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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 uder traits are as
follows:


ITA (SIM)          Reduction in information due to pedigree verification.
NLD (HOL, JER)     Reduction in information due to pedigree verification.
KOR (HOL)          Reduction in reliability due to exclusion of recent data in this evaluation.
CHE (BSW, HOL, SIM) Reduction in information is due to data edits.
BEL (HOL)          The observed decreases in information is attributed to the existence of breeds alias or errors/corrections in the pedigree.
DEU (HOL)          Reduction in information due to routine data editing/selection procedures.
AUS (JER, RDC, HOL) Updated variance parameters and heritability and changed reliability calculation to better reflect the weighting on Mastitis as we use a multi-trait model. Reduction in information is a result of data clean-up and pedigree verification.
DEA (BSW, SIM)     Base change.
JPN (HOL)          Reduction in information due to pedigree verification.
USA (ALL)          Drops in information due to pedigree varification and data edits.
GBR (ALL)          Drops in information due to data changes and edits.
NZL (ALL)          Pedigree verification due to genomic information, causing change in information for many animals. New heritabilities.
URY (HOL)          Reduction in information due to pedigree verification.
HUN (HOL)          First data submission since 2021. Revision of scope of data used in breeding value estimation, data editing cut-off changed cows having their first lactation from 2000 onwards.
ESP (ALL)          Reduction in daughters due to pedigree verification.
POL (HOL)          Reduction in information due to data 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
50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at
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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 (December Routine Evaluation 2024).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		154	9006	1790	857	
BEL			2390			
CAN	288	111	14284	931	896	
CHE	3291		3491	106		3749
CZE			4964			
DEA	6182					25493
DEU			24862		314	
DFS			14834	2398	8388	
ESP			4832			
EST			1472		501	
FRA	508		18840			499
FRM						4918
GBR	164	317	7814	813	625	110
HUN			3469			190
IRL			3265			
ISR			1815			
ITA	2248		9425	59		1922
JPN			7239			
KOR			1818			
LTU			898		362	
LVA			1408		679	
NLD	259		17560	293	113	557
NOR					4410	
NZL	83	57	9423	5397	1500	
POL			13260			
PRT			3179			
SVK			1209			
SVN	353		727			719
URY			2233			
USA	1221	752	43133	5474	795	118
ZAF			1206	621	125	
HRV			986			1069
CAM					49	
No.Records	14597	1391	229042	17882	19614	39344
Pub. Proofs	11567	1070	162430	14423	18384	35215

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

         CAN   FRA   NLD   USA   CHE   DEA   NZL   ITA   GBR   SVN

```
CAN     6.55
FRA     0.91    1.02
NLD     0.90    0.93    3.68
USA     0.88    0.90    0.84    0.21
CHE     0.88    0.94    0.93    0.80   10.63
DEA     0.87    0.97    0.92    0.85    0.96   11.94
NZL     0.70    0.76    0.75    0.66    0.72    0.64    0.35
ITA     0.88    0.90    0.89    0.83    0.96    0.92    0.66   15.29
GBR     0.93    0.96    0.94    0.90    0.93    0.94    0.80    0.89   11.39
SVN     0.80    0.80    0.80    0.79    0.79    0.78    0.66    0.81    0.82   11.00
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BSW   mas

```
        CAN     FRA     NLD     USA     CHE     DEA     NZL     ITA     GBR     SVN
CAN     6.46
FRA     0.81    0.96
NLD     0.80    0.73    4.06
USA     0.82    0.84    0.75    2.85
CHE     0.87    0.86    0.86    0.79   11.48
DEA     0.89    0.69    0.88    0.71    0.89   11.95
NZL     0.68    0.64    0.65    0.64    0.69    0.73    0.35
ITA     0.85    0.72    0.81    0.67    0.89    0.92    0.69   15.29
GBR     0.83    0.83    0.82    0.80    0.81    0.72    0.63    0.73    2.29
SVN     0.79    0.72    0.74    0.72    0.71    0.83    0.76    0.83    0.76   10.98
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GUE   scs

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        CAN     GBR     USA     AUS     NZL
CAN     6.00
GBR     0.92   13.62
USA     0.92    0.90    0.24
AUS     0.81    0.87    0.77    0.23
NZL     0.75    0.80    0.68    0.89    0.62
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HOL   scs

```
        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    5.70
CHE    0.90   10.84
DEU    0.94   0.95   12.93
DFS    0.93   0.92   0.97   11.79
EST    0.89   0.88   0.94   0.92   18.70
FRA    0.95   0.94   0.96   0.96   0.90    1.14
GBR    0.94   0.93   0.96   0.94   0.89   0.96   12.89
NLD    0.92   0.95   0.97   0.95   0.91   0.95   0.96    4.25
USA    0.94   0.84   0.89   0.87   0.90   0.90   0.91   0.87    0.20
ISR    0.84   0.82   0.84   0.80   0.84   0.81   0.80   0.79   0.86    0.24
ITA    0.90   0.90   0.94   0.92   0.93   0.94   0.91   0.90   0.88   0.81    5.90
AUS    0.79   0.85   0.81   0.81   0.74   0.83   0.86   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   0.85   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   0.81   0.73   0.78   0.83    0.45
ESP    0.93   0.90   0.95   0.94   0.91   0.96   0.93   0.91   0.91   0.85   0.95   0.77   0.92   0.96   0.82   11.88
ZAF    0.90   0.88   0.91   0.89   0.86   0.93   0.90   0.88   0.89   0.80   0.92   0.82   0.90   0.91   0.84   0.94   26.32
NZL    0.75   0.80   0.77   0.78   0.71   0.79   0.82   0.79   0.68   0.63   0.72   0.89   0.65   0.74   0.76   0.72   0.79    0.40
IRL    0.80   0.90   0.86   0.86   0.81   0.85   0.88   0.88   0.77   0.74   0.80   0.81   0.82   0.86   0.75   0.83   0.82   0.80    0.12
CZE    0.88   0.82   0.91   0.89   0.86   0.89   0.86   0.85   0.86   0.77   0.90   0.69   0.89   0.90   0.83   0.92   0.89   0.68   0.75   15.19
SVK    0.85   0.85   0.91   0.89   0.87   0.89   0.84   0.84   0.85   0.80   0.89   0.70   0.93   0.92   0.77   0.91   0.90   0.62   0.80   0.90    0.40
POL    0.89   0.88   0.94   0.93   0.92   0.92   0.89   0.90   0.86   0.81   0.92   0.75   0.94   0.94   0.79   0.93   0.87   0.70   0.82   0.89   0.88   10.97
LTU    0.82   0.86   0.90   0.88   0.90   0.86   0.84   0.85   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   0.89    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   0.77   0.84   0.87   0.86   0.93   0.90   480.07
PRT    0.77   0.78   0.80   0.78   0.77   0.78   0.78   0.77   0.77   0.75   0.78   0.66   0.79   0.79   0.77   0.79   0.79   0.65   0.75   0.78   0.77   0.78   0.77   0.77    0.45
KOR    0.88   0.82   0.87   0.89   0.85   0.86   0.89   0.84   0.86   0.79   0.87   0.78   0.84   0.86   0.81   0.87   0.82   0.73   0.71   0.80   0.78   0.87   0.81   0.87   0.77    0.33
SVN    0.80   0.83   0.87   0.87   0.83   0.84   0.84   0.83   0.77   0.74   0.85   0.75   0.82   0.88   0.77   0.83   0.79   0.68   0.86   0.77   0.82   0.86   0.81   0.88   0.77   0.78   10.70
HRV    0.78   0.78   0.80   0.78   0.83   0.77   0.78   0.78   0.78   0.76   0.79   0.67   0.79   0.82   0.77   0.80   0.78   0.59   0.74   0.78   0.78   0.83   0.81   0.84   0.77   0.78   0.78   11.63
URY    0.78   0.80   0.83   0.80   0.78   0.80   0.78   0.79   0.77   0.75   0.78   0.76   0.79   0.81   0.77   0.79   0.82   0.75   0.76   0.77   0.80   0.82   0.78   0.78   0.77   0.77   0.78   0.78    0.20
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HOL     mas
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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     7.57
CHE     0.93   11.11
DEU     0.90   0.88   9.37
DFS     0.94   0.89   0.90   12.25
EST     0.80   0.86   0.83   0.84   18.71
FRA     0.96   0.94   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   0.82   5.04
USA     0.87   0.83   0.86   0.83   0.78   0.90   0.81   0.80   2.51
ISR     0.74   0.75   0.74   0.78   0.85   0.74   0.69   0.75   0.73   0.24
ITA     0.78   0.88   0.70   0.76   0.82   0.79   0.74   0.89   0.66   0.75   6.10
AUS     0.67   0.74   0.63   0.66   0.74   0.64   0.66   0.63   0.63   0.68   0.66   0.13
HUN     0.84   0.87   0.75   0.82   0.90   0.82   0.81   0.86   0.75   0.84   0.88   0.73   1.36
BEL     0.87   0.94   0.83   0.87   0.93   0.88   0.82   0.89   0.76   0.82   0.88   0.82   0.93   0.52
JPN     0.74   0.83   0.68   0.72   0.76   0.73   0.69   0.79   0.68   0.75   0.82   0.74   0.80   0.84   0.45
ESP     0.85   0.91   0.76   0.84   0.88   0.86   0.82   0.87   0.75   0.84   0.86   0.78   0.93   0.96   0.84   11.88
ZAF     0.83   0.90   0.77   0.77   0.81   0.83   0.79   0.84   0.74   0.79   0.85   0.83   0.90   0.93   0.85   0.94   26.04
NZL     0.62   0.68   0.62   0.62   0.71   0.62   0.62   0.62   0.62   0.72   0.64   0.87   0.71   0.77   0.77   0.76   0.81   0.40
IRL     0.77   0.86   0.75   0.78   0.86   0.77   0.76   0.78   0.66   0.78   0.81   0.89   0.86   0.94   0.82   0.91   0.91   0.89   0.11
CZE     0.83   0.87   0.74   0.81   0.84   0.81   0.78   0.84   0.72   0.78   0.87   0.73   0.90   0.92   0.85   0.92   0.90   0.71   0.84   15.19
SVK     0.82   0.86   0.80   0.80   0.88   0.84   0.78   0.86   0.77   0.80   0.87   0.72   0.93   0.92   0.78   0.90   0.89   0.71   0.84   0.90   0.39
POL     0.85   0.88   0.77   0.84   0.92   0.83   0.81   0.84   0.73   0.81   0.84   0.72   0.94   0.96   0.81   0.94   0.87   0.72   0.90   0.90   0.88   10.93
LTU     0.78   0.81   0.78   0.81   0.87   0.81   0.76   0.79   0.71   0.77   0.77   0.68   0.87   0.91   0.76   0.86   0.82   0.70   0.82   0.86   0.87   0.89   0.35
LVA     0.78   0.83   0.73   0.81   0.92   0.79   0.78   0.82   0.72   0.80   0.82   0.81   0.92   0.93   0.77   0.90   0.85   0.78   0.90   0.87   0.87   0.94   0.90   479.42
PRT     0.73   0.81   0.70   0.73   0.77   0.74   0.69   0.75   0.68   0.76   0.72   0.68   0.81   0.84   0.77   0.81   0.82   0.71   0.81   0.82   0.77   0.79   0.80   0.80   0.45
KOR     0.78   0.82   0.69   0.80   0.83   0.77   0.75   0.72   0.69   0.76   0.72   0.80   0.84   0.88   0.83   0.88   0.82   0.74   0.82   0.81   0.78   0.89   0.82   0.87   0.77   0.33
SVN     0.77   0.81   0.73   0.79   0.80   0.78   0.76   0.75   0.68   0.73   0.76   0.78   0.80   0.89   0.76   0.82   0.78   0.72   0.89   0.80   0.79   0.86   0.81   0.87   0.78   0.77   10.72
HRV     0.68   0.76   0.68   0.69   0.83   0.70   0.74   0.76   0.70   0.77   0.75   0.68   0.84   0.84   0.77   0.80   0.79   0.71   0.78   0.78   0.78   0.83   0.85   0.84   0.77   0.76   0.78   11.40
URY     0.69   0.74   0.72   0.69   0.79   0.68   0.69   0.71   0.68   0.75   0.70   0.74   0.80   0.83   0.77   0.80   0.83   0.76   0.84   0.77   0.81   0.83   0.78   0.81   0.77   0.77   0.76   0.77   0.20


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JER     scs
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        CAN    DFS    GBR    NLD    USA    AUS    ZAF    NZL    CHE    ITA
CAN     6.01
DFS     0.91   12.43
GBR     0.92   0.92   11.49
NLD     0.92   0.95   0.95   4.10
USA     0.90   0.83   0.88   0.84   0.17
AUS     0.76   0.84   0.83   0.85   0.72   0.23
ZAF     0.86   0.87   0.86   0.89   0.83   0.79   20.86
NZL     0.66   0.72   0.75   0.77   0.64   0.88   0.72   0.37
CHE     0.87   0.85   0.85   0.90   0.81   0.72   0.81   0.66   13.73
ITA     0.87   0.91   0.87   0.88   0.86   0.74   0.87   0.65   0.85   6.53


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JER     mas
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        CAN    DFS    GBR    NLD    USA    AUS    ZAF    NZL    CHE    ITA
CAN     7.53
DFS     0.92   11.75
GBR     0.78   0.83   1.94
NLD     0.83   0.83   0.80   4.66
USA     0.79   0.76   0.73   0.71   2.53
AUS     0.65   0.65   0.65   0.71   0.64   0.12
ZAF     0.72   0.71   0.71   0.81   0.70   0.82   20.82
NZL     0.63   0.63   0.63   0.66   0.63   0.86   0.74   0.37
CHE     0.82   0.81   0.75   0.79   0.75   0.71   0.80   0.73   13.70
ITA     0.77   0.73   0.74   0.86   0.67   0.69   0.82   0.69   0.83   6.53


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RDC     scs
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        CAN    DFS    GBR    NOR    USA    DEU    AUS    EST    ZAF    NZL    LTU    LVA    NLD    CAM
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	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	6.07													
DFS	0.93	12.95												
GBR	0.94	0.91	11.60											
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	0.91	0.88	14.47								
AUS	0.80	0.85	0.86	0.82	0.71	0.83	0.26							
EST	0.89	0.89	0.89	0.84	0.84	0.93	0.80	19.11						
ZAF	0.82	0.86	0.85	0.87	0.86	0.91	0.76	0.87	25.25					
NZL	0.74	0.74	0.79	0.73	0.68	0.77	0.88	0.71	0.75	0.42				
LTU	0.82	0.88	0.84	0.90	0.79	0.89	0.80	0.88	0.86	0.73	0.37			
LVA	0.86	0.88	0.90	0.84	0.83	0.92	0.81	0.94	0.87	0.74	0.89	433.82		
NLD	0.92	0.95	0.94	0.86	0.86	0.96	0.84	0.87	0.88	0.78	0.84	0.87	4.16	
CAM	0.88	0.88	0.88	0.87	0.84	0.88	0.84	0.87	0.88	0.81	0.87	0.87	0.89	6.28

RDC   mas

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	8.35												
DFS	0.88	13.38											
GBR	0.87	0.82	2.09										
NOR	0.80	0.69	0.72	13.61									
USA	0.80	0.73	0.78	0.78	0.23								
AUS	0.67	0.64	0.68	0.88	0.68	0.15							
EST	0.80	0.72	0.78	0.83	0.80	0.82	19.11						
ZAF	0.84	0.80	0.83	0.87	0.80	0.78	0.83	25.34					
NZL	0.64	0.63	0.64	0.74	0.70	0.88	0.77	0.77	0.42				
LTU	0.75	0.74	0.76	0.85	0.77	0.80	0.90	0.85	0.76	0.36			
LVA	0.78	0.72	0.79	0.86	0.76	0.82	0.94	0.86	0.79	0.91	435.86		
NLD	0.84	0.80	0.84	0.84	0.84	0.76	0.83	0.84	0.69	0.81	0.82	4.94	
CAM	0.83	0.83	0.83	0.87	0.81	0.89	0.88	0.87	0.86	0.87	0.87	0.84	6.28

SIM   scs

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.06										
FRA	0.89	1.10									
ITA	0.87	0.88	12.16								
NLD	0.91	0.94	0.84	4.00							
CHE	0.93	0.93	0.86	0.93	10.44						
DEA	0.92	0.96	0.84	0.92	0.89	12.29					
HUN	0.88	0.91	0.91	0.88	0.88	0.88	16.33				
SVN	0.82	0.81	0.79	0.81	0.83	0.79	0.82	9.26			
GBR	0.91	0.95	0.87	0.95	0.90	0.93	0.89	0.84	10.79		
HRV	0.86	0.78	0.78	0.78	0.79	0.77	0.82	0.78	0.78	9.71	
USA	0.84	0.90	0.87	0.87	0.84	0.81	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	12.13								
NLD	0.87	0.87	0.79	4.23							
CHE	0.81	0.88	0.86	0.82	9.97						
DEA	0.92	0.91	0.84	0.89	0.72	12.29					
HUN	0.86	0.82	0.87	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	2.46		
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	0.82	0.80	0.75	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	99	60	198	158	170	34	153	69	37
FRA	91	0	101	138	198	265	32	238	68	54
NLD	55	87	0	99	125	183	36	155	44	51
USA	196	103	90	0	338	357	39	250	97	44
CHE	135	160	113	316	0	679	37	536	80	85
DEA	152	219	171	326	572	0	55	771	84	115
NZL	34	25	29	36	30	51	0	48	23	13
ITA	135	203	129	180	480	670	39	0	85	107
GBR	68	56	36	94	61	56	20	62	0	21
SVN	33	52	50	34	80	104	12	101	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	88	56	57	83	168	34	151	32	37
FRA	81	0	77	28	84	229	26	208	33	53
NLD	49	66	0	21	63	162	36	143	24	49
USA	58	27	19	0	31	51	15	45	18	12
CHE	76	69	59	27	0	283	19	242	20	69
DEA	152	183	150	45	249	0	55	770	42	114
NZL	34	22	29	14	17	51	0	48	12	13
ITA	134	175	117	36	215	670	39	0	45	107
GBR	31	28	19	17	17	29	9	34	0	14
SVN	33	50	48	11	65	104	12	101	12	0

GUE
----
common bulls below diagonal
common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL
CAN	0	36	80	57	14
GBR	31	0	95	48	13
USA	72	97	0	77	29
AUS	55	41	75	0	26
NZL	11	11	29	26	0

GUE

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	995	2788	1872	362	1753	1926	1977	4255	183	2063	1708	1254	955	1570	1543	506	898	604	1357	476	1927	301	580	1360	867	242	355	949
CHE	921	0	1266	835	210	810	785	1042	1121	73	802	707	482	680	532	635	257	467	417	577	251	804	146	277	605	322	149	224	365
DEU	2269	1201	0	3171	564	2817	2308	3951	3999	205	2859	1876	1476	1416	1599	1796	550	1128	882	2121	733	3268	553	836	1552	758	392	730	948
DFS	1705	787	2500	0	436	1985	1796	2642	2618	186	1827	1512	1124	1042	1156	1285	506	983	771	1521	454	2161	361	554	1225	620	292	494	783
EST	245	126	428	306	0	330	341	497	473	67	375	275	263	245	253	264	113	177	148	356	140	478	105	202	260	156	107	153	190
FRA	1325	753	1778	1276	184	0	1732	2375	2782	152	1756	1461	1097	1141	1355	1449	504	915	730	1450	481	2189	290	493	1200	636	234	395	707
GBR	2183	750	1822	1433	209	1217	0	2048	2570	180	1669	1600	1005	989	1174	1216	508	1038	979	1219	405	1718	322	487	1145	596	228	387	822
NLD	1950	1041	3818	2418	370	1722	1845	0	3042	202	2011	1689	1176	1491	1263	1388	515	1257	924	1795	593	2497	368	592	1364	618	310	529	842
USA	4879	1051	3123	2199	352	1668	2397	2785	0	292	2966	2268	1608	1123	2223	1823	634	1284	841	1973	597	2907	403	781	1709	1057	277	453	1389
ISR	130	43	156	138	38	93	131	156	287	0	179	143	144	100	140	130	66	137	116	164	59	205	56	89	132	82	52	78	113
ITA	1862	738	2192	1581	241	1183	1399	1830	2526	126	0	1257	1232	897	1247	1448	403	714	558	1420	416	2242	339	594	1233	703	295	443	780
AUS	1748	629	1460	1142	146	1055	1413	1498	2343	92	1014	0	844	857	1032	1020	482	1355	746	974	336	1317	265	440	988	547	185	338	808
HUN	1205	405	1225	952	162	827	874	1026	1623	100	1124	648	0	629	832	923	393	569	451	1094	357	1266	255	414	906	547	186	303	602
BEL	958	698	1470	990	156	1181	976	1720	1015	63	909	759	554	0	633	789	339	590	520	766	321	998	189	321	809	368	184	312	414
JPN	909	372	797	695	100	573	652	747	1148	70	697	614	499	431	0	1035	429	640	442	981	342	1212	232	415	866	665	181	270	686
ESP	1089	531	1227	1035	132	1223	978	1273	1282	78	1095	754	763	781	541	0	449	625	508	1017	351	1421	244	429	1045	590	219	340	620

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 ZAF  465  216  428  389   56  399  444  439  618   42  324  420  314  288  299  400    0  368  295  409  180  418  106  165  448  267   72  158  328
 NZL  883  394  880  718   91  604  901 1151 1244  110  566 1361  437  481  361  483  298    0  774  713  270  822  192  286  679  360  138  255  643
 IRL  534  399  722  611   76  575  938  824  727   89  468  618  358  483  281  456  246  642    0  534  210  665  146  215  503  238  109  194  399
 CZE 1055  436 1709 1091  228 1006  898 1649 1649  130 1108  671 1011  618  505  772  287  531  394    0  545 1701  297  476  983  572  241  430  669
 SVK  336  129  552  244   59  276  236  426  407   25  264  168  249  195  134  182   97  163   99  468    0  513  106  170  361  223   82  159  259
 POL 1787  704 3108 1882  357 1659 1539 2414 2996  160 1991 1049 1178  937  711 1094  371  641  525 1477  371    0  418  710 1358  730  329  570  850
 LTU  172   59  515  217   48  122  172  228  283   25  186  121  161   92   78  101   40   91   69  193   48  325    0  208  251  164   73  166  187
 LVA  368  144  678  352  112  262  280  403  684   56  386  224  303  186  188  238   96  160  118  316   79  577  135    0  473  285  124  279  316
 PRT 1422  549 1469 1150  173 1096 1058 1380 1839   85 1199  837  908  823  552 1023  401  557  423  834  246 1382  158  370    0  586  196  372  667
 KOR  844  231  542  473   77  407  441  463 1193   43  586  400  439  278  426  430  199  262  159  414  134  617   72  175  502    0  124  173  460
 SVN  187  106  384  237   65  177  167  270  225   36  257  125  140  144  100  158   51   94   82  174   38  293   32   72  154   76    0  128  112
 HRV  218  148  754  398  110  288  276  485  350   54  340  214  225  250  129  260  108  153  131  328   79  523  113  217  309   82  102    0  216
 URY  913  287  711  562  106  479  686  698 1686   65  588  635  477  322  415  487  295  534  306  482  152  707  104  178  575  357   62  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  307  827 1025  237 1022 1091  437 1497  122 1407 1012  846  630  963 1024  251  506  346  863  267 1313  218  370  881  620  197  249  574
 CHE  275    0  292  295   87  291  281  189  278   29  308  265  156  244  201  235   65  173  136  182   72  309   64   89  211  141   81   73  118
 DEU  665  263    0 1117  286  956  872  650  806  103 1104  717  648  638  599  777  201  444  336  793  240 1501  260  427  658  343  289  429  379
 DFS 1054  272  998    0  396 1495 1516  883 1238  173 1406 1384 1037  931 1087 1401  374 1658  527  970  210 1920  327  469 1125  567  270  452  666
 EST  162   49  208  278    0  282  316  216  296   66  320  269  255  233  247  259  110  172  135  350  123  459  100  185  249  152  105  151  176
 FRA  829  268  724  969  157    0 1334  614  988  125 1327 1167  961  973 1083 1241  415  728  592 1257  359 1890  244  404 1013  538  214  337  543
 GBR 1117  263  726 1232  202  975    0  658 1313  179 1410 1458  963  919 1073 1150  467  953  865 1168  352 1626  289  418 1062  553  222  362  719
 NLD  423  180  593  900  155  515  645    0  454  101  607  555  433  617  416  518  208  535  371  759  184 1011  168  252  535  233  161  304  316
 USA 1723  246  689 1260  233  803 1436  415    0  217 1643 1169 1046  635 1134 1742  245  500 1059 1092  500 1742  500  500 1059  751  211  252  826
 ISR   81   14   69  123   38   76  129   79  214    0  154  139  141   99  138  130   64  136   97  164   57  201   52   77  132   82   51   76  107
 ITA 1225  273  865 1239  211  917 1208  558 1692  104    0 1075 1097  763 1095 1223  322  603  449 1223  338 1921  282  457 1075  630  260  360  630
 AUS 1087  233  579 1021  147  875 1304  482 1278   91  903    0  831  831 1031 1018  465 1326  700  969  309 1284  244  396  964  529  186  325  737
 HUN  814  121  516  877  162  715  852  370 1115   98 1023  645    0  611  825  914  382  565  416 1089  335 1240  241  375  881  528  182  291  542
 BEL  665  241  650  888  154  990  933  644  616   63  790  755  550    0  610  772  331  574  489  749  292  961  174  296  785  358  184  301  385
 JPN  685  150  384  637  100  503  636  314  905   70  649  614  499  431    0 1035  426  633  432  981  317 1196  217  390  841  638  180  258  612
 ESP  727  186  559  952  132 1020  952  492  840   78  954  750  762  781  541    0  443  624  480 1016  322 1402  227  400 1026  578  216  330  567
 ZAF  236   52  155  373   56  326  429  184  393   42  268  414  314  288  299  400    0  364  284  403  169  408   99  162  436  254   72  149  307
 NZL  453  149  361  657   90  502  806  483  628  110  502 1327  436  478  361  483  296    0  716  712  258  802  182  266  664  350  138  246  600
 IRL  344  134  304  527   72  482  844  350  424   70  393  577  337  462  271  438  234  587    0  507  190  608  141  200  468  232  102  184  358
 CZE  674  129  614  970  228  820  880  724 1038  130  976  665 1011  618  505  772  287  531  366    0  514 1678  278  442  962  553  241  415  606
 SVK  193   28  145  210   58  215  228  104  213   25  224  165  246  189  134  182   96  161   96  468    0  458   93  157  339  208   78  147  232
 POL 1266  266 1536 1653  352 1425 1498 1012 1985  159 1765 1043 1167  923  711 1092  316  637  486 1477  350    0  391  623 1300  697  324  545  763
 LTU  137   23  210  206   47  111  169  106  179   25  158  122  159   91   78  101   40   89   66  193   46  315    0  189  232  145   70  155  168
 LVA  227   34  337  284  105  202  250  157  418   49  281  196  279  176  177  223   94  147  107  292   78  503  127    0  436  261  117  267  278
 PRT  913  183  587 1053  172  930 1020  541 1167   85 1076  831  899  820  552 1022  400  555  403  834  239 1348  156  341    0  565  195  352  614
 KOR  600  109  251  434   77  358  424  175  810   43  547  395  435  278  426  430  198  258  159  414  132  602   69  159  496    0  123  161  414
 SVN  154   56  282  212   65  164  164  129  170   35  226  127  140  144  100  158   51   94   75  174   38  291   32   68  154   76    0  126  109
 HRV  162   47  416  366  110  248  273  273  203   54  275  212  225  247  129  260  108  153  127  328   79  516  112  214  306   81  101    0  200
 URY  554   87  286  506  106  392  650  256  908   65  523  633  467  320  415  487  292  531  296  482  151  688  104  167  567  348   62  131    0
-----------------------------------------------------------------------------------------------------------------------------------------------------
```

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

```
      CAN  DFS  GBR  NLD  USA  AUS  ZAF  NZL  CHE  ITA
----------------------------------------------------------------------
 CAN    0  157  194   61  539  301  164  226   47   28
 DFS  152    0  212  194  254  187  165  198   63   33
 GBR  197  207    0  116  281  256  179  268   77   37
 NLD   55  198  109    0  128   91   84  113   44   24
 USA  569  238  307  132    0  550  305  448   79   37
 AUS  309  159  260   81  600    0  247  494   64   36
 ZAF  160  148  182   80  321  237    0  216   58   34
 NZL  235  175  272  107  521  547  224    0   60   30
 CHE   41   62   75   37   80   54   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   58   93   22  105  145   76  105   28   20
    DFS   54    0  140  159   78  148  144  162   61   30
    GBR   92  135    0   85  103  190  141  197   69   37
    NLD   16  156   81    0   50   82   80  103   40   24
    USA   98   69  104   47    0  189  131  158   44   22
    AUS  134  115  194   75  200    0  242  489   60   35
    ZAF   69  124  143   77  142  236    0  211   55   34
    NZL   97  135  201   98  157  540  221    0   56   30
    CHE   26   58   66   35   38   53   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  203   98    8  228   14  110    3   70   99   22   10    8    0
    DFS  210    0  134  151  230   72  227  150   51  207  103  134   70    0
    GBR   98  128    0   82  137   16  107   15   40  100   26   16   50    0
    NOR    7  126   86    0   88   18   82   33    0   58   19   22   56    0
    USA  217  228  132   89    0   29  155   29   59  141   37   27   53   32
    DEU   13   63   16   17   27    0   49   35    1   26   28   37   21    0
    AUS  111  199  103   71  158   48    0   49   34  176   44   41   50   13
    EST    2  138   13   33   28   34   44    0    0   25   22   55   27    0
    ZAF   72   48   35    0   53    1   34    0    0   35    5    2    3    0
    NZL   97  202   95   58  142   25  176   23   30    0   23   21   32   13
    LTU   21   89   24   18   33   27   41   22    5   23    0   44   15    0
    LVA   10   93   16   20   24   31   37   47    2   18   40    0   19    0
    NLD    8   68   49   55   52   20   48   26    3   31   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   91   34    3   86   36    0   35   41   18    7    3    0
    DFS   91    0   94  152  223  240  150   46  205  102  126   68    0
    GBR   33   91    0   69   96   67    9   27   67   20   14   38    0
    NOR    3  126   73    0   88   81   33    0   58   19   19   51    0
    USA   86  221   95   89    0  143   29   54  138   37   25   50   32
    AUS   36  216   67   70  147    0   49   31  167   41   38   47   12
    EST    0  138    9   33   28   44    0    0   25   22   49   25    0
    ZAF   36   46   26    0   52   33    0    0   33    5    2    2    0
    NZL   41  198   67   58  142  168   23   30    0   23   18   30   13
    LTU   17   88   18   18   33   39   22    5   23    0   44   14    0
    LVA    7   84   14   17   22   35   41    2   15   40    0   14    0
    NLD    3   66   38   50   50   45   24    2   29   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  194  139  256  277    2   11   67    2   96
    FRA    1    0  153   86   15  271    4   59    0  110    3
    ITA  219  138    0  283  106 1087   19  170   46  346   39
    NLD  164   82  279    0   95  430    9   91   49  178   32
    CHE  308   12  108   99    0  379    2    2   53    3   34
    DEA  315  228  997  450  346    0   39  287   49  739   41
    HUN    0    3   15    9    1   24    0   10    0   20    1
```

```
   SVN    10   55  157   84    2  270    9    0    0  135    2
   GBR    84    0   50   49   60   52    0    0    0    0   20
   HRV     1   99  328  172    3  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   27    2   37
   FRA     1    0   84   31    2  161    3   25    0   58    1
   ITA   183   72    0  269   11 1087   19  170   18  346   39
   NLD   128   30  264    0    9  400    8   87   19  168   32
   CHE     5    2   11    9    0  109    0    0    1    0    5
   DEA   276  124  997  418  102    0   39  287   21  739   41
   HUN     0    2   15    8    0   24    0   10    0   20    1
   SVN    10   22  157   80    0  270    9    0    0  135    2
   GBR    36    0   23   21    1   26    0    0    0    0   17
   HRV     1   51  328  163    0  774   17  125    0    0    5
   USA    52    1   46   33    5   43    1    2   23    5    0
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