FRA     0.88    0.91    0.79    0.77    0.73   24.55
NLD     0.83    0.90    0.86    0.70    0.73    0.83   23.81
IRL     0.77    0.74    0.78    0.58    0.67    0.80    0.73    6.26
GBR     0.83    0.83    0.81    0.74    0.65    0.83    0.83    0.72    7.23
HRV     0.62    0.57    0.75    0.58    0.59    0.59    0.60    0.57    0.60   10.69
USA     0.82    0.76    0.75    0.83    0.75    0.87    0.85    0.72    0.80    0.62   17.85
```

----
^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   99  200  158  154  171   62   37   38   78  106
  FRA    90    0  139  198  237  265  102   53   37   75   80
  USA   196  102    0  338  265  363   99   44   49  111  136
  CHE   135  155  316    0  538  673  124   85   46   90  129
  ITA   136  198  192  480    0  846  156  106   53   98  136
  DEA   150  214  331  564  744    0  180  113   63   97  143
  NLD    57   87   91  114  132  171    0   51   40   49   72
  SVN    33   51   34   80  100  103   51    0   15   22   29
```

```
   NZL    37    27    41    34    44    57    33    13     0    31    43
   GBR    74    62   104    68    72    65    40    17    26     0    69
   AUS   109    64   128    89   101   105    55    21    35    61     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    99   200   158   154   171    62    37    38    78   106
   FRA    90     0   139   198   237   265   102    53    37    75    80
   USA   196   102     0   338   265   363    99    44    49   111   136
   CHE   135   155   316     0   538   674   124    85    46    90   129
   ITA   136   198   192   480     0   847   156   106    53    98   136
   DEA   150   214   331   564   745     0   180   113    63    97   143
   NLD    57    87    91   114   132   171     0    51    40    49    72
   SVN    33    51    34    80   100   103    51     0    15    22    29
   NZL    37    27    41    34    44    57    33    13     0    31    43
   GBR    74    62   104    68    72    65    40    17    26     0    69
   AUS   109    64   128    89   101   105    55    21    35    61     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    99   200   158   154   171    62    37    38    78   106
   FRA    90     0   139   198   237   265   102    53    37    75    80
   USA   196   102     0   338   265   363    99    44    49   111   136
   CHE   135   155   316     0   538   674   124    85    46    90   129
   ITA   136   198   192   480     0   847   156   106    53    98   136
   DEA   150   214   331   564   745     0   180   113    63    97   143
   NLD    57    87    91   114   132   171     0    51    40    49    72
   SVN    33    51    34    80   100   103    51     0    15    22    29
   NZL    37    27    41    34    44    57    33    13     0    31    43
   GBR    74    62   104    68    72    65    40    17    26     0    69
   AUS   109    64   128    89   101   105    55    21    35    61     0
   --------------------------------------------------------------------------
GUE
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
         CAN   USA   AUS   GBR   NZL
   --------------------------------------------------------------------------
   CAN     0    80    56    41    14
   USA    72     0    73   104    32
   AUS    53    70     0    47    27
   GBR    35   105    40     0    16
   NZL    11    29    27    14     0
   --------------------------------------------------------------------------
GUE
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
         CAN   USA   AUS   GBR   NZL
   --------------------------------------------------------------------------
   CAN     0    80    56    41    14
   USA    72     0    73   104    32
   AUS    53    70     0    47    27
   GBR    35   105    40     0    16
   NZL    11    29    27    14     0
   --------------------------------------------------------------------------
GUE
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
         CAN   USA   AUS   GBR   NZL
```

```
--------------------------------------------------------------------------------
 CAN    0   80   56   41   14
 USA   72    0   73  104   32
 AUS   53   70    0   47   27
 GBR   35  105   40    0   16
 NZL   11   29   27   14    0
--------------------------------------------------------------------------------
```

HOL
----

common bulls below diagonal
common three quarter sib group above diagonal

```
        CAN  DEU  DFS  FRA  ITA  NLD  USA  CHE  GBR  NZL  AUS  BEL  IRL  ESP  CZE  SVN  EST  ISR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  HRV
--------------------------------------------------------------------------------------------------------------------------------------------------------------
 CAN     0 2765 1824 1747 1476 1907 4207  984 2006  898 1688  950  653 1511 1398  242  352  179 1111 1897  516 1513  605  478  300 1264  831  543  355
 DEU  2246    0 3094 2793 2111 3846 3981 1256 2376 1128 1863 1404  954 1747 2182  394  551  203 1307 3214  561 1542  958  734  552 1449  731  518  730
 DFS  1647 2416    0 1952 1263 2555 2551  817 1822  980 1494 1028  814 1240 1548  290  425  183  993 2092  516 1106  587  448  359 1121  586  457  493
 FRA  1315 1764 1251    0 1277 2347 2784  806 1769  928 1460 1131  804 1417 1517  238  324  151 1048 2150  515 1321  533  483  289 1140  637  456  391
 ITA   937 1151  783  553    0 1334 2169  567 1202  467  866  602  399 1016  958  216  243  117  686 1582  223  850  419  303  255  746  397  247  293
 NLD  1874 3685 2308 1690  902    0 2971 1018 2076 1252 1662 1473  981 1337 1847  305  482  196 1058 2426  525 1207  661  589  367 1265  594  473  524
 USA  4828 3104 2109 1666 1255 2700    0 1113 2659 1277 2249 1123  910 1787 2049  277  465  281 1431 2855  648 2154  811  598  403 1592 1010  746  454
 CHE   909 1191  771  753  376 1016 1047    0  810  472  705  676  444  624  591  150  204   73  455  800  259  515  333  251  146  566  310  229  224
 GBR  2272 1869 1444 1231  703 1873 2488  771    0 1089 1631  996 1083 1223 1297  233  344  180  941 1751  520 1160  521  412  329 1102  586  497  390
 NZL   890  884  717  614  248 1142 1235  399  951    0 1357  593  819  622  754  142  178  136  554  822  378  634  302  280  196  669  365  416  259
 AUS  1727 1445 1130 1047  454 1474 2327  626 1438 1364    0  847  793 1017 1009  188  273  139  796 1306  488  999  462  337  266  945  538  484  339
 BEL   954 1457  974 1169  458 1693 1014  694  990  485  751    0  560  776  805  183  240  100  599  989  343  612  356  324  188  769  361  275  310
 IRL   608  830  671  679  225  922  829  449 1107  713  686  549    0  550  610  119  160  123  467  706  332  473  245  222  156  538  273  298  207
 ESP  1057 1175  982 1190  511 1211 1243  520  967  476  741  764  515    0 1037  214  257  128  844 1374  455  996  436  352  243  978  571  390  330
 CZE  1094 1786 1093 1066  500 1704 1716  455  956  565  695  663  480  781    0  243  357  163 1042 1724  440  979  529  558  306  970  570  437  437
 SVN   188  386  234  180  138  265  226  106  172   96  129  144   88  152  177    0  105   53  162  328   74  178  139   83   73  179  117   67  129
 EST   234  414  292  177   84  354  343  122  211   92  145  156   83  126  228   64    0   67  233  466  114  240  233  139  103  244  147  128  153
 ISR   127  154  134   94   47  152  273   43  132  109   89   63   96   76  130   36   38    0  124  202   68  136   91   58   56  125   77   80   78
 HUN  1048 1053  806  773  334  897 1409  379  819  431  601  517  407  682  973  120  140   85    0 1087  405  779  393  339  248  826  521  403  299
 POL  1756 3057 1810 1623 1042 2339 2931  703 1577  642 1036  928  588 1049 1496  293  349  156  984    0  427 1162  792  508  418 1262  686  470  566
 ZAF   479  438  396  409   94  447  635  221  456  312  430  294  298  408  313   53   57   43  336  324    0  432  176  184  108  451  279  281  162
 JPN   818  729  628  531  198  673 1022  348  610  339  566  406  301  494  469   96   93   60  426  657  283    0  412  328  230  811  639  419  263
 LVA   378  803  379  293  173  455  698  186  305  171  239  216  143  236  361   84  141   58  281  651  101  180    0  207  207  483  277  212  298
 SVK   334  549  241  270  126  420  405  129  238  168  196  108  180  481   39   58   24  235  367  101  118  105    0  106  353  226  193  159
 LTU   171  514  213  122   79  225  283   59  180   92  121   92   74   98  199   32   47   25  150  325   41   74  134   48    0  245  159  135  166
 PRT  1329 1365 1037 1046  488 1283 1708  516 1022  546  792  784  482  954  824  142  166   81  820 1299  405  495  374  237  153    0  553  431  365
 KOR   815  513  435  400  149  438 1166  222  433  271  399  269  191  416  415   73   72   41  422  582  208  391  168  136   71  472    0  326  173
 URY   540  393  335  313   84  379  932  181  424  339  384  212  244  316  343   39   75   44  343  407  241  261  125  123   79  385  264    0  155
 HRV   219  755  396  287  152  476  352  149  279  156  216  250  143  246  339  104  110   55  219  519  109  122  233   79  114  302   83  102    0
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HOL
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common bulls below diagonal
common three quarter sib group above diagonal

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        CAN  DEU  DFS  FRA  ITA  NLD  USA  CHE  GBR  NZL  AUS  BEL  IRL  ESP  CZE  SVN  EST  ISR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  HRV
--------------------------------------------------------------------------------------------------------------------------------------------------------------
 CAN     0 2765 1823 1747 1478 1907 4204  984 2006  898 1688  950  653 1510 1394  243  352  179 1111 1897  515 1507  605  478  300 1264  831  543  354
 DEU  2246    0 3094 2793 2113 3846 3977 1256 2375 1128 1863 1404  954 1747 2177  395  551  203 1307 3214  560 1536  958  734  552 1449  731  518  729
 DFS  1647 2415    0 1952 1264 2555 2548  817 1822  980 1494 1028  813 1239 1544  291  425  183  992 2091  515 1102  587  448  359 1121  586  457  492
 FRA  1315 1764 1251    0 1279 2347 2783  806 1769  928 1460 1131  805 1417 1515  239  324  151 1048 2150  514 1318  533  483  289 1140  637  456  390
 ITA   938 1153  784  555    0 1336 2170  569 1204  468  868  604  401 1017  957  217  244  118  687 1584  223  851  421  304  255  748  398  248  294
 NLD  1874 3685 2308 1690  904    0 2968 1018 2076 1252 1662 1473  983 1337 1843  306  482  196 1058 2426  524 1202  661  589  367 1265  594  473  523
 USA  4826 3100 2104 1665 1256 2698    0 1113 2657 1276 2248 1122  909 1785 2036  278  464  281 1430 2854  647 2148  810  598  403 1590 1010  746  452
 CHE   909 1191  771  753  378 1016 1047    0  810  472  705  676  444  624  591  151  204   73  455  800  258  511  333  251  146  566  310  229  223
 GBR  2272 1869 1444 1231  704 1873 2486  771    0 1089 1631  996 1084 1223 1295  234  344  180  941 1751  519 1155  521  412  329 1102  586  497  390
 NZL   890  884  717  614  248 1142 1234  399  951    0 1357  593  819  622  754  143  178  136  554  822  377  633  302  280  196  669  365  416  258
 AUS  1727 1445 1130 1047  455 1474 2326  626 1438 1364    0  847  793 1017 1009  189  273  139  796 1306  487  995  462  337  266  945  538  484  339
 BEL   954 1457  974 1169  460 1693 1013  694  990  485  751    0  560  776  804  184  240  100  599  989  342  611  356  324  188  769  361  275  309
 IRL   608  830  671  679  226  924  829  449 1108  713  686  549    0  549  610  120  160  123  467  707  332  471  245  222  156  538  273  298  206
 ESP  1057 1175  981 1190  512 1211 1240  520  967  476  741  764  515    0 1036  215  257  128  843 1373  436  993  436  352  243  978  571  390  330
 CZE  1088 1781 1091 1065  497 1699 1701  455  953  565  694  663  480  781    0  244  357  163 1042 1716  439  977  529  557  306  970  570  437  435
 SVN   188  386  234  180  139  265  226  106  172   96  129  144   88  152  177    0  105   53  162  329   74  178  140   84   74  180  117   68  130
 EST   234  414  292  177   84  354  342  122  211   92  145  156   83  126  228   64    0   67  233  466  114  237  233  139  103  244  147  128  153
 ISR   127  154  134   94   47  152  273   43  132  109   89   63   96   76  129   36   38    0  124  202   67  135   91   58   56  125   77   80   78
 HUN  1048 1053  806  773  335  897 1408  379  819  431  601  517  407  682  973  120  140   85    0 1087  404  777  393  339  248  826  521  403  299
 POL  1756 3056 1809 1623 1044 2339 2928  703 1577  642 1036  928  588 1049 1490  293  349  156  984    0  426 1157  792  508  418 1262  686  470  565
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 ZAF   478  437  395  408   95  446  634  220  455  312  429  294  298  407  312   52   57   43  335  323    0  430  175  183  107  450  278  280  161
 JPN   811  724  626  527  198  669 1013  345  605  337  560  404  299  491  467   96   90   59  424  651  282    0  410  327  230  807  638  418  263
 LVA   378  803  379  293  174  455  697  186  305  171  239  216  143  236  361   84  141   58  281  651  101  178    0  207  207  483  277  212  298
 SVK   334  549  241  270  127  420  405  129  238  168  168  196  108  180  480   39   58   24  235  367  101  117  105    0  106  353  226  193  159
 LTU   171  514  213  122   79  225  283   59  180   92  121   92   74   98  199   32   47   25  150  325   40   74  134   48    0  245  159  135  166
 PRT  1328 1364 1036 1044  490 1282 1706  516 1021  546  791  783  482  953  824  142  166   81  820 1299  404  490  374  237  153    0  553  431  364
 KOR   815  513  435  400  149  438 1164  222  433  271  399  269  191  416  415   73   72   41  422  582  208  389  168  136   71  472    0  326  173
 URY   540  393  335  313   84  379  932  181  424  339  384  212  244  316  343   39   75   44  343  407  241  258  125  123   79  385  264    0  155
 HRV   217  753  394  285  152  474  349  147  278  155  215  249  141  246  336  103  110   54  218  517  109  122  233   79  113  300   82  102    0
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HOL
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common bulls below diagonal
common three quarter sib group above diagonal

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       CAN  DEU  DFS  FRA  ITA  NLD  USA  CHE  GBR  NZL  AUS  BEL  IRL  ESP  CZE  SVN  EST  ISR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  HRV
 --------------------------------------------------------------------------------
 CAN     0 2765 1823 1747 1476 1907 4198  984 2006  898 1688  950  653 1510 1394  242  352  179 1111 1897  515 1506  605  478  300 1264  831  543  355
 DEU  2246    0 3094 2793 2111 3846 3975 1256 2376 1128 1863 1404  954 1747 2177  394  551  203 1307 3214  560 1536  958  734  552 1449  731  518  730
 DFS  1647 2415    0 1952 1262 2555 2546  817 1823  980 1494 1028  813 1239 1544  290  425  183  992 2091  515 1102  587  448  359 1121  586  457  493
 FRA  1315 1764 1251    0 1277 2347 2782  806 1770  928 1460 1131  805 1417 1515  238  324  151 1048 2150  514 1318  533  483  289 1140  637  456  391
 ITA   937 1151  783  553    0 1334 2168  567 1202  467  866  602  399 1015  955  216  243  117  686 1582  222  850  419  303  255  746  397  247  293
 NLD  1874 3684 2308 1690  901    0 2967 1018 2077 1252 1662 1473  983 1337 1843  305  482  196 1058 2426  524 1201  661  589  367 1265  594  473  524
 USA  4823 3100 2104 1665 1255 2698    0 1113 2656 1276 2245 1121  909 1784 2036  277  464  281 1430 2854  647 2145  810  597  403 1590 1011  746  453
 CHE   909 1191  771  753  376 1016 1046    0  810  472  705  676  444  624  591  150  204   73  455  800  258  510  333  251  146  566  310  229  224
 GBR  2272 1871 1446 1233  703 1874 2486  771    0 1090 1631  997 1085 1224 1295  233  344  180  941 1752  519 1155  521  412  329 1103  586  497  391
 NZL   890  884  717  614  248 1142 1234  399  951    0 1357  593  819  622  754  142  178  136  554  822  377  633  302  280  196  669  365  416  259
 AUS  1727 1445 1130 1047  454 1473 2325  626 1438 1364    0  847  793 1017 1009  188  273  139  796 1306  487  995  462  337  266  945  538  484  339
 BEL   954 1457  974 1169  458 1693 1012  694  991  485  751    0  560  776  804  183  240  100  599  989  342  611  356  324  188  769  361  275  310
 IRL   608  830  671  679  225  924  829  449 1110  713  686  549    0  549  610  119  160  123  467  707  332  471  245  222  156  538  273  298  207
 ESP  1057 1175  981 1190  511 1211 1240  520  968  476  741  764  515    0 1036  214  257  128  843 1373  454  993  436  352  243  978  571  390  330
 CZE  1088 1781 1091 1065  495 1699 1701  455  954  565  694  663  480  781    0  243  357  163 1042 1716  439  977  529  557  306  970  570  437  436
 SVN   188  386  234  180  138  265  226  106  172   96  129  144   88  152  177    0  105   53  162  328   73  178  139   83   73  179  117   67  129
 EST   234  414  292  177   84  354  342  122  211   92  145  156   83  126  228   64    0   67  233  466  114  236  233  139  103  244  147  128  153
 ISR   127  154  134   94   47  152  273   43  132  109   89   63   96   76  129   36   38    0  124  202   67  135   91   58   56  125   77   80   78
 HUN  1048 1053  806  773  334  897 1408  379  819  431  601  517  407  682  973  120  140   85    0 1087  393  777  393  339  248  826  521  403  299
 POL  1756 3056 1809 1623 1042 2338 2928  703 1579  642 1036  928  588 1049 1490  293  349  156  984    0  426 1157  792  508  418 1262  686  470  566
 ZAF   478  437  395  408   94  446  634  220  455  312  429  294  298  407  312   52   57   43  335  323    0  430  175  183  107  450  278  280  161
 JPN   810  724  626  527  198  668 1012  345  606  337  560  404  299  491  467   96   89   59  424  651  282    0  410  327  230  807  638  418  263
 LVA   378  803  379  293  173  455  697  186  306  171  239  216  143  236  361   84  141   58  281  651  101  178    0  207  207  483  277  212  298
 SVK   334  549  241  270  126  420  404  129  238  168  168  196  108  180  480   39   58   24  235  367  101  117  105    0  106  353  226  193  159
 LTU   171  514  213  122   79  225  283   59  181   92  121   92   74   98  199   32   47   25  150  325   40   74  134   48    0  245  159  135  166
 PRT  1329 1365 1037 1045  488 1283 1706  516 1024  546  791  784  482  954  824  142  166   81  820 1299  404  491  373  237  153    0  553  403  365
 KOR   815  513  435  400  149  438 1166  222  433  271  399  269  191  416  415   73   72   41  422  582  208  389  168  136   71  472    0  326  173
 URY   540  393  335  313   84  379  932  181  424  339  384  212  244  316  343   39   75   44  343  407  241  258  125  123   79  385  264    0  155
 HRV   218  754  395  286  152  475  350  148  280  156  215  250  142  246  337  103  110   54  218  518  109  122  233   79  113  301   82  102    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  152  530  219  301  198   55  169   70  103    9   46
 DFS   149    0  247  199  184  211  180  167  108  190   37   62
 USA   560  232    0  434  548  287  124  325   99  177   39   78
 NZL   229  178  513    0  510  273  107  226   85  114  106   60
 AUS   308  157  593  567    0  259   87  259   84  108   53   62
 GBR   197  202  310  273  255    0  114  183  102  131   68   77
 NLD    49  184  128  103   77  105    0   84   56  129   27   44
 ZAF   165  149  339  233  243  184   80    0   89   97   34   59
 ITA    67  108  106   85   79  104   56   82    0   60   19   44
 DEU    99  189  176  109   99  127  126   94   61    0   21   54
 IRL     6   33   40  118   50   71   25   34   18   21    0   18
 CHE    40   62   79   51   52   74   37   52   43   50   13    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  152  530  219  301  198   55  169   70  103    9   46
  DFS   149    0  247  199  184  211  180  167  108  190   37   62
  USA   560  232    0  434  548  286  124  324   99  177   39   78
  NZL   229  178  513    0  510  273  107  226   85  114  106   61
  AUS   308  157  593  567    0  259   87  259   84  108   53   62
  GBR   197  202  309  273  255    0  114  183  102  131   68   77
  NLD    49  184  128  103   77  105    0   84   56  129   27   44
  ZAF   165  149  338  233  243  184   80    0   89   97   34   59
  ITA    67  108  106   85   79  104   56   82    0   60   19   44
  DEU    99  189  176  109   99  127  126   94   61    0   21   54
  IRL     6   33   40  118   50   71   25   34   18   21    0   18
  CHE    40   62   79   51   52   74   37   52   43   50   13    0
      ------------------------------------------------------------------
JER
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  DFS  USA  NZL  AUS  GBR  NLD  ZAF  ITA  DEU  IRL  CHE
      ------------------------------------------------------------------
  CAN     0  152  530  219  301  198   55  169   70  103    9   46
  DFS   149    0  247  199  184  211  180  167  108  190   37   62
  USA   560  232    0  434  548  288  124  324   99  177   39   78
  NZL   229  178  513    0  510  274  107  226   85  114  106   60
  AUS   308  157  593  567    0  260   87  259   84  108   53   62
  GBR   198  203  312  275  256    0  114  183  102  131   68   77
  NLD    49  184  128  103   77  105    0   84   56  129   27   44
  ZAF   165  149  338  233  243  184   80    0   89   97   34   59
  ITA    67  108  106   85   79  104   56   82    0   60   19   44
  DEU    99  189  176  109   99  127  126   94   61    0   21   54
  IRL     6   33   40  118   50   71   25   34   18   21    0   18
  CHE    40   62   79   51   52   74   37   52   43   50   13    0
      ------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  NOR  USA  NZL  AUS  GBR  DFS  DEU  ZAF  EST  LVA  LTU  IRL  NLD  CAM
      ------------------------------------------------------------------------------
  CAN     0    8  236   99  110  102  203   14   75    3   10   22    3    7    0
  NOR     7    0   89   56   81   83  148   17    0   34   22   25   49   55    0
  USA   220   90    0  144  156  141  233   28   64   28   27   41   25   51   32
  NZL   100   56  144    0  175  101  211   23   39   23   20   25   11   30   13
  AUS   111   70  158  175    0  107  223   50   38   51   41   46   15   49   14
  GBR   100   87  133   97  105    0  136   16   43   15   17   29   19   49    0
  DFS   210  123  229  207  197  130    0   71   53  149  134  108   15   63    0
  DEU    13   16   26   23   49   16   62    0    1   35   37   28    5   21    0
  ZAF    77    0   58   34   39   37   50    1    0    0    2    5    2    2    0
  EST     2   34   27   21   45   13  136   34    0    0   58   22    0   27    0
  LVA    10   20   24   17   37   16   93   31    2   50    0   48    3   18    0
  LTU    21   22   36   24   43   27   93   27    5   22   43    0    6   16    0
  IRL     3   48   25   11   14   18   12    5    2    0    3    6    0   10    0
  NLD     7   54   50   29   47   48   60   20    2   26   17   15   10    0    0
  CAM     0    0   32   13   14    0    0    0    0    0    0    0    0    0    0
      ------------------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  NOR  USA  NZL  AUS  GBR  DFS  DEU  ZAF  EST  LVA  LTU  IRL  NLD  CAM
      ------------------------------------------------------------------------------
  CAN     0    8  236   99  110  102  203   14   75    3   10   22    3    7    0
  NOR     7    0   88   56   81   83  148   17    0   34   22   25   49   55    0
  USA   220   89    0  144  156  140  231   28   64   28   27   41   25   51   32
  NZL   100   56  144    0  175  101  211   23   39   23   20   25   11   30   13
  AUS   111   70  158  175    0  107  223   50   38   51   41   46   15   49   14
  GBR   100   87  132   97  105    0  136   16   43   15   17   29   19   49    0
  DFS   210  123  227  207  197  130    0   71   53  149  134  108   15   63    0
```

```
    DEU   13   16   26   23   49   16   62    0    1   35   37   28    5   21    0
    ZAF   77    0   58   34   39   37   50    1    0    0    2    5    2    2    0
    EST    2   34   27   21   45   13  136   34    0    0   58   22    0   27    0
    LVA   10   20   24   17   37   16   93   31    2   50    0   48    3   18    0
    LTU   21   22   36   24   43   27   93   27    5   22   43    0    6   16    0
    IRL    3   48   25   11   14   18   12    5    2    0    3    6    0   10    0
    NLD    7   54   50   29   47   48   60   20    2   26   17   15   10    0    0
    CAM    0    0   32   13   14    0    0    0    0    0    0    0    0    0    0
    --------------------------------------------------------------------------------
RDC
--------
    common bulls below diagonal
    common three quarter sib group above diagonal
          CAN  NOR  USA  NZL  AUS  GBR  DFS  DEU  ZAF  EST  LVA  LTU  IRL  NLD  CAM
    --------------------------------------------------------------------------------
    CAN    0    8  236   99  110  102  203   14   75    3   10   22    3    7    0
    NOR    7    0   88   56   81   83  148   17    0   34   22   25   49   55    0
    USA  220   89    0  144  156  141  231   28   64   28   27   41   25   51   32
    NZL  100   56  144    0  175  101  211   23   39   23   20   25   11   30   13
    AUS  111   70  158  175    0  107  223   50   38   51   41   46   15   49   14
    GBR  100   87  133   97  105    0  136   16   43   15   17   29   19   49    0
    DFS  210  123  227  207  197  130    0   71   53  149  134  108   15   63    0
    DEU   13   16   26   23   49   16   62    0    1   35   37   28    5   21    0
    ZAF   77    0   58   34   39   37   50    1    0    0    2    5    2    2    0
    EST    2   34   27   21   45   13  136   34    0    0   58   22    0   27    0
    LVA   10   20   24   17   37   16   93   31    2   50    0   48    3   18    0
    LTU   21   22   36   24   43   27   93   27    5   22   43    0    6   16    0
    IRL    3   48   25   11   14   18   12    5    2    0    3    6    0   10    0
    NLD    7   54   50   29   47   48   60   20    2   26   17   15   10    0    0
    CAM    0    0   32   13   14    0    0    0    0    0    0    0    0    0    0
    --------------------------------------------------------------------------------
SIM
--------
    common bulls below diagonal
    common three quarter sib group above diagonal
          CHE  DEA  FRM  ITA  SVN  FRA  NLD  IRL  GBR  HRV  USA
    --------------------------------------------------------------------------------
    CHE    0  394  251  106    2   15   94   57   56    2   34
    DEA  362    0  292 1134  288  269  416   68   55  741   41
    FRM  303  335    0  195   11    2  135   72   73    2   96
    ITA  108 1042  220    0  167  156  271   66   48  350   39
    SVN    2  270   10  155    0   59   89    6    0  135    2
    FRA   12  227    1  141   55    0   86    6    0  110    3
    NLD   96  435  158  266   82   82    0   59   53  172   32
    IRL   54   61   77   62    6    6   53    0   40   10   18
    GBR   64   58   94   52    0    0   54   34    0    0   20
    HRV    2  775    1  332  125   99  166    9    0    0    5
    USA   33   43  111   46    2    3   33   17   28    5    0
    --------------------------------------------------------------------------------
SIM
--------
    common bulls below diagonal
    common three quarter sib group above diagonal
          CHE  DEA  FRM  ITA  SVN  FRA  NLD  IRL  GBR  HRV  USA
    --------------------------------------------------------------------------------
    CHE    0  393  251  106    2   15   94   57   56    2   34
    DEA  362    0  292 1136  288  269  416   68   55  739   41
    FRM  303  335    0  195   11    2  135   72   73    2   96
    ITA  108 1044  220    0  167  156  272   66   48  349   39
    SVN    2  270   10  155    0   59   89    6    0  136    2
    FRA   12  227    1  141   55    0   86    6    0  110    3
    NLD   96  435  158  267   82   82    0   59   53  172   32
    IRL   54   61   77   62    6    6   53    0   40   10   18
    GBR   64   58   94   52    0    0   54   34    0    0   20
    HRV    2  773    1  331  126   99  166    9    0    0    5
    USA   33   43  111   46    2    3   33   17   28    5    0
    --------------------------------------------------------------------------------
SIM
--------
```

```
common bulls below diagonal
common three quarter sib group above diagonal
       CHE  DEA  FRM  ITA  SVN  FRA  NLD  IRL  GBR  HRV  USA
--------------------------------------------------------------------------------

  CHE    0  393  251  106    2   15   94   57   56    2   34
  DEA  362    0  292 1134  288  269  416   68   55  740   41
  FRM  303  335    0  195   11    2  135   72   73    2   96
  ITA  108 1042  220    0  167  156  271   66   48  349   39
  SVN    2  270   10  155    0   59   89    6    0  135    2
  FRA   12  227    1  141   55    0   86    6    0  110    3
  NLD   96  435  158  266   82   82    0   59   53  172   32
  IRL   54   61   77   62    6    6   53    0   40   10   18
  GBR   64   58   94   52    0    0   54   34    0    0   20
  HRV    2  774    1  331  125   99  166    9    0    0    5
  USA   33   43  111   46    2    3   33   17   28    5    0
--------------------------------------------------------------------------------
```