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Introduction
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The latest routine international evaluation for udder traits took place
as scheduled at the Interbull Centre. Data from thirty-three (33) countries were
included in this evaluation.

International genetic evaluations for udder health traits of bulls from
Australia, Austria-Germany, Belgium, Canada, Croatia, Czech Republic, Denmark-Finland-Sweden, Estonia,
France, Hungary, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, South Africa,
Slovak Republic, Spain, Switzerland, the United Kingdom, the United States of America, Poland,
Lithuania, Latvia, Croatia, Slovenia, Portugal and Uruguay were computed.
Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed
data were included in this evaluation.


Countries sending real MAS data (other countries participate to the MAS evaluation using SCS data as predictor):
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HOL : DFS, NLD, FRA, CAN, ITA, CHE, USA, DEU, GBR, AUS
RDC : DFS, NLD, CAN, GBR, AUS
BSW : NLD, FRA, CHE, GBR, USA
JER : DFS, NLD, CAN, GBR, AUS, USA
SIM : NLD, CHE, GBR
GUE : No evaluation for MAS yet
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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.
           Drop in information and reliabilities due to data editing.
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) 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 bulls 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.
USA  (ALL) Drop in information due to pedigree corrections and herd-year edits.


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
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50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at
least 10 herds. Table 1 presents the amount of data included
in this Interbull evaluation for all breeds.

National proofs were first de-regressed within country and then analysed
jointly with a linear model including the effects of evaluation country,
genetic group of bull and bull merit. Heritability estimates used in both
the de-regression and international evaluation were as in each country's
national evaluation.

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

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

SCIENTIFIC LITERATURE

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

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

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

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

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

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

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

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

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

NEXT ROUTINE INTERNATIONAL EVALUATION

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

NEXT TEST INTERNATIONAL EVALUATION

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

PUBLICATION OF INTERBULL ROUTINE RUN

Results were distributed by the Interbull Centre to designated
representatives in each country. The international evaluation file comprised

international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to conversions.

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

PUBLICATION OF INTERBULL TEST RUN

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

^LTable 1. National evaluation data considered in the Interbull evaluation for udder health (August Routine Evaluation 2024).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		153	8958	1781	849	
BEL			2370			
CAN	287	111	14183	916	894	
CHE	3273		3461	105		3718
CZE			4912			
DEA	6157					25348
DEU			24753		312	
DFS			14777	2384	8376	
ESP			4766			
EST			1447		495	
FRA	505		18753			498
FRM						4897
GBR	163	315	7771	803	623	110
HUN			3164			190
IRL			3258			
ISR			1783			
ITA	2235		9321	59		1899
JPN			7206			
KOR			1716			
LTU			898		362	
LVA			1408		679	
NLD	250		17459	287	111	545
NOR					4394	
NZL	80	57	9164	5257	1477	
POL			13133			
PRT			2966			
SVK			1201			
SVN	353		726			719
URY			2189			
USA	1214	750	42925	5415	786	118
ZAF			1206	621	125	
HRV			986			1069
CAM					49	
No.Records	14517	1386	226860	17628	19532	39111
Pub. Proofs	11533	1067	161614	14227	18322	35036

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW   scs

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           CAN     FRA     NLD     USA     CHE     DEA     NZL     ITA     GBR     SVN
CAN       6.54
FRA       0.91    1.02
NLD       0.90    0.93    3.69
USA       0.88    0.90    0.85    0.21
CHE       0.89    0.94    0.93    0.80   10.56
DEA       0.87    0.97    0.92    0.85    0.96   11.92
NZL       0.71    0.76    0.77    0.67    0.72    0.64    0.37
ITA       0.88    0.90    0.89    0.83    0.96    0.91    0.67   15.36
GBR       0.93    0.96    0.94    0.90    0.93    0.94    0.80    0.89   11.22
SVN       0.80    0.80    0.80    0.79    0.79    0.78    0.68    0.81    0.82   11.00


----------------------------------------------------------------------
BSW    mas
----------------------------------------------------------------------

           CAN     FRA     NLD     USA     CHE     DEA     NZL     ITA     GBR     SVN
CAN       6.45
FRA       0.81    0.96
NLD       0.80    0.73    4.04
USA       0.81    0.84    0.75    2.93
CHE       0.87    0.87    0.86    0.80   11.46
DEA       0.89    0.69    0.88    0.71    0.90   11.93
NZL       0.68    0.64    0.65    0.64    0.69    0.74    0.37
ITA       0.85    0.72    0.81    0.67    0.88    0.92    0.70   15.36
GBR       0.83    0.83    0.83    0.80    0.82    0.73    0.64    0.74    2.24
SVN       0.79    0.72    0.73    0.72    0.71    0.82    0.76    0.83    0.76   10.98


----------------------------------------------------------------------
GUE    scs
----------------------------------------------------------------------

           CAN     GBR     USA     AUS     NZL
CAN       6.00
GBR       0.92   13.55
USA       0.93    0.90    0.24
AUS       0.81    0.87    0.77    0.23
NZL       0.75    0.81    0.69    0.89    0.62


----------------------------------------------------------------------
HOL    scs
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           CAN     CHE     DEU     DFS     EST     FRA     GBR     NLD     USA     ISR     ITA     AUS     HUN     BEL     JPN     ESP     ZAF     NZL     IRL     CZE     SVK     POL     LTU     LVA     PRT     KOR     SVN     HRV     URY
CAN       5.71
CHE       0.90   10.78
DEU       0.94    0.95   12.90
DFS       0.93    0.92    0.97   11.78
EST       0.89    0.88    0.94    0.92   18.74
FRA       0.95    0.94    0.96    0.96    0.90    1.14
GBR       0.94    0.93    0.96    0.94    0.90    0.96   12.88
NLD       0.92    0.95    0.97    0.95    0.91    0.95    0.96    4.23
USA       0.94    0.84    0.89    0.87    0.90    0.90    0.91    0.87    0.20
ISR       0.85    0.82    0.84    0.81    0.85    0.82    0.80    0.80    0.86    0.24
ITA       0.90    0.89    0.94    0.93    0.93    0.94    0.91    0.90    0.88    0.81    5.84
AUS       0.79    0.85    0.81    0.81    0.74    0.83    0.87    0.84    0.74    0.65    0.77    0.25
HUN       0.88    0.88    0.93    0.90    0.91    0.91    0.89    0.88    0.91    0.86    0.93    0.73    1.36
BEL       0.92    0.92    0.97    0.96    0.94    0.96    0.93    0.94    0.89    0.81    0.94    0.79    0.92    0.52
JPN       0.86    0.79    0.83    0.85    0.81    0.89    0.84    0.81    0.85    0.75    0.80    0.73    0.78    0.83    0.45
ESP       0.93    0.90    0.96    0.94    0.92    0.96    0.93    0.91    0.91    0.85    0.95    0.77    0.93    0.96    0.82   11.87
ZAF       0.90    0.88    0.91    0.89    0.87    0.93    0.91    0.88    0.89    0.80    0.92    0.82    0.90    0.91    0.84    0.94   26.30
NZL       0.76    0.81    0.78    0.79    0.72    0.80    0.83    0.81    0.69    0.63    0.73    0.90    0.67    0.75    0.77    0.74    0.81    0.41
IRL       0.80    0.90    0.86    0.86    0.81    0.85    0.87    0.88    0.77    0.74    0.80    0.81    0.82    0.86    0.75    0.84    0.82    0.81    0.12
CZE       0.87    0.82    0.91    0.89    0.86    0.89    0.86    0.85    0.86    0.77    0.90    0.70    0.89    0.90    0.83    0.92    0.89    0.70    0.75   15.38
SVK       0.85    0.86    0.91    0.89    0.87    0.89    0.84    0.84    0.85    0.81    0.90    0.70    0.94    0.92    0.77    0.91    0.89    0.65    0.81    0.89    0.40
POL       0.90    0.90    0.96    0.94    0.93    0.93    0.91    0.91    0.88    0.84    0.93    0.76    0.94    0.96    0.80    0.94    0.88    0.72    0.83    0.90    0.89   10.92
LTU       0.82    0.86    0.90    0.88    0.90    0.87    0.84    0.86    0.79    0.81    0.85    0.70    0.87    0.92    0.77    0.88    0.84    0.68    0.79    0.86    0.87    0.90    0.36
LVA       0.86    0.90    0.93    0.93    0.93    0.90    0.90    0.90    0.84    0.79    0.91    0.80    0.91    0.94    0.79    0.90    0.88    0.78    0.84    0.87    0.86    0.94    0.90  480.07
PRT       0.77    0.78    0.80    0.78    0.77    0.79    0.79    0.78    0.77    0.75    0.78    0.67    0.80    0.80    0.77    0.80    0.80    0.67    0.75    0.79    0.77    0.80    0.78    0.78    0.45
KOR       0.88    0.82    0.88    0.90    0.86    0.87    0.89    0.85    0.86    0.79    0.87    0.78    0.85    0.88    0.81    0.88    0.83    0.74    0.71    0.80    0.79    0.90    0.81    0.87    0.77    0.33
SVN       0.79    0.83    0.87    0.86    0.83    0.85    0.84    0.83    0.77    0.74    0.84    0.75    0.82    0.88    0.77    0.83    0.79    0.70    0.87    0.77    0.81    0.86    0.81    0.88    0.77    0.78   10.64
HRV       0.78    0.78    0.80    0.78    0.84    0.77    0.78    0.78    0.78    0.77    0.80    0.67    0.84    0.82    0.77    0.80    0.78    0.60    0.74    0.78    0.78    0.84    0.81    0.84    0.77    0.78    0.79   11.63
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	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
URY	0.78	0.80	0.83	0.80	0.79	0.80	0.78	0.80	0.78	0.76	0.78	0.77	0.79	0.81	0.77	0.79	0.82	0.76	0.76	0.78	0.79	0.81	0.77	0.78	0.77	0.78	0.78	0.78	0.20

HOL   mas

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	7.59																												
CHE	0.93	11.04																											
DEU	0.91	0.88	9.33																										
DFS	0.94	0.89	0.90	12.27																									
EST	0.80	0.87	0.84	0.84	18.75																								
FRA	0.96	0.95	0.91	0.93	0.82	1.15																							
GBR	0.88	0.90	0.82	0.84	0.76	0.88	2.36																						
NLD	0.84	0.91	0.80	0.85	0.83	0.87	0.83	5.06																					
USA	0.87	0.83	0.86	0.83	0.78	0.90	0.81	0.80	2.50																				
ISR	0.74	0.77	0.75	0.78	0.87	0.75	0.69	0.76	0.73	0.24																			
ITA	0.79	0.88	0.70	0.76	0.83	0.79	0.75	0.89	0.66	0.76	6.08																		
AUS	0.64	0.68	0.64	0.64	0.71	0.63	0.64	0.64	0.64	0.67	0.64	0.12																	
HUN	0.84	0.88	0.77	0.82	0.90	0.82	0.82	0.87	0.74	0.86	0.89	0.68	1.36																
BEL	0.87	0.94	0.84	0.87	0.93	0.88	0.83	0.89	0.76	0.82	0.88	0.74	0.93	0.52															
JPN	0.74	0.83	0.68	0.72	0.77	0.73	0.69	0.79	0.68	0.76	0.83	0.68	0.80	0.84	0.45														
ESP	0.85	0.91	0.77	0.85	0.89	0.86	0.83	0.87	0.75	0.85	0.87	0.71	0.93	0.96	0.84	11.86													
ZAF	0.83	0.89	0.78	0.77	0.83	0.84	0.79	0.84	0.74	0.81	0.85	0.74	0.90	0.93	0.86	0.95	26.03												
NZL	0.62	0.70	0.63	0.62	0.72	0.62	0.62	0.62	0.62	0.72	0.65	0.75	0.71	0.77	0.77	0.77	0.82	0.41											
IRL	0.77	0.86	0.76	0.78	0.86	0.78	0.77	0.78	0.66	0.79	0.81	0.76	0.86	0.94	0.82	0.91	0.91	0.90	0.11										
CZE	0.83	0.87	0.74	0.81	0.85	0.82	0.78	0.84	0.72	0.79	0.88	0.68	0.90	0.92	0.85	0.92	0.90	0.72	0.84	15.38									
SVK	0.83	0.87	0.81	0.80	0.89	0.84	0.79	0.86	0.77	0.82	0.87	0.68	0.93	0.92	0.78	0.91	0.89	0.71	0.85	0.90	0.40								
POL	0.86	0.90	0.79	0.86	0.93	0.84	0.83	0.86	0.74	0.84	0.85	0.69	0.95	0.97	0.82	0.95	0.89	0.74	0.91	0.91	0.89	10.88							
LTU	0.79	0.82	0.78	0.82	0.88	0.82	0.76	0.79	0.71	0.79	0.78	0.68	0.87	0.92	0.76	0.86	0.83	0.71	0.83	0.86	0.88	0.89	0.36						
LVA	0.78	0.83	0.73	0.81	0.92	0.79	0.79	0.83	0.72	0.80	0.83	0.73	0.91	0.94	0.77	0.90	0.86	0.79	0.91	0.87	0.87	0.95	0.90	479.43					
PRT	0.73	0.81	0.70	0.74	0.78	0.74	0.70	0.75	0.68	0.77	0.73	0.68	0.82	0.84	0.77	0.81	0.82	0.71	0.81	0.82	0.77	0.81	0.81	0.81	0.45				
KOR	0.79	0.82	0.69	0.80	0.84	0.78	0.76	0.74	0.69	0.77	0.73	0.69	0.85	0.88	0.83	0.89	0.83	0.74	0.83	0.82	0.78	0.91	0.83	0.87	0.77	0.33			
SVN	0.78	0.81	0.73	0.80	0.81	0.79	0.77	0.75	0.68	0.74	0.76	0.69	0.80	0.89	0.77	0.83	0.79	0.73	0.89	0.79	0.79	0.87	0.83	0.88	0.79	0.77	10.66		
HRV	0.69	0.77	0.69	0.69	0.83	0.70	0.75	0.76	0.70	0.78	0.75	0.68	0.85	0.84	0.77	0.81	0.80	0.71	0.79	0.78	0.79	0.84	0.86	0.85	0.77	0.77	0.79	11.40	
URY	0.69	0.74	0.73	0.69	0.80	0.68	0.69	0.71	0.68	0.76	0.71	0.68	0.80	0.83	0.77	0.80	0.84	0.78	0.85	0.77	0.82	0.83	0.78	0.81	0.77	0.77	0.77	0.77	0.20

JER   scs

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	5.99									
DFS	0.91	12.40								
GBR	0.92	0.92	11.39							
NLD	0.92	0.95	0.95	4.10						
USA	0.90	0.83	0.88	0.84	0.17					
AUS	0.77	0.83	0.83	0.85	0.72	0.23				
ZAF	0.86	0.87	0.86	0.89	0.84	0.80	20.91			
NZL	0.67	0.72	0.76	0.78	0.65	0.89	0.73	0.39		
CHE	0.87	0.85	0.85	0.90	0.81	0.72	0.81	0.67	13.38	
ITA	0.87	0.91	0.87	0.88	0.86	0.73	0.87	0.65	0.85	6.53

JER   mas

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	7.52									
DFS	0.92	11.79								
GBR	0.78	0.84	1.94							
NLD	0.82	0.83	0.81	4.58						
USA	0.79	0.76	0.73	0.71	2.52					
AUS	0.64	0.65	0.64	0.72	0.64	0.11				
ZAF	0.72	0.71	0.71	0.82	0.70	0.72	20.88			
NZL	0.63	0.63	0.63	0.67	0.63	0.71	0.76	0.38		
CHE	0.82	0.81	0.75	0.79	0.75	0.70	0.80	0.73	13.34	
ITA	0.76	0.73	0.74	0.85	0.67	0.69	0.83	0.70	0.83	6.53

RDC   scs

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	6.09													
DFS	0.93	12.94												
GBR	0.94	0.91	11.67											
NOR	0.85	0.91	0.80	13.61										
USA	0.92	0.85	0.88	0.79	0.23									
DEU	0.94	0.96	0.95	0.90	0.88	14.29								
AUS	0.80	0.84	0.86	0.82	0.71	0.83	0.26							
EST	0.89	0.89	0.89	0.84	0.85	0.93	0.80	18.92						
ZAF	0.82	0.86	0.85	0.87	0.86	0.91	0.75	0.87	25.25					
NZL	0.76	0.76	0.80	0.74	0.70	0.78	0.89	0.74	0.77	0.43				
LTU	0.82	0.88	0.84	0.90	0.79	0.89	0.80	0.87	0.86	0.75	0.37			
LVA	0.86	0.88	0.90	0.85	0.83	0.92	0.82	0.94	0.87	0.77	0.89	433.82		
NLD	0.92	0.95	0.94	0.86	0.86	0.96	0.84	0.87	0.88	0.79	0.85	0.87	4.22	
CAM	0.88	0.88	0.88	0.87	0.83	0.88	0.85	0.87	0.88	0.82	0.87	0.87	0.89	6.28

RDC   mas

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	8.40												
DFS	0.88	13.39											
GBR	0.87	0.82	2.10										
NOR	0.81	0.70	0.73	13.61									
USA	0.79	0.73	0.78	0.79	0.23								
AUS	0.65	0.64	0.65	0.77	0.67	0.12							
EST	0.81	0.72	0.78	0.83	0.80	0.72	18.92						
ZAF	0.84	0.81	0.83	0.87	0.80	0.73	0.84	25.34					
NZL	0.64	0.63	0.65	0.75	0.70	0.78	0.80	0.77	0.43				
LTU	0.75	0.74	0.76	0.85	0.77	0.73	0.90	0.85	0.78	0.36			
LVA	0.78	0.72	0.79	0.86	0.76	0.72	0.94	0.86	0.81	0.91	435.86		
NLD	0.83	0.80	0.85	0.84	0.84	0.70	0.83	0.84	0.69	0.81	0.82	4.94	
CAM	0.83	0.83	0.83	0.87	0.81	0.88	0.88	0.87	0.87	0.87	0.87	0.85	6.28

SIM   scs

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.06										
FRA	0.89	1.09									
ITA	0.87	0.88	12.27								
NLD	0.91	0.94	0.84	4.01							
CHE	0.93	0.93	0.86	0.93	10.38						
DEA	0.92	0.96	0.84	0.92	0.89	12.25					
HUN	0.88	0.91	0.91	0.89	0.88	0.89	16.33				
SVN	0.82	0.81	0.80	0.81	0.83	0.79	0.82	9.26			
GBR	0.91	0.96	0.87	0.95	0.90	0.93	0.89	0.84	10.78		
HRV	0.86	0.78	0.78	0.78	0.79	0.78	0.82	0.78	0.78	9.71	
USA	0.83	0.90	0.87	0.87	0.84	0.80	0.91	0.78	0.90	0.79	0.20

SIM   mas

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.08										
FRA	0.87	1.00									
ITA	0.90	0.82	12.24								
NLD	0.88	0.87	0.79	4.26							
CHE	0.81	0.88	0.86	0.82	9.96						
DEA	0.92	0.91	0.84	0.89	0.72	12.25					
HUN	0.86	0.82	0.88	0.86	0.83	0.86	16.33				
SVN	0.81	0.80	0.79	0.77	0.79	0.80	0.81	9.26			
GBR	0.71	0.88	0.74	0.81	0.88	0.75	0.81	0.75	2.56		
HRV	0.83	0.77	0.78	0.70	0.76	0.77	0.82	0.78	0.74	9.71	
USA	0.82	0.89	0.70	0.84	0.81	0.80	0.74	0.69	0.80	0.72	0.20

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^LAPPENDIX II. Number of common bulls

```
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  FRA  NLD  USA  CHE  DEA  NZL  ITA  GBR  SVN
     -------------------------------------------------------------------
  CAN    0   98   60  196  158  169   33  150   69   37
  FRA   90    0   98  139  199  267   31  236   66   54
  NLD   55   84    0   96  121  180   36  155   43   50
  USA  194  102   87    0  338  355   38  248   97   44
  CHE  135  156  110  316    0  671   38  529   79   85
  DEA  151  216  169  324  564    0   54  762   82  114
  NZL   33   24   29   34   30   49    0   47   23   13
  ITA  133  198  129  178  473  660   39    0   83  106
  GBR   68   56   36   94   61   56   20   62    0   20
  SVN   33   52   49   34   80  103   12  100   15    0
     -------------------------------------------------------------------

BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  FRA  NLD  USA  CHE  DEA  NZL  ITA  GBR  SVN
     -------------------------------------------------------------------
  CAN    0   87   56   60   83  167   33  148   32   37
  FRA   80    0   76   27   82  231   25  206   32   53
  NLD   49   65    0   21   61  159   36  140   23   49
  USA   61   26   19    0   32   52   15   45   19   12
  CHE   76   66   57   28    0  275   20  235   20   69
  DEA  151  180  147   46  241    0   54  761   41  113
  NZL   33   21   29   14   17   49    0   47   12   13
  ITA  132  170  114   36  208  660   39    0   44  106
  GBR   31   28   19   18   17   29    9   34    0   14
  SVN   33   50   48   11   65  103   12  100   12    0
     -------------------------------------------------------------------

GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  USA  AUS  NZL
     -------------------------------------------------------------------
  CAN    0   36   80   56   14
  GBR   31    0   94   47   13
  USA   72   96    0   76   29
  AUS   54   40   74    0   26
  NZL   11   11   29   26    0
     -------------------------------------------------------------------

GUE
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HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEU  DFS  EST  FRA  GBR  NLD  USA  ISR  ITA  AUS  HUN  BEL  JPN  ESP  ZAF  NZL  IRL  CZE  SVK  POL  LTU  LVA  PRT  KOR  SVN  HRV  URY
     -----------------------------------------------------------------------------------------------------------------------------------------------------
  CAN    0  984 2765 1854  351 1741 1905 1945 4196  178 2033 1685 1122  950 1562 1520  506  874  601 1348  474 1900  300  580 1262  810  241  355  927
  CHE  909    0 1256  826  204  803  782 1032 1111   72  796  702  457  675  531  627  257  460  415  573  250  801  146  277  567  304  149  224  364
  DEU 2246 1191    0 3137  548 2791 2290 3914 3974  201 2819 1863 1323 1402 1591 1764  550 1106  880 2098  730 3223  553  836 1450  718  392  730  933
  DFS 1685  779 2466    0  424 1967 1788 2611 2597  182 1802 1499 1002 1028 1149 1260  506  964  767 1506  451 2137  361  554 1135  575  292  494  771
  EST  232  122  412  293    0  323  332  484  462   67  367  270  234  240  250  259  113  170  148  347  139  467  103  200  244  146  105  153  182
  FRA 1313  749 1758 1259  177    0 1727 2359 2775  148 1740 1456 1041 1132 1349 1432  504  907  728 1442  480 2158  290  492 1147  617  233  395  698
  GBR 2160  744 1805 1426  204 1208    0 2031 2545  177 1646 1582  932  978 1170 1206  508 1018  972 1212  403 1696  322  487 1082  563  226  387  807
  NLD 1915 1031 3780 2385  356 1705 1826    0 3008  197 1978 1676 1065 1476 1254 1364  515 1226  918 1780  592 2459  367  592 1275  578  308  530  827
  USA 4814 1044 3097 2175  341 1661 2371 2751    0  277 2916 2242 1429 1117 2212 1797  634 1250  838 1948  594 2865  403  781 1590  985  276  453 1362
  ISR  126   42  154  136   38   93  129  153  269    0  174  140  124  100  139  126   66  135  113  161   58  200   56   88  125   76   52   78  111
  ITA 1836  734 2153 1561  232 1175 1375 1796 2471  123    0 1243 1044  886 1239 1419  403  698  554 1400  410 2187  339  593 1134  659  294  443  755
  AUS 1723  624 1446 1129  142 1048 1396 1485 2319   89 1003    0  802  849 1024 1012  482 1334  739  971  335 1303  265  439  944  519  184  338  794
  HUN 1067  383 1079  836  141  780  818  923 1418   86  925  613    0  602  797  861  396  549  431 1017  335 1102  250  395  833  511  165  300  572
  BEL  953  693 1455  976  153 1172  965 1703 1010   63  900  751  524    0  626  781  339  578  515  760  321  989  188  320  768  353  181  310  408
  JPN  901  372  790  688   98  567  647  740 1134   68  689  606  469  425    0 1023  429  634  440  974  340 1204  231  415  833  636  180  270  673
```

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 ESP 1068  525 1202 1013  129 1210  969 1251 1256   77 1075  747  704  773  533    0  449  616  504 1005  351 1390  244  428  985  561  217  338  607
 ZAF  465  216  428  389   56  399  444  439  618   42  324  420  320  288  299  400    0  368  295  409  180  418  106  165  443  267   72  158  328
 NZL  863  388  861  701   88  598  883 1119 1211  108  553 1341  427  470  356  476  298    0  764  704  270  804  192  286  656  343  137  255  628
 IRL  531  397  720  608   76  574  932  819  725   86  467  611  351  479  279  453  246  634    0  533  210  662  146  215  483  230  108  194  388
 CZE 1040  435 1686 1081  222  999  889 1634 1618  127 1083  666  943  616  496  762  287  524  393    0  539 1677  297  475  931  547  239  429  659
 SVK  334  129  549  242   58  275  234  424  404   24  258  168  235  195  132  182   97  164   99  462    0  508  106  170  351  219   82  159  254
 POL 1757  704 3067 1864  349 1630 1518 2375 2936  156 1946 1037 1015  927  702 1069  317  629  523 1450  367    0  418  710 1264  682  327  568  833
 LTU  171   59  515  217   47  122  172  227  283   25  186  121  152   91   77  101   40   91   69  193   48  325    0  208  245  159   73  166  188
 LVA  368  144  678  352  112  262  280  403  684   56  385  224  283  186  188  237   96  160  118  316   79  576  135    0  454  277  124  279  310
 PRT 1325  516 1364 1057  165 1052 1008 1291 1704   81 1101  795  835  782  532  964  396  535  406  784  236 1300  153  353    0  545  178  366  645
 KOR  798  219  506  434   72  392  416  431 1125   40  553  384  412  265  406  407  198  255  153  395  132  579   71  168  467    0  116  173  442
 SVN  187  106  384  235   63  176  164  267  225   36  253  125  124  142   99  157   51   92   81  173   38  292   32   72  141   73    0  128  110
 HRV  218  148  754  398  110  288  276  486  350   54  339  214  219  249  129  259  108  153  131  327   79  521  113  217  301   82  102    0  216
 URY  893  285  694  551  103  469  667  681 1656   64  568  620  462  316  407  478  294  522  297  476  149  691  105  175  552  349   59  132    0
--------------------------------------------------------------------------------------
```

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

```
      CAN  CHE  DEU  DFS  EST  FRA  GBR  NLD  USA  ISR  ITA  AUS  HUN  BEL  JPN  ESP  ZAF  NZL  IRL  CZE  SVK  POL  LTU  LVA  PRT  KOR  SVN  HRV  URY
--------------------------------------------------------------------------------------
 CAN    0  306  816 1015  232 1011 1082  431 1486  119 1400  993  748  628  957 1009  251  495  346  859  266 1306  218  369  818  580  196  249  566
 CHE  272    0  289  288   84  288  273  184  274   28  302  260  135  241  200  230   65  166  135  180   72  307   64   90  187  126   81   73  119
 DEU  648  259    0 1097  276  949  860  635  790   99 1077  701  568  629  593  758  202  431  336  779  239 1476  260  429  614  321  288  431  366
 DFS 1044  266  974    0  386 1483 1502  870 1217  170 1379 1358  929  917 1076 1170  489  897  694 1385  369 1898  327  469 1043  528  267  452  652
 EST  154   47  202  267    0  278  307  212  287   66  312  263  226  228  244  254  110  165  135  341  122  449   98  184  233  142  103  151  169
 FRA  819  263  712  958  154    0 1327  604  983  125 1311 1160  917  962 1079 1221  415  723  591 1250  359 1871  244  404  975  521  214  337  536
 GBR 1105  256  709 1219  196  968    0  644 1293  176 1392 1431  890  910 1069 1140  467  926  855 1161  351 1605  289  418 1005  523  219  362  701
 NLD  415  174  577  887  151  506  629    0  446  101  592  543  406  606  411  520  371  743  183  997  167  251  516  219  159  304  309
 USA 1708  242  669 1245  226  797 1418  404    0  206 1605 1136  876  630 1122  992  351  629  439 1069  296 1718  245  500  965  696  210  252  802
 ISR   79   13   68  122   38   76  127   79  204    0  148  134  121   99  137  126   64  134   97  161   56  197   52   77  125   76   51   76  105
 ITA 1216  268  843 1212  202  902 1191  540 1659  100    0 1054  920  753 1086 1245  322  586  449 1208  334 1884  282  456  979  590  258  358  613
 AUS 1066  228  565 1000  143  866 1280  471 1248   87  884    0  786  818 1018 1101  465 1300  244  396  918  500  183  323  717
 HUN  723  105  446  776  141  672  797  343  933   84  834  608    0  582  788  850  384  544  413 1013  312 1079  235  373  810  493  163  288  515
 BEL  663  238  640  872  151  979  925  630  611   63  784  744  520    0  603  764  331  562  488  743  292  952  173  296  744  344  181  299  379
 JPN  678  149  376  629   98  499  631  307  892   68  637  604  469  425    0 1023  426  627  432  974  315 1188  216  390  808  611  179  258  600
 ESP  714  182  543  931  129 1004  945  480  822   77  935  743  703  773  533    0  443  615  480 1003  322 1373  227  400  966  549  214  327  555
 ZAF  236   52  155  373   56  326  429  184  393   42  268  414  319  288  299  400    0  364  284  403  169  409   99  162  431  254   72  149  307
 NZL  444  143  350  642   87  497  780  468  607  108  490 1302  426  467  356  476  296    0  714  703  257  784  182  266  641  333  137  246  583
 IRL  344  133  300  527   72  481  834  350  424   70  393  575  339  462  271  438  234  586    0  507  190  609  141  200  458  226  102  184  355
 CZE  669  127  603  957  222  814  870  711 1012  127  958  658  943  616  496  762  287  524  366    0  508 1656  278  442  910  530  239  414  597
 SVK  191   28  143  206   57  215  226  103  210   24  221  164  231  189  132  182   96  161   96  462    0  454   93  157  329  205   78  147  228
 POL 1254  262 1507 1631  344 1410 1476  997 1949  155 1728 1022 1005  912  702 1067  316  624  485 1450  347    0  391  624 1211  654  321  543  747
 LTU  137   23  210  206   46  111  169  106  179   25  158  122  150   90   77  101   40   89   66  193   46  315    0  189  226  141   70  155  169
 LVA  227   34  337  284  105  202  250  155  418   49  280  196  272  176  177  223   94  147  107  292   78  503  127    0  423  257  117  267  277
 PRT  854  163  545  970  164  897  975  519 1072   81  988  787  827  780  532  963  395  532  393  784  229 1269  151  332    0  527  177  346  592
 KOR  569   99  234  401   72  346  400  161  764   40  515  377  408  265  406  407  197  251  157  395  130  566   68  157  464    0  115  161  398
 SVN  152   56  280  210   63  164  162  127  169   35  225  125  124  142   99  157   51   92   75  173   38  289   32   68  141   73    0  126  107
 HRV  162   47  418  366  110  248  273  273  203   54  274  210  219  246  129  258  108  153  127  327   79  514  112  214  298   81  101    0  200
 URY  543   88  273  493  103  384  631  248  882   64  507  613  452  314  407  478  291  519  293  476  148  672  105  166  544  340   59  131    0
--------------------------------------------------------------------------------------
```

JER
----

common bulls below diagonal
common three quarter sib group above diagonal

```
      CAN  DFS  GBR  NLD  USA  AUS  ZAF  NZL  CHE  ITA
--------------------------------------------------------------------------------------
 CAN    0  152  191   57  527  296  163  215   46   28
 DFS  148    0  208  189  246  185  165  194   62   33
 GBR  194  203    0  115  277  252  177  267   76   37
 NLD   51  193  108    0  126   89   84  108   44   24
 USA  556  230  303  130    0  545  305  429   78   37
 AUS  305  157  256   79  594    0  246  484   63   36
 ZAF  159  148  180   80  321  236    0  216   58   34
 NZL  225  172  270  103  504  539  224    0   60   30
 CHE   40   61   74   37   79   53   51   51    0   24
 ITA   23   32   36   20   35   30   29   28   24    0
--------------------------------------------------------------------------------------
```

JER

```
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  USA  AUS  ZAF  NZL  CHE  ITA
 ------------------------------------------------------------------------------
 CAN    0   57   93   22  104  143   76  102   28   20
 DFS   53    0  136  155   77  147  143  161   60   30
 GBR   92  131    0   81  101  186  140  191   68   37
 NLD   16  152   77    0   47   82   80   99   40   24
 USA   97   68  102   45    0  186  130  145   43   22
 AUS  132  114  190   75  198    0  242  480   59   35
 ZAF   69  123  142   77  141  236    0  211   55   34
 NZL   94  135  194   95  147  533  221    0   56   30
 CHE   26   57   65   35   37   52   50   50    0   24
 ITA   15   28   34   20   21   29   29   28   24    0
 ------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NOR  USA  DEU  AUS  EST  ZAF  NZL  LTU  LVA  NLD  CAM
 ------------------------------------------------------------------------------
 CAN    0  201   98    8  228   14  108    3   70   97   22   10    8    0
 DFS  208    0  134  149  228   71  223  145   51  200  103  134   69    0
 GBR   98  128    0   82  136   16  106   15   40  100   26   16   50    0
 NOR    7  124   86    0   88   17   81   32    0   55   19   22   55    0
 USA  215  225  131   89    0   28  153   28   59  140   37   27   52   32
 DEU   13   62   16   16   26    0   50   35    1   23   28   37   21    0
 AUS  109  195  101   70  156   49    0   48   34  172   44   41   50   13
 EST    2  133   13   32   27   34   43    0    0   22   22   55   26    0
 ZAF   72   48   35    0   53    1   34    0    0   35    5    2    3    0
 NZL   95  196   95   55  141   23  172   20   30    0   22   20   31   13
 LTU   21   89   24   18   33   27   41   22    5   22    0   44   15    0
 LVA   10   93   16   20   24   31   37   47    2   17   40    0   19    0
 NLD    8   67   49   54   51   20   48   25    3   30   14   18    0    0
 CAM    0    0    0    0   32    0   13    0    0   13    0    0    0    0
 ------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NOR  USA  AUS  EST  ZAF  NZL  LTU  LVA  NLD  CAM
 ------------------------------------------------------------------------------
 CAN    0   90   33    3   86   35    0   35   40   18    7    3    0
 DFS   90    0   93  150  220  234  145   46  197  102  126   68    0
 GBR   32   90    0   69   95   67    9   27   67   20   14   38    0
 NOR    3  124   73    0   88   80   32    0   55   19   19   51    0
 USA   85  217   94   89    0  141   28   54  137   37   25   49   32
 AUS   35  210   66   69  145    0   46   31  163   41   38   46   12
 EST    0  133    9   32   27   42    0    0   22   22   49   25    0
 ZAF   36   46   26    0   52   33    0    0   33    5    2    2    0
 NZL   40  191   67   55  141  164   20   30    0   22   18   29   13
 LTU   17   88   18   18   33   39   22    5   22    0   44   14    0
 LVA    7   84   14   17   22   35   41    2   15   40    0   14    0
 NLD    3   66   38   50   49   44   24    2   28   13   13    0    0
 CAM    0    0    0    0   32   12    0    0   13    0    0    0    0
 ------------------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      FRM  FRA  ITA  NLD  CHE  DEA  HUN  SVN  GBR  HRV  USA
 ------------------------------------------------------------------------------
 FRM    0    2  193  137  251  277    2   11   67    2   96
 FRA    1    0  151   86   15  270    4   59    0  110    3
 ITA  218  136    0  278  105 1069   19  167   46  345   39
 NLD  162   82  273    0   94  420    9   91   49  177   32
 CHE  303   12  107   98    0  375    2    2   53    2   34
 DEA  315  227  979  440  342    0   39  287   49  739   41
```

```
 HUN      0    3   15    9    1   24    0   10    0   20    1
 SVN     10   55  155   84    2  270    9    0    0  135    2
 GBR     84    0   50   49   60   52    0    0    0    0   20
 HRV      1   99  327  171    2  774   17  125    0    0    5
 USA    111    3   46   33   33   43    1    2   27    5    0
       --------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        FRM  FRA  ITA  NLD  CHE  DEA  HUN  SVN  GBR  HRV  USA
       --------------------------------------------------------------------
 FRM      0    2  158  105    5  228    2   11   25    2   37
 FRA      1    0   83   31    2  161    3   25    0   58    1
 ITA    183   71    0  266   11 1069   19  167   18  345   39
 NLD    128   30  261    0    9  392    8   87   18  168   32
 CHE      5    2   11    9    0  106    0    0    1    0    5
 DEA    276  124  979  410   99    0   39  287   20  739   41
 HUN      0    2   15    8    0   24    0   10    0   20    1
 SVN     10   22  155   80    0  270    9    0    0  135    2
 GBR     34    0   23   20    1   25    0    0    0    0   17
 HRV      1   51  327  163    0  774   17  125    0    0    5
 USA     52    1   46   33    5   43    1    2   23    5    0
       --------------------------------------------------------------------
```