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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 twentysix (26) countries were
included in this evaluation.

International genetic evaluations for udder health traits of bulls from
Australia, Austria-Germany, Belgium, Canada, 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 and Portugal were computed.
Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed
data were included in this evaluation.



Changes in national procedures
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Changes in the national genetic evaluation of udder health traits  are as
follows:

AUS (HOL, JER)    Decrease in information due to pedigree changes.
CAN (ALL)         Decrease in information due to pedigree changes.
HRV (HOL, SIM)    Decreased in information due to updates in the pedigree.
JPN (HOL)         Decrease in information due to correction in some cow's pedigree.
GBR (ALL)         Base adjuastment
EST (RDC,HOL)     Base change
LTU (RDC,HOL)     Base change
ESP (HOL)         Base change



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

Table 2 presents the date of evaluation as supplied by each country
in the 01x-proof file.

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


SCIENTIFIC LITERATURE
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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
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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 TEST RUN
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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 2015).
Number of records for milk somatic cells by breed

| Country | BSW | GUE | HOL | JER | RDC | SIM |
|---------|-----|-----|-----|-----|-----|-----|
| ARG |  |  |  |  |  |  |
| AUS |  | 122 | 6912 | 1387 | 606 |  |
| BEL |  |  | 986 |  |  |  |
| CAN | 202 | 91 | 10588 | 582 | 724 |  |
| CHE | 2800 |  | 2757 |  |  | 2834 |
| CZE |  |  | 3372 |  |  |  |
| DEA | 5158 |  |  |  |  | 20309 |
| DEU |  |  | 25347 |  | 393 |  |
| DFS |  |  | 12105 | 1935 | 7257 |  |
| ESP |  |  | 3043 |  |  |  |
| EST |  |  | 912 |  | 373 |  |
| FRA | 331 |  | 15667 |  |  | 358 |
| FRM |  |  |  |  |  | 3829 |
| FRR |  |  | 222 |  |  |  |
| GBR | 97 | 256 | 5822 | 622 | 415 | 79 |
| HUN |  |  | 2365 |  |  | 149 |
| IRL |  |  | 2074 |  |  |  |
| ISR |  |  | 1170 |  |  |  |
| ITA | 1655 |  | 9208 |  |  | 1237 |
| JPN |  |  | 5218 |  |  |  |
| KOR |  |  | 959 |  |  |  |
| LTU |  |  | 615 |  | 379 |  |
| LVA |  |  | 527 |  | 562 |  |
| NLD | 159 |  | 14015 | 113 | 60 | 278 |
| NOR |  |  |  |  | 3728 |  |
| NZL | 41 | 57 | 6491 | 3860 | 1139 |  |
| POL |  |  | 7464 |  |  |  |
| PRT |  |  | 2210 |  |  |  |
| SVK |  |  | 961 |  |  | 504 |
| SVN | 306 |  | 387 |  |  | 503 |
| URY |  |  |  |  |  |  |
| USA | 951 | 649 | 33329 | 3724 | 578 |  |
| ZAF |  | 16 | 1076 | 506 | 119 |  |
| HRV |  |  | 587 |  |  | 698 |
| No.Records | 11700 | 1191 | 176389 | 12729 | 16333 | 30778 |
| Pub. Proofs | 9595 | 933 | 139450 | 10587 | 15820 | 27990 |

^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      0.25
FRA      0.92    1.02
NLD      0.89    0.93    4.13
USA      0.90    0.91    0.86    0.21
CHE      0.93    0.96    0.92    0.85   10.45
DEA      0.92    0.96    0.91    0.85    0.97   11.92
NZL      0.77    0.82    0.86    0.75    0.82    0.78    0.38
ITA      0.92    0.91    0.87    0.87    0.96    0.93    0.76   12.96
GBR      0.92    0.96    0.96    0.90    0.94    0.95    0.86    0.89   13.15
SVN      0.87    0.86    0.86    0.87    0.86    0.86    0.77    0.86    0.87   10.65


--------------------------------------------------------------------------------
BSW     mas
--------------------------------------------------------------------------------
          CAN     FRA     NLD     USA     CHE     DEA     NZL     ITA     GBR     SVN
CAN      0.25
FRA      0.66    1.08
NLD      0.81    0.73    3.81
USA      0.84    0.61    0.86    0.21
CHE      0.92    0.53    0.85    0.85   10.45
DEA      0.91    0.49    0.88    0.85    0.98   11.92
NZL      0.72    0.53    0.73    0.75    0.81    0.77    0.38
ITA      0.91    0.63    0.86    0.87    0.96    0.93    0.76   12.96
GBR      0.86    0.62    0.89    0.90    0.94    0.94    0.85    0.89   13.15
SVN      0.84    0.52    0.72    0.86    0.86    0.86    0.76    0.86    0.86   10.65


--------------------------------------------------------------------------------
GUE     scs
--------------------------------------------------------------------------------
          CAN     GBR     USA     AUS     NZL     ZAF
CAN      0.25
GBR      0.92   13.38
USA      0.93    0.90    0.25
AUS      0.84    0.92    0.81   29.06
NZL      0.78    0.86    0.76    0.95    0.63
ZAF      0.89    0.90    0.88    0.88    0.85   24.10


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HOL     scs
--------------------------------------------------------------------------------
          CAN      CHE      DEU      DFS      EST      FRA      FRR      GBR      NLD      USA      ISR
ITA      AUS      HUN      BEL      JPN      ESP      ZAF      NZL      IRL      CZE      SVK      POL      LTU
LVA      PRT      KOR      SVN      HRV
CAN      0.27
CHE      0.87    10.81
DEU      0.92     0.93    12.79
DFS      0.91     0.91     0.96    11.93
EST      0.86     0.85     0.93     0.92    13.12
FRA      0.93     0.92     0.95     0.97     0.89     1.20
FRR      0.88     0.88     0.92     0.91     0.87     0.94     1.11
GBR      0.93     0.93     0.94     0.94     0.91     0.96     0.91    12.83
NLD      0.91     0.92     0.95     0.95     0.90     0.94     0.94     0.97     4.69
USA      0.94     0.85     0.88     0.87     0.90     0.89     0.82     0.89     0.86     0.21
ISR      0.82     0.76     0.81     0.80     0.81     0.82     0.73     0.77     0.76     0.84     0.24
ITA      0.90     0.88     0.94     0.93     0.92     0.92     0.87     0.90     0.87     0.89     0.84
5.86
AUS      0.83     0.91     0.88     0.89     0.81     0.90     0.83     0.93     0.92     0.77     0.72
0.80    30.10
HUN      0.88     0.87     0.91     0.90     0.90     0.91     0.83     0.89     0.87     0.92     0.84
0.93     0.79     1.28
BEL      0.91     0.92     0.96     0.95     0.94     0.96     0.92     0.94     0.94     0.90     0.78
0.94     0.87     0.92     0.49
JPN      0.88     0.85     0.85     0.88     0.84     0.90     0.84     0.86     0.87     0.87     0.74
0.85     0.82     0.85     0.85     0.42
ESP      0.92     0.90     0.95     0.94     0.93     0.95     0.88     0.93     0.91     0.91     0.83
0.95     0.84     0.93     0.96     0.85    11.60
ZAF      0.90     0.88     0.90     0.90     0.88     0.91     0.81     0.92     0.88     0.89     0.83
0.91     0.87     0.91     0.91     0.85     0.94    26.35
NZL      0.77     0.86     0.82     0.85     0.80     0.84     0.76     0.87     0.88     0.75     0.73
0.75     0.97     0.76     0.81     0.82     0.78     0.83     0.40
IRL      0.88     0.93     0.93     0.93     0.88     0.93     0.88     0.96     0.94     0.84     0.74
0.88     0.96     0.86     0.94     0.85     0.90     0.90     0.92     0.11
CZE      0.86     0.85     0.89     0.88     0.89     0.88     0.88     0.85     0.85     0.85     0.80
0.91     0.76     0.90     0.89     0.85     0.90     0.87     0.75     0.84    16.45
SVK      0.84     0.85     0.89     0.88     0.85     0.89     0.84     0.86     0.85     0.86     0.76
0.88     0.77     0.94     0.88     0.85     0.91     0.87     0.75     0.84     0.88     0.42
POL      0.89     0.87     0.93     0.92     0.90     0.92     0.90     0.88     0.87     0.87     0.78
0.93     0.82     0.90     0.93     0.85     0.93     0.88     0.78     0.89     0.88     0.86    10.27
LTU      0.84     0.83     0.87     0.85     0.82     0.84     0.80     0.85     0.84     0.84     0.72
0.85     0.77     0.84     0.84     0.84     0.87     0.82     0.76     0.82     0.84     0.84     0.85
0.37
LVA      0.86     0.86     0.93     0.91     0.92     0.89     0.84     0.88     0.87     0.84     0.73
0.91     0.84     0.87     0.93     0.85     0.89     0.85     0.82     0.89     0.86     0.84     0.93
0.86     0.48
PRT      0.85     0.85     0.85     0.85     0.85     0.85     0.83     0.85     0.85     0.85     0.79
0.85     0.75     0.85     0.85     0.85     0.85     0.85     0.75     0.81     0.85     0.85     0.85
0.84     0.84     0.50
KOR      0.87     0.84     0.86     0.89     0.86     0.88     0.82     0.87     0.85     0.85     0.72
0.88     0.79     0.85     0.86     0.85     0.90     0.85     0.77     0.83     0.85     0.85     0.90
0.84     0.88     0.85     0.34
SVN      0.84     0.83     0.85     0.84     0.83     0.84     0.79     0.84     0.84     0.84     0.71
0.84     0.75     0.84     0.84     0.84     0.84     0.83     0.73     0.81     0.84     0.82     0.84
0.79     0.82     0.84     0.82    10.40
HRV      0.84     0.84     0.85     0.85     0.83     0.84     0.81     0.84     0.85     0.85     0.72
0.85     0.76     0.85     0.85     0.84     0.85     0.84     0.74     0.78     0.85     0.83     0.85
0.84     0.86     0.85     0.83     0.83    11.93


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HOL    mas
--------------------------------------------------------------------------------
          CAN      CHE      DEU      DFS      EST      FRA      FRR      GBR      NLD      USA      ISR
ITA       AUS      HUN      BEL      JPN      ESP      ZAF      NZL      IRL      CZE      SVK      POL      LTU
LVA       PRT      KOR      SVN      HRV
CAN       9.23
CHE       0.72    10.81
DEU       0.79     0.93    12.79
DFS       0.92     0.70     0.81    12.26
EST       0.77     0.84     0.93     0.82    13.13
FRA       0.95     0.71     0.80     0.93     0.79     1.21
FRR       0.72     0.57     0.60     0.77     0.62     0.78     1.04
GBR       0.74     0.93     0.94     0.78     0.90     0.76     0.56    12.83
NLD       0.85     0.86     0.94     0.85     0.90     0.85     0.71     0.90     4.95
USA       0.79     0.85     0.88     0.83     0.90     0.81     0.59     0.89     0.88     0.21
ISR       0.63     0.75     0.80     0.66     0.80     0.70     0.54     0.76     0.77     0.82     0.24
ITA       0.79     0.88     0.94     0.81     0.92     0.83     0.65     0.90     0.90     0.89     0.83
5.86
AUS       0.61     0.91     0.87     0.64     0.82     0.60     0.43     0.93     0.80     0.77     0.71
0.80    30.11
HUN       0.76     0.87     0.91     0.82     0.89     0.80     0.61     0.89     0.89     0.92     0.83
0.93     0.79     1.28
BEL       0.82     0.91     0.96     0.84     0.94     0.84     0.65     0.94     0.94     0.90     0.76
0.94     0.86     0.92     0.49
JPN       0.69     0.85     0.85     0.71     0.83     0.71     0.54     0.86     0.80     0.87     0.73
0.85     0.82     0.85     0.85     0.42
ESP       0.83     0.90     0.95     0.85     0.93     0.87     0.64     0.93     0.92     0.91     0.82
0.95     0.83     0.93     0.96     0.85    11.22
ZAF       0.78     0.88     0.89     0.77     0.87     0.80     0.55     0.91     0.87     0.89     0.83
0.91     0.87     0.90     0.90     0.85     0.94    26.24
NZL       0.54     0.85     0.82     0.62     0.79     0.55     0.44     0.87     0.76     0.75     0.71
0.75     0.97     0.76     0.80     0.82     0.78     0.83     0.40
IRL       0.73     0.93     0.93     0.77     0.87     0.75     0.59     0.96     0.89     0.83     0.74
0.88     0.95     0.86     0.94     0.84     0.90     0.89     0.92     0.11
CZE       0.76     0.85     0.89     0.77     0.89     0.78     0.70     0.85     0.87     0.85     0.79
0.90     0.76     0.89     0.90     0.85     0.90     0.87     0.75     0.84    16.45
SVK       0.73     0.85     0.89     0.78     0.85     0.78     0.62     0.85     0.86     0.87     0.73
0.88     0.76     0.94     0.88     0.84     0.91     0.87     0.74     0.84     0.88     0.41
POL       0.80     0.88     0.93     0.80     0.90     0.84     0.68     0.89     0.89     0.86     0.78
0.93     0.82     0.90     0.94     0.85     0.92     0.88     0.78     0.90     0.88     0.87    10.27
LTU       0.68     0.83     0.87     0.73     0.81     0.72     0.55     0.84     0.79     0.83     0.70
0.84     0.77     0.83     0.83     0.83     0.86     0.81     0.75     0.81     0.84     0.84     0.84
0.36
LVA       0.70     0.84     0.93     0.77     0.91     0.75     0.59     0.87     0.88     0.84     0.71
0.90     0.81     0.85     0.92     0.84     0.88     0.83     0.80     0.87     0.85     0.83     0.92
0.85     0.48
PRT       0.66     0.85     0.85     0.72     0.84     0.76     0.65     0.85     0.79     0.85     0.78
0.85     0.75     0.85     0.85     0.85     0.85     0.84     0.75     0.81     0.85     0.84     0.85
0.84     0.84     0.50
KOR       0.78     0.84     0.86     0.80     0.85     0.84     0.63     0.87     0.82     0.85     0.72
0.88     0.79     0.85     0.86     0.85     0.90     0.85     0.76     0.83     0.84     0.85     0.90
0.82     0.85     0.85     0.34
SVN       0.69     0.83     0.84     0.76     0.82     0.72     0.57     0.84     0.77     0.84     0.69
0.84     0.74     0.83     0.84     0.83     0.84     0.81     0.73     0.81     0.84     0.81     0.84
0.76     0.81     0.84     0.80    10.40
HRV       0.63     0.83     0.85     0.67     0.83     0.67     0.48     0.84     0.78     0.84     0.70
0.84     0.75     0.85     0.85     0.83     0.85     0.82     0.73     0.76     0.84     0.82     0.84
0.83     0.85     0.84     0.82     0.83    11.93


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```
JER     scs
--------------------------------------------------------------------------------
         CAN      DFS      GBR      NLD      USA      AUS      ZAF      NZL
CAN      0.23
DFS      0.88    12.49
GBR      0.91     0.91    11.33
NLD      0.92     0.93     0.96     4.24
USA      0.91     0.83     0.87     0.86     0.19
AUS      0.79     0.87     0.88     0.91     0.77    28.90
ZAF      0.87     0.83     0.87     0.91     0.86     0.89    20.83
NZL      0.76     0.78     0.83     0.85     0.75     0.96     0.85     0.38


--------------------------------------------------------------------------------
JER     mas
--------------------------------------------------------------------------------
         CAN      DFS      GBR      NLD      USA      AUS      ZAF      NZL
CAN      8.75
DFS      0.88    12.42
GBR      0.61     0.70    11.34
NLD      0.84     0.82     0.88     4.22
USA      0.69     0.75     0.88     0.86     0.19
AUS      0.50     0.57     0.89     0.81     0.78    28.92
ZAF      0.57     0.66     0.88     0.87     0.86     0.88    20.83
NZL      0.45     0.46     0.83     0.75     0.75     0.95     0.84     0.38


--------------------------------------------------------------------------------
RDC     scs
--------------------------------------------------------------------------------
         CAN      DFS      GBR      NOR      USA      DEU      AUS      EST      ZAF      NZL      LTU
LVA      NLD
CAN      0.26
DFS      0.92    12.68
GBR      0.93     0.92    11.54
NOR      0.90     0.90     0.87    11.65
USA      0.93     0.88     0.88     0.86     0.24
DEU      0.92     0.93     0.94     0.88     0.88    13.65
AUS      0.86     0.92     0.91     0.88     0.78     0.89    31.23
EST      0.87     0.93     0.91     0.90     0.89     0.94     0.88    11.95
ZAF      0.87     0.82     0.89     0.89     0.87     0.90     0.81     0.89    25.63
NZL      0.78     0.86     0.83     0.85     0.75     0.83     0.96     0.83     0.79     0.41
LTU      0.87     0.86     0.88     0.87     0.86     0.87     0.83     0.92     0.88     0.80     0.35
LVA      0.87     0.86     0.89     0.87     0.86     0.93     0.89     0.95     0.87     0.85     0.89
0.43
NLD      0.91     0.93     0.96     0.91     0.86     0.95     0.91     0.91     0.89     0.87     0.87
0.88     4.07


--------------------------------------------------------------------------------
RDC     mas
--------------------------------------------------------------------------------
         CAN      DFS      GBR      NOR      USA      DEU      AUS      EST      ZAF      NZL      LTU
LVA      NLD
CAN      8.83
DFS      0.83    13.28
GBR      0.71     0.73    11.58
NOR      0.61     0.54     0.86    11.65
USA      0.73     0.76     0.88     0.85     0.24
DEU      0.76     0.73     0.93     0.88     0.88    13.65
AUS      0.56     0.58     0.90     0.86     0.76     0.88    31.30
EST      0.76     0.70     0.90     0.87     0.89     0.93     0.87    11.95
ZAF      0.71     0.77     0.89     0.85     0.87     0.90     0.81     0.88    25.82
NZL      0.49     0.62     0.83     0.82     0.75     0.83     0.96     0.81     0.79     0.40
LTU      0.60     0.65     0.87     0.87     0.86     0.87     0.85     0.92     0.87     0.82     0.34
LVA      0.65     0.63     0.87     0.87     0.85     0.94     0.88     0.95     0.86     0.84     0.90
0.43
NLD      0.85     0.84     0.88     0.75     0.86     0.92     0.79     0.84     0.87     0.75     0.73
0.80     3.75


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

```
SIM    scs
--------------------------------------------------------------------------------
        FRM     FRA     ITA     NLD     CHE     DEA     HUN     SVK     SVN     GBR     HRV
FRM     1.08
FRA     0.92    1.00
ITA     0.96    0.90    14.79
NLD     0.92    0.94    0.86    4.29
CHE     0.93    0.91    0.90    0.91    10.25
DEA     0.94    0.92    0.90    0.91    0.90    12.12
HUN     0.92    0.91    0.92    0.87    0.88    0.93    16.34
SVK     0.88    0.88    0.90    0.87    0.87    0.85    0.92    0.38
SVN     0.88    0.86    0.86    0.86    0.87    0.86    0.87    0.86    9.02
GBR     0.91    0.95    0.88    0.95    0.89    0.91    0.89    0.86    0.85    10.87
HRV     0.91    0.86    0.85    0.86    0.85    0.85    0.87    0.86    0.86    0.85    10.16


--------------------------------------------------------------------------------
SIM    mas
--------------------------------------------------------------------------------
        FRM     FRA     ITA     NLD     CHE     DEA     HUN     SVK     SVN     GBR     HRV
FRM     1.08
FRA     0.88    1.00
ITA     0.96    0.87    14.79
NLD     0.86    0.84    0.86    3.78
CHE     0.92    0.76    0.91    0.82    10.25
DEA     0.93    0.91    0.90    0.87    0.89    12.12
HUN     0.88    0.83    0.92    0.87    0.87    0.89    16.34
SVK     0.86    0.85    0.90    0.82    0.86    0.85    0.90    0.38
SVN     0.86    0.84    0.85    0.73    0.84    0.85    0.84    0.85    9.02
GBR     0.91    0.76    0.88    0.88    0.89    0.89    0.89    0.84    0.82    10.87
HRV     0.87    0.83    0.85    0.64    0.82    0.85    0.85    0.85    0.86    0.82    10.16


--------------------------------------------------------------------------------

        FRM     FRA     ITA     NLD     CHE     DEA     HUN     SVK     SVN     GBR     HRV
```

```
---------
^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    73    46   141   106   110    19    97    55    22
   FRA   66     0    74   114   138   181    17   154    47    43
   NLD   42    60     0    70    79   125    18   105    34    33
   USA  138    75    60     0   283   279    23   191    71    30
   CHE   87    98    69   266     0   504    18   362    59    54
   DEA   95   135   115   247   403     0    26   505    61    76
   NZL   19    13    11    21    14    21     0    18    13     4
   ITA   84   120    83   129   312   406    13     0    57    71
   GBR   56    39    27    69    47    42    11    40     0    16
   SVN   20    43    34    24    54    72     3    72    13     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    64    40   141   106   110    19    97    55    22
   FRA   58     0    54   100   132   160    13   140    43    41
   NLD   34    45     0    58    65   100    17    84    29    30
   USA  138    67    46     0   283   279    23   191    71    30
   CHE   87    96    57   266     0   504    18   362    59    54
   DEA   95   121    88   247   403     0    26   505    61    76
   NZL   19    10    10    21    14    21     0    18    13     4
   ITA   84   112    63   129   312   406    13     0    57    71
   GBR   56    39    24    69    47    42    11    40     0    16
   SVN   20    41    30    24    54    72     3    72    13     0
      -------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN   GBR   USA   AUS   NZL   ZAF
      -------------------------------------------------------------------
   CAN    0    26    60    42    13     1
   GBR   21     0    74    32    13     3
   USA   51    77     0    55    29     6
   AUS   40    27    51     0    26     3
   NZL   11    11    29    26     0     2
   ZAF    0     2     3     2     0     0
      -------------------------------------------------------------------
```

```
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN CHE DEU DFS EST FRA FRR GBR NLD USA ISR ITA AUS HUN BEL JPN ESP ZAF
NZL IRL CZE SVK POL LTU LVA PRT KOR SVN HRV
 ----------------------------------------------------------------------------
   CAN    0  583 1913 1040  164 1118   13 1194 1058 2414   73 1291 1018  722  380 1081  990  404
564  363  779  336  894  149  191  804  467  130  197
   CHE  418    0  871  495  101  452   38  486  647  693   43  524  423  323  313  333  396  198
285  257  368  159  437   70  127  385  158   91  144
   DEU 1025  697    0 2394  307 2110  128 1720 2907 3026  117 2273 1378 1017  648 1285 1271  507
814  641 1501  629 1751  358  307 1094  461  208  459
   DFS  702  399 1310    0  206 1380   48 1241 1683 1672  106 1374 1030  725  457  812  822  429
682  543  981  351 1163  216  210  820  360  173  283
   EST   82   53  204  117    0  180   21  174  272  253   40  198  159  142   83  149  142   80
103   93  187   90  218   52   88  150   73   59   84
   FRA  620  384  916  601   71    0   27 1268 1617 2129   97 1577 1038  753  507 1028  911  402
671  539  967  331 1168  163  177  799  375  137  204
   FRR    7   26  100   32   18   21    0   23   88   29    4   28   24    9   34    7   15   11
11    9   36   25   81    1   23   21    2   14   17
   GBR 1265  432 1115  818   93  690   17    0 1390 1682   96 1284 1093  686  460  847  851  437
739  658  788  301  955  176  177  821  364  151  243
   NLD  835  600 2389 1266  193  861   52 1087    0 2002  111 1492 1191  776  677  875  888  441
850  642 1134  447 1290  205  226  939  348  175  330
   USA 2196  585 1722 1057  160  993   15 1307 1572    0  116 2235 1470 1017  487 1652 1226  551
891  553 1254  441 1444  227  260 1091  626  162  266
   ISR   42   28   96   83   26   51    3   66   91   96    0  104   77   76   42   73   83   52
79   61   84   35   95   30   28   89   42   31   47
   ITA  750  431 1297  877  107  702   23  859 1054 1175   76    0 1011  829  451 1042 1047  441
653  486 1024  344 1198  203  225  897  452  174  281
   AUS  896  351  883  647   68  625   17  863  967 1304   54  632    0  569  419  714  687  407
979  519  653  246  760  146  163  673  312  127  208
   HUN  596  254  781  548   88  483    8  586  626  938   60  664  410    0  291  580  604  330
414  314  709  262  721  138  139  607  340  119  186
   BEL  323  273  555  365   47  448   28  383  705  367   25  354  321  223    0  289  361  203
288  265  318  152  385   74   96  378  143   91  142
   JPN  472  209  465  402   51  329    5  395  424  664   34  419  367  332  168    0  736  363
463  316  657  260  745  136  149  595  403  119  154
   ESP  510  304  761  560   66  613    8  658  754  720   56  724  462  477  319  329    0  379
438  362  654  255  770  149  165  709  332  130  211
   ZAF  335  166  381  315   40  268    7  374  369  516   38  328  340  271  157  250  335    0
316  248  302  151  329   76   94  385  208   72  115
   NZL  552  237  591  441   55  358    8  604  757  810   67  453  952  325  212  240  321  252
0  521  470  205  504  120  111  498  226   95  158
   IRL  278  230  475  383   43  357    7  590  524  424   44  353  397  249  225  175  315  198
398    0  334  149  398   90   95  373  137   76  124
   CZE  459  230 1020  545  114  505   28  460  903  837   59  605  355  603  203  257  396  190
291  191    0  354  968  158  182  623  350  146  250
   SVK  217   77  461  172   42  169   13  160  288  276   15  183  118  186   78   90  123   86
125   73  258    0  339   65   95  267  150   51   97
   POL  589  330 1342  836  148  614   84  684 1051 1149   72  833  495  607  301  355  507  237
345  268  699  215    0  213  244  792  398  165  321
   LTU   65   20  339  111   20   39    0   75  106  136   14  102   52   76   23   34   65   25
52   34   96   32  154    0   71  148   89   33   95
   LVA  109   73  208  130   62   78   19  102  148  208   20  152   77   99   53   66   92   55
54   53  118   46  183   50    0  197   98   44  111
   PRT  807  348 1029  725  101  704   19  784  982 1136   74  846  529  599  361  361  738  367
428  336  502  195  791   98  154    0  359  123  242
   KOR  410  102  283  236   38  194    0  258  220  691   25  350  213  277   74  231  221  157
157   80  241   89  310   43   59  299    0   70   90
   SVN   92   62  185  142   38   89   13  108  145  126   24  142   91   93   72   67   96   53
67   53  108   32  146   16   27  101   38    0   71
   HRV   96   95  472  215   61  118   17  173  293  197   35  219  130  139  119   77  168   82
91   82  183   49  279   67   92  207   38   57    0
 ----------------------------------------------------------------------------
```

```
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  CHE  DEU  DFS  EST  FRA  FRR  GBR  NLD  USA  ISR  ITA  AUS  HUN  BEL  JPN  ESP  ZAF
NZL  IRL  CZE  SVK  POL  LTU  LVA  PRT  KOR  SVN  HRV
 -----------------------------------------------------------------------------
  CAN    0  363 1031  480   83  519    0  598  500 1235   40  788  491  435  238  577  559  177
256  184  477  171  610   95  108  400  295   89  133
  CHE  268    0  869  455  101  380   23  486  607  692   43  523  423  323  313  333  385  198
285  257  368  157  437   70  126  372  158   91  144
  DEU  630  696    0 2252  307 1561   69 1717 2723 3017  117 2270 1374 1017  648 1283 1206  504
811  641 1501  620 1750  357  305 1050  456  208  459
  DFS  388  362 1123    0  195 1015   25 1176 1465 1551  101 1290  967  687  437  767  757  416
651  528  910  319 1084  208  201  755  331  166  271
  EST   46   53  204  106    0  140   15  174  261  252   40  198  159  142   83  148  134   79
102   93  187   89  218   52   88  145   73   59   84
  FRA  319  317  617  435   60    0   11  968 1157 1442   81 1244  779  635  425  762  712  318
506  436  832  253 1006  138  145  639  303  121  175
  FRR    0   20   51   22   14    8    0   14   55   19    3   18   17    5   22    2   10    8
5    5   26   18   68    0   17   15    1   11   15
  GBR  525  432 1115  732   93  536   11    0 1323 1680   96 1284 1093  686  460  847  821  434
737  658  788  294  955  175  175  795  361  151  243
  NLD  423  550 2137  991  183  578   36  991    0 1880  110 1395 1134  738  653  828  802  424
828  628 1083  422 1227  195  211  859  336  172  310
  USA 1112  585 1720  884  160  574   11 1307 1384    0  116 2233 1467 1016  487 1650 1164  547
886  553 1254  434 1443  226  259 1034  620  162  266
  ISR   29   28   96   75   26   46    3   66   89   96    0  104   77   76   42   73   81   52
79   61   84   34   95   30   28   89   42   31   47
  ITA  485  431 1296  776  107  522   17  859  920 1174   76    0 1010  829  450 1042  988  439
653  486 1024  339 1196  203  224  859  450  174  280
  AUS  474  351  883  560   68  481   12  863  888 1304   54  632    0  568  419  714  660  406
977  519  653  238  760  145  162  649  308  127  208
  HUN  391  254  781  505   88  407    5  586  570  938   60  664  410    0  291  580  578  329
413  314  709  260  721  138  138  590  339  119  186
  BEL  213  273  555  341   47  366   20  383  664  367   25  354  321  223    0  289  350  203
288  265  318  148  385   74   95  371  143   91  142
  JPN  347  209  465  361   51  283    2  395  389  664   34  419  367  332  168    0  707  362
460  316  657  254  745  136  147  567  400  119  154
  ESP  274  291  719  498   63  502    7  633  651  677   55  685  437  457  310  306    0  376
427  351  620  243  723  144  163  682  321  126  204
  ZAF  161  166  381  299   40  228    6  374  343  516   38  328  340  271  157  250  332    0
316  248  302  149  327   76   93  381  206   72  114
  NZL  230  237  590  408   54  282    4  604  724  810   67  453  952  325  212  240  312  252
0  520  469  202  504  120  110  485  224   95  158
  IRL  172  230  475  360   43  307    5  590  497  424   44  353  397  249  225  175  308  198
398    0  334  147  397   90   94  368  137   76  124
  CZE  305  230 1020  478  114  392   20  460  833  837   59  605  355  603  203  257  380  190
291  191    0  353  968  158  182  601  347  146  250
  SVK  111   77  460  152   42  122   11  160  268  276   15  182  117  186   78   90  121   86
125   73  258    0  337   65   94  260  150   51   97
  POL  457  330 1342  743  148  518   74  684  974 1149   72  833  495  607  301  355  477  237
345  268  699  215    0  213  244  762  398  165  321
  LTU   48   20  339  101   20   32    0   75   93  136   14  102   52   76   23   34   62   25
52   34   96   32  154    0   70  145   88   33   95
  LVA   66   73  208  121   62   68   15  102  129  208   20  152   77   99   53   66   91   55
54   53  118   46  183   50    0  193   98   44  111
  PRT  379  338 1002  654   99  585   15  771  898 1089   74  825  512  587  355  345  713  365
422  333  493  192  767   95  153    0  348  117  240
  KOR  261  102  283  210   38  161    0  258  197  691   25  350  213  277   74  231  210  157
157   80  241   89  310   43   59  293    0   70   90
  SVN   67   62  185  131   38   80   10  108  141  126   24  142   91   93   72   67   91   53
67   53  108   32  146   16   27   95   38    0   71
  HRV   77   95  472  196   61  104   15  173  269  197   35  219  130  139  119   77  161   82
91   82  183   49  279   67   92  206   38   57    0
 -----------------------------------------------------------------------------
```

```
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN   DFS   GBR   NLD   USA   AUS   ZAF   NZL
-------------------------------------------------------------------------------
  CAN     0    65   123    28   302   193   108   137
  DFS    49     0   125    63   138   105   110   105
  GBR   124   113     0    63   188   166   134   166
  NLD    22    61    58     0    66    53    56    56
  USA   311   110   204    70     0   392   221   295
  AUS   194    70   170    46   422     0   178   338
  ZAF   104    86   132    51   233   170     0   162
  NZL   151    79   170    48   369   383   168     0
-------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN   DFS   GBR   NLD   USA   AUS   ZAF   NZL
-------------------------------------------------------------------------------
  CAN     0    24    50     9   108    70    40    48
  DFS    19     0   120    49   127    95   101    96
  GBR    49   108     0    50   186   166   133   165
  NLD     4    42    46     0    55    46    49    47
  USA    93    89   204    59     0   392   221   295
  AUS    60    58   170    42   422     0   178   337
  ZAF    34    75   132    44   233   170     0   162
  NZL    46    67   170    39   369   382   168     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
-------------------------------------------------------------------------------
  CAN     0   111    60     4   162    11    85     1    66    69    14     7     5
  DFS   107     0    49    93   135    57   142    74    47   135   102    90    35
  GBR    60    48     0    17    68     5    47     1    33    47    12     5    14
  NOR     4    71    18     0    48    17    46    11     0    32    23    16    28
  USA   147   134    64    48     0    21    97    11    54    84    28    12    27
  DEU    10    48     5    17    21     0    33    21     1    14    30    28    13
  AUS    85   118    45    38    98    32     0    16    29   112    40    26    20
  EST     1    64     1    11    10    20    16     0     0     3    21    34     8
  ZAF    68    44    29     0    49     1    29     0     0    29     5     1     3
  NZL    68   133    44    31    84    14   114     2    25     0    23    12    11
  LTU    13    87    11    18    22    28    36    20     5    19     0    35    13
  LVA     7    59     5    14    10    23    25    28     1    10    31     0     9
  NLD     5    35    14    27    24    13    18     7     3    10    11     8     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
-------------------------------------------------------------------------------
  CAN     0    62    28     3    64     5    27     0    33    25    10     4     3
  DFS    59     0    46    94   127    57   160    74    43   133   100    91    31
  GBR    28    45     0    17    66     5    45     1    30    45    12     5    12
  NOR     3    71    18     0    48    17    46    11     0    32    23    16    24
  USA    66   126    64    48     0    21    95    11    50    82    28    12    24
  DEU     5    48     5    17    21     0    33    21     1    14    30    28    13
  AUS    27   139    44    38    97    32     0    16    27   111    40    26    17
  EST     0    64     1    11    10    20    16     0     0     3    21    34     8
  ZAF    35    42    28     0    49     1    29     0     0    27     5     1     2
  NZL    26   129    44    31    84    14   113     2    25     0    23    12     8
  LTU     9    85    11    18    22    28    36    20     5    19     0    35    12
  LVA     4    59     5    14    10    23    25    28     1    10    31     0     7
  NLD     3    31    12    23    21    13    15     7     2     7    10     6     0
-------------------------------------------------------------------------------
```

```
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      FRM  FRA  ITA  NLD  CHE  DEA  HUN  SVK  SVN  GBR  HRV
  ----------------------------------------------------------------------------
   FRM    0    2  142  100  143  198    2   52   17   63    2
   FRA    1    0   94   39    8  172    3   41   38    0   65
   ITA  171   84    0  136   70  639    7  117   76   42  178
   NLD  123   38  131    0   68  185    2   47   36   46   69
   CHE  184    5   74   73    0  242    1   27    4   49    0
   DEA  236  131  542  193  208    0   26  319  140   45  412
   HUN    0    2    6    2    0   14    0    6    5    0    8
   SVK   52   35  100   40   19  325    5    0   37    8   72
   SVN   17   35   73   34    4  126    4   37    0    0   59
   GBR   79    0   46   45   55   46    0    3    0    0    0
   HRV    1   59  172   67    0  432    8   56   49    0    0
  ----------------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      FRM  FRA  ITA  NLD  CHE  DEA  HUN  SVK  SVN  GBR  HRV
  ----------------------------------------------------------------------------
   FRM    0    2  142   89  143  197    2   52   17   63    2
   FRA    1    0   85   29    8  158    3   39   34    0   58
   ITA  171   75    0  115   70  639    7  117   76   42  178
   NLD  108   27  112    0   62  148    2   41   29   41   61
   CHE  184    5   74   65    0  242    1   27    4   49    0
   DEA  235  121  542  155  208    0   26  319  140   45  412
   HUN    0    2    6    2    0   14    0    6    5    0    8
   SVK   52   31  100   35   19  325    5    0   37    8   72
   SVN   17   29   73   29    4  126    4   37    0    0   59
   GBR   79    0   46   41   55   46    0    3    0    0    0
   HRV    1   51  172   59    0  432    8   56   49    0    0
  ----------------------------------------------------------------------------
```