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Introduction
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The latest routine international evaluation for females fertility traits took place
as scheduled at the Interbull Centre. Data from twentyone (21) countries were
included in this evaluation.

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

Based on a decision made by Interbull Steering committee in August 2007,
female fertility traits are classified as follows:

T1 (HC): Maiden (H)eifer's ability to (C)onceive. A measure of confirmed
         conception, such as conception rate (CR), will be considered for this
         trait group. In the absence of confirmed conception an alternative
         measure, such as interval first-last insemination (FL), interval first
         insemination-conception (FC), number of inseminations (NI), or
         non-return rate (NR,preferably NR56) can be submitted;
T2 (CR): Lactating (C)ow's ability to (R)ecycle after calving. The interval
         calving-first insemination (CF) is an example for this ability. In the
         abscence of such a trait, a measure of the interval calving-conception,
         such as says oprn (DO) or calving interval (CI) can be submitted;
T3 (C1): Lactating (C)ow's ability to conceive (1), expressed as a rate trait.
         Traits like conception rate (CR) and non-return rate (NR, preferably
         NR56) will be considered for this trait group;
T4 (C2): Lactating (C)ow's ability to conceive (2), expressed as an interval
         trait. The interval first insemination-conception (FC) or interval
         first-last insemination (FL) will be considered for this trait group.
         As an alternative, number of inseminations (NI) can be submitted.
         In the absence of any of these traits, a measure of interval
         calving-conception such as days open (DO), or calving interval (CI)
         can be submitted. All countries are expected to submit data for this
         trait group, and as a last resort the trait submitted under T3 can be
         submitted for T4 as well.
T5 (IT): Lactating cow's measurements of (I)nterval (T)raits calving-conception,
         such as days open (DO) and calving interval (CI).


Based on the above trait definitions the following traits have been submitted for
international genetic evaluation of female fertility traits.

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Country  Traits  Submitted traits and their definitions
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AUS      T4=C2   Calving interval converted to 42 days pregnancy rate
         T5=IT   Calving interval converted to 42 days pregnancy rate

BEL      T2=CY   PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
         T4=C2   PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
         T5=IT   PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)

CAN      T1=HC   NR=Non Return Rate after 56 Days in heifers (NRR), %
         T2=CY   CF=Interval from Calving to First Service in cows(CF)
         T3=C1   NR=Non Return Rate after 56 Days in cows(NRR), %
         T4=C2   FC=Interval first insemination-conception in cows
         T5=IT   DO=Days open

CHE      T1=HC   CR=Heifers' Conception rate
         T2=CR   CF=Interval from Calving to First Service (ICF), days
         T3=C1   NR=Non Return Rate after 56 Days (NRR), %
         T4=C2   FL=Interval from first to last insemination cows

CZE      T1=HC   CR=Heifers' Conception rate (pregnant or not after 3 months)
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            T3=C1   CR=Cows' Conception rate (pregnant or not after 3 months)
            T4=C2   CR=Cows' Conception rate (pregnant or not after 3 months)

AUT/DEU  T1=HC   NR=Heifers' Non Return Rate after 56 days
            T2=CY   CF=Interval from calving to first insemination cows (days)
            T3=C1   NR=Cows' Non Return Rate after 56 days
            T4=C2   FL=Interval from first to last insemination cows (days)
            T5=IT   DO=Days open (days)

DFS      T1=HC   CR=Heifers' Conception rate for maiden heifers
            T2=CY   CF=Interval from calving to first insemination cows (days)
            T3=C1   CR=Cows' conception rate for cows
            T4=C2   FL=Interval from first to last insemination cows (days)
            T5=IT   DO=Days open (days)

ESP      T2=CY   Interval from Calving to First Service (ICF)
            T3=C1   Conception rate
            T4=C2   Interval first insemination to conception
            T5=IT   Days Open

FRA      T1=HC   CR=Heifers' Conception rate (binary trait) for maiden heifers
            T2=CY   Interval between calving and first AI
            T3=C1   CR=Cows' Conception rate (binary trait)
            T4=C2   FL=Interval from first to last insemination cows (days)
            T5=IT   FL=Interval from first to last insemination cows (days)

GBR      T2=CY   CI=days between 1st and 2nd calvings
            T3=C1   NR=1st lactation non return at 56 days
            T4=C2   CI=days between 1st and 2nd calvings
            T5=IT   CI=days between 1st and 2nd calvings

IRL      T2=CY   CI=Calving interval
            T4=C2   CI=Calving interval
            T5=IT   CI=Calving interval

ISR      T3=C1   CR=Inverse of the number of insemination to conception (%)
            T4=C2   CR=Inverse of the number of insemination to conception (%)

ITA      T1=HC   NR= non-return rate 56 days (heifers)
            T2=CY   CF=Days to first service
            T3=C1   NR=Non-return rate at 56 days (%)
            T4=C2   FL=Interval from first to last insemination cows (days)
            T5=IT   DO=days open (days)

ITA(BSW) T2=CY   CF=Interval calving to first insemination
            T4=C2   Days Open
            T5=IT   CI=Calving interval

NLD      T1=HC   CR=Heifers' Conception rate
            T2=CY   CF=Interval calving to first insemination (days)
            T3=C1   CR=Cows' Conception rate (binary trait) for cows
            T4=C2   FL=Interval from first to last insemination cows (days)
            T5=IT   CI=Days Open

NOR      T1=HC   NI=Number of inseminations (heifers)
            T2=CY   CF=Days from calving to first insemination (days)
            T3=C1   NI=Number of inseminations (cows)
            T4=C2   NI=Number of inseminations (cows)
            T5=IT   CF=Days from calving to first insemination (days)

NZL      T2=CY   PM=Lactating cow's ability to start cycling
            T4=C2   CR= Cow's conception rate at 42 days
            T5=IT   CR= Cow's conception rate at 42 days

POL      T1=HC   CR=Conception Rate (heifer)
            T2=CR   CF=Interval from calving to first insemination
            T3=C1   CR=Conception Rate (cow)
            T4=IT   DO=Days open
            T5=IT   DO=Days open
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URY      T4=C2   Days open expressed as Daughter Pregnancy Rate
         T5=IT   Days open expressed as Daughter Pregnancy Rate

USA      T1=HC   CR=Conception rate (heifer)
         T2=CY   CF=Interval from calving to first insemination
         T3=C1   CR=Conception rate (cow)
         T4=C2   DP=Daughter Pregnancy Rate
         T5=IT   DP=Daughter Pregnancy Rate

ZAF      T4=IT   CI=Calving Interval
         T5=IT   CI=Calving Interval

JPN      T1=HC   CR=Heifers'Conception rate
         T3=C1   CR=Cows'Conception rate
         T4=C2   DO=Days open
         T5=IT   DO=Days open

SVN      T5=IT   CI=Calving interval (days)
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CHANGES IN NATIONAL PROCEDURES

Changes in the national genetic evaluation of female fertility traits are as
follows:

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JPN (HOL)      Decrease in information due to the pedigree updates.
AUS (ALL)      Decrease in information due to the pedigree updates and status changes of some bulls which then leads to no longer qualifying.
CHE (ALL)      Decrease in information due to the manual edits/ data correction in data base, change of hys assignment
ITA (BSW)      Decrease in information due to routine database adjusments.
POL (HOL)      Decrease in information due to data edits
USA (ALL)      Decrease in information due to the pedigree correction and heard-year minimum edits.
NZL(ALL)       Decrease in information due to continuous DNA parentage testing and some update in phenotype records.
ESP (HOL)      Base change
CZE (HOL)      Drop in information due to trimming old insemintaion phenotypes: since last evaluation the second half of year 2007 has been trimmed.
               Pedigree verification
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INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

Post-processing Windows:

According to the decision taken by ITC in Orlando (2015) to review the
post-processing windows every 5 years, during the 2020 the relative working group
has been re-activated and new windows have been identified.

As before, 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. Over the past five years, in fact, the previous adopted lower value (25th percentile) had been found too high
causing estimated and post-processed correlations to differ significantly from each other.
The new lower values have been applied to all breeds and traits.

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.
The new weights are as follows:
No changes   :: 2
Small changes:: 1
Big changes :: 0

More information can be read on https://interbull.org/ib/rg_procedure

DATA AND METHOD OF ANALYSIS

Data were national genetic evaluations of AI sampled bulls with at least
10 daughters or 10 EDC (for clinical mastitis and maternal calving traits at least
50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at
least 10 herds. Table 1 presents the amount of data included
in this Interbull evaluation for all breeds.

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

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

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.

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PUBLICATION OF INTERBULL ROUTINE RUN
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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
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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 fertility (August Routine Evaluation 2023).
Number of records for lactating cow's ability to conceive (cc2) by breed
------------------------------------------------------------------------------------------------
Country      BSW        GUE        HOL         JER         RDC          SIM
------------------------------------------------------------------------------------------------
AUS                     149        8728        1857         790
BEL                                2106
CAN          184        50         10297        643         595
CHE          3009                  3274
CZE                                3648
DEA          4937
DEU                                25558                    316
DFS                                17362       2512        10601
ESP                                6610
EST
FRA          436                   17222
FRM
GBR          110        253        7620         621         462
HUN
IRL                                3333         242          75
ISR                                1659
ITA          1959                  9400
JPN                                6611
KOR
LTU
LVA
NLD          220                   16593        246          96
NOR                                                        3117
NZL          55         49         8483        4883        1327
POL                                9095
PRT
SVK
SVN
URY                                1953
USA          1197       796        42128       5315         795
ZAF                                1276         748         158
HRV
CAM
================================================================================================
No.Records   12107      1297       202956      17067       18332
Pub. Proofs  10664      1071       158535      14194       18099          0
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW    hco
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        CAN     DEA     FRA     USA     CHE     NLD
CAN     9.40
DEA     0.86    9.89
FRA     0.77    0.86    0.88
USA     0.78    0.80    0.88    2.63
CHE     0.90    0.94    0.87    0.81    13.17
NLD     0.79    0.65    0.74    0.75    0.67    4.62

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BSW    crc
------------------------------------------------------------------------------------------

        CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN     6.80
CHE     0.82    11.36
DEA     0.78    0.95    15.00
NLD     0.83    0.87    0.86    3.60
NZL     0.61    0.61    0.69    0.62    0.12
USA     0.77    0.84    0.81    0.79    0.60    8.13
GBR     0.71    0.70    0.63    0.74    0.64    0.73    3.95
FRA     0.82    0.96    0.95    0.88    0.63    0.84    0.74    1.78
ITA     0.82    0.78    0.79    0.80    0.65    0.78    0.74    0.81    16.21

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BSW    cc1
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        CAN     CHE     DEA     NLD     USA     GBR     FRA
CAN     7.55
CHE     0.82    11.79
DEA     0.79    0.94    11.47
NLD     0.75    0.70    0.67    3.91
USA     0.75    0.68    0.67    0.81    2.85
GBR     0.77    0.81    0.78    0.71    0.68    0.03
FRA     0.74    0.69    0.67    0.84    0.88    0.72    0.96

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BSW    cc2
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        CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN     6.60
CHE     0.78    11.10
DEA     0.77    0.93    12.29
NLD     0.83    0.80    0.79    3.28
NZL     0.71    0.66    0.73    0.70    6.11
USA     0.81    0.83    0.83    0.79    0.70    2.48
GBR     0.71    0.81    0.81    0.73    0.70    0.81    3.95
FRA     0.84    0.87    0.87    0.84    0.70    0.82    0.79    0.96
ITA     0.80    0.70    0.78    0.80    0.67    0.80    0.77    0.76    21.49

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BSW    int
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        CAN     DEA     NLD     NZL     USA     GBR     ITA     SVN
CAN     7.22
DEA     0.80    14.31
NLD     0.84    0.89    3.17
NZL     0.68    0.81    0.69    6.11
USA     0.91    0.83    0.79    0.68    2.48
GBR     0.82    0.73    0.83    0.67    0.82    3.95
ITA     0.85    0.92    0.86    0.68    0.79    0.82    17.49
SVN     0.72    0.68    0.72    0.71    0.71    0.76    0.71    19.95

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GUE    crc
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         CAN      GBR      NZL      USA      AUS
CAN     7.78
GBR     0.74     4.77
NZL     0.61     0.64     0.11
USA     0.78     0.76     0.60     6.85
AUS     0.68     0.79     0.89     0.66     6.97

------------------------------------------------------------------------------------
GUE    cc1
------------------------------------------------------------------------------------
         CAN      GBR      USA
CAN     7.54
GBR     0.77     0.03
USA     0.81     0.73     3.46

------------------------------------------------------------------------------------
GUE    cc2
------------------------------------------------------------------------------------
         CAN      GBR      NZL      USA      AUS
CAN     7.37
GBR     0.70     4.77
NZL     0.69     0.70     5.88
USA     0.85     0.81     0.70     2.80
AUS     0.68     0.68     0.69     0.72    10.26

------------------------------------------------------------------------------------
GUE    int
------------------------------------------------------------------------------------
         CAN      GBR      NZL      USA      AUS
CAN     8.16
GBR     0.82     4.77
NZL     0.67     0.67     5.88
USA     0.90     0.81     0.67     2.80
AUS     0.73     0.70     0.72     0.73    10.26

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HOL    hco
------------------------------------------------------------------------------------
         CAN      CZE      DEU      DFS      FRA      USA      POL      CHE      NLD      ITA      JPN
CAN     7.83
CZE     0.77    17.80
DEU     0.90     0.80    15.18
DFS     0.79     0.84     0.84    13.54
FRA     0.81     0.80     0.82     0.89     0.83
USA     0.84     0.85     0.84     0.87     0.88     2.38
POL     0.63     0.53     0.63     0.52     0.52     0.56    19.60
CHE     0.96     0.79     0.93     0.79     0.84     0.86     0.55    13.64
NLD     0.81     0.77     0.83     0.86     0.84     0.83     0.51     0.80     5.20
ITA     0.80     0.77     0.92     0.73     0.75     0.80     0.63     0.87     0.73     0.04
JPN     0.85     0.71     0.84     0.72     0.78     0.84     0.63     0.84     0.75     0.73     6.19

------------------------------------------------------------------------------------
HOL    crc
------------------------------------------------------------------------------------
         BEL      CAN      CHE      DEU      DFS      ESP      GBR      IRL      ITA      NLD      NZL      USA      POL      FRA
BEL     4.63
CAN     0.75     7.29
CHE     0.81     0.83    12.28
DEU     0.72     0.83     0.87    10.92
DFS     0.79     0.86     0.94     0.92    11.59
ESP     0.77     0.79     0.81     0.79     0.80    10.95
GBR     0.89     0.74     0.77     0.72     0.79     0.76     4.59
IRL     0.85     0.60     0.67     0.60     0.62     0.71     0.82     3.55
ITA     0.80     0.86     0.86     0.86     0.86     0.83     0.80     0.67     7.60
NLD     0.80     0.84     0.90     0.86     0.93     0.80     0.77     0.60     0.82     4.47
NZL     0.60     0.60     0.61     0.59     0.62     0.60     0.63     0.56     0.69     0.58     0.09
USA     0.74     0.78     0.82     0.82     0.86     0.78     0.78     0.59     0.80     0.79     0.60     6.84
POL     0.75     0.90     0.89     0.85     0.84     0.81     0.74     0.66     0.95     0.80     0.67     0.76    13.58
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FRA       0.78    0.85    0.94    0.92    0.94    0.81    0.79    0.65    0.90    0.91    0.63    0.82    0.88    1.18

------------------------------------------------------------------------------------
HOL     cc1
------------------------------------------------------------------------------------
          CAN     CHE     CZE     DEU     DFS     FRA     GBR     ISR     ITA     NLD     USA     POL     JPN
CAN       6.71
CHE       0.93   10.88
CZE       0.83    0.75   17.42
DEU       0.91    0.92    0.80   14.71
DFS       0.75    0.69    0.87    0.78   13.16
FRA       0.78    0.75    0.90    0.76    0.89    1.02
GBR       0.76    0.77    0.70    0.78    0.66    0.73    0.03
ISR       0.78    0.70    0.92    0.77    0.87    0.89    0.75    3.26
ITA       0.87    0.86    0.80    0.94    0.71    0.75    0.79    0.79    0.05
NLD       0.76    0.74    0.87    0.78    0.90    0.92    0.71    0.87    0.72    4.60
USA       0.80    0.71    0.95    0.75    0.84    0.87    0.67    0.93    0.78    0.83    2.81
POL       0.73    0.75    0.72    0.74    0.60    0.61    0.66    0.67    0.78    0.61    0.64   19.62
JPN       0.78    0.76    0.89    0.76    0.83    0.82    0.76    0.85    0.76    0.80    0.92    0.66    7.57

------------------------------------------------------------------------------------
HOL     cc2
------------------------------------------------------------------------------------
          BEL     CAN     CHE     CZE     DEU     DFS     ESP     FRA     GBR     IRL     ISR     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     JPN
BEL       4.63
CAN       0.75    6.19
CHE       0.82    0.90   10.97
CZE       0.65    0.87    0.87   17.42
DEU       0.79    0.93    0.92    0.91   13.47
DFS       0.81    0.85    0.88    0.83    0.94   12.84
ESP       0.74    0.76    0.83    0.84    0.79    0.75   10.94
FRA       0.82    0.89    0.93    0.84    0.93    0.86    0.79    0.97
GBR       0.89    0.71    0.74    0.66    0.77    0.80    0.73    0.75    4.59
IRL       0.84    0.76    0.83    0.70    0.80    0.77    0.75    0.82    0.82    3.56
ISR       0.64    0.74    0.74    0.87    0.83    0.78    0.80    0.78    0.65    0.68    3.26
ITA       0.76    0.86    0.88    0.90    0.91    0.84    0.86    0.86    0.79    0.80    0.88   15.02
NLD       0.79    0.86    0.88    0.83    0.94    0.90    0.76    0.91    0.73    0.78    0.79    0.84    4.34
NZL       0.69    0.68    0.63    0.63    0.68    0.69    0.64    0.68    0.69    0.69    0.61    0.63    0.69    4.59
USA       0.80    0.86    0.85    0.88    0.90    0.86    0.78    0.81    0.82    0.82    0.82    0.91    0.81    0.69    2.35
POL       0.80    0.71    0.73    0.63    0.71    0.72    0.71    0.72    0.81    0.78    0.64    0.80    0.70    0.69    0.79   12.42
ZAF       0.77    0.78    0.82    0.72    0.82    0.76    0.73    0.79    0.78    0.87    0.64    0.84    0.74    0.62    0.87    0.81   15.46
AUS       0.69    0.68    0.73    0.63    0.70    0.64    0.65    0.71    0.69    0.84    0.63    0.69    0.64    0.62    0.72    0.62    0.79    8.44
URY       0.72    0.70    0.66    0.62    0.70    0.70    0.65    0.70    0.71    0.71    0.57    0.64    0.69    0.72    0.70    0.72    0.78    0.67    1.39
JPN       0.84    0.82    0.85    0.77    0.84    0.85    0.76    0.81    0.86    0.86    0.71    0.87    0.78    0.68    0.92    0.89    0.89    0.71    0.72   18.29

------------------------------------------------------------------------------------
HOL     int
------------------------------------------------------------------------------------
          BEL     CAN     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     FRA     JPN     SVN
BEL       4.63
CAN       0.88    6.66
DEU       0.86    0.91   12.30
DFS       0.90    0.91    0.95   12.75
ESP       0.86    0.80    0.81    0.83   10.94
GBR       0.89    0.83    0.86    0.89    0.82    4.59
IRL       0.85    0.83    0.83    0.80    0.84    0.83    3.56
ITA       0.85    0.89    0.90    0.89    0.87    0.87    0.83   19.54
NLD       0.90    0.87    0.89    0.94    0.81    0.85    0.80    0.86    4.28
NZL       0.69    0.66    0.66    0.66    0.66    0.66    0.66    0.66    0.66    4.59
USA       0.81    0.93    0.91    0.88    0.84    0.83    0.82    0.91    0.82    0.66    2.35
POL       0.81    0.86    0.79    0.82    0.76    0.82    0.78    0.91    0.79    0.67    0.79   12.42
ZAF       0.79    0.84    0.85    0.81    0.83    0.81    0.87    0.86    0.79    0.66    0.88    0.84   15.46
AUS       0.72    0.73    0.71    0.69    0.71    0.71    0.84    0.70    0.68    0.66    0.74    0.69    0.81    8.44
URY       0.73    0.69    0.69    0.69    0.69    0.70    0.74    0.72    0.68    0.72    0.68    0.72    0.80    0.70    1.39
FRA       0.81    0.87    0.81    0.81    0.79    0.73    0.80    0.81    0.80    0.66    0.80    0.70    0.78    0.72    0.66    0.97
JPN       0.85    0.93    0.90    0.90    0.84    0.87    0.84    0.93    0.86    0.66    0.92    0.90    0.89    0.73    0.74    0.79   18.29
SVN       0.88    0.75    0.77    0.84    0.76    0.80    0.76    0.81    0.83    0.66    0.72    0.67    0.65    0.68    0.67    0.79    0.76   20.10

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

```
JER     hco
------------------------------------------------------------------------------------
         CAN     DFS     USA     NLD
CAN      7.96
DFS      0.73   17.21
USA      0.77    0.83    2.72
NLD      0.82    0.82    0.72    4.80


------------------------------------------------------------------------------------
JER     crc
------------------------------------------------------------------------------------
         CAN     DFS     GBR     NLD     NZL     USA     IRL
CAN      6.96
DFS      0.82   13.42
GBR      0.66    0.84    3.89
NLD      0.81    0.83    0.69    3.35
NZL      0.57    0.69    0.66    0.56    0.07
USA      0.77    0.83    0.78    0.76    0.66    8.20
IRL      0.62    0.62    0.79    0.60    0.56    0.60    2.39


------------------------------------------------------------------------------------
JER     cc1
------------------------------------------------------------------------------------
         CAN     DFS     GBR     NLD     USA
CAN      7.01
DFS      0.71   15.33
GBR      0.78    0.67    0.03
NLD      0.73    0.77    0.68    3.58
USA      0.75    0.82    0.67    0.70    2.88


------------------------------------------------------------------------------------
JER     cc2
------------------------------------------------------------------------------------
         CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN      6.83
DFS      0.80   15.59
GBR      0.71    0.75    3.90
NLD      0.80    0.81    0.71    3.18
NZL      0.70    0.70    0.69    0.70    3.96
USA      0.80    0.80    0.78    0.75    0.70    2.61
ZAF      0.67    0.66    0.73    0.67    0.76    0.85   11.37
AUS      0.64    0.65    0.65    0.64    0.62    0.65    0.71    6.40
IRL      0.76    0.74    0.77    0.75    0.70    0.77    0.78    0.73    2.39


------------------------------------------------------------------------------------
JER     int
------------------------------------------------------------------------------------
         CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN      6.61
DFS      0.84   15.35
GBR      0.76    0.83    3.90
NLD      0.80    0.83    0.76    3.09
NZL      0.67    0.67    0.67    0.67    3.96
USA      0.83    0.82    0.78    0.74    0.69    2.61
ZAF      0.72    0.72    0.75    0.71    0.76    0.85   11.37
AUS      0.70    0.69    0.69    0.67    0.66    0.69    0.73    6.40
IRL      0.80    0.74    0.76    0.75    0.67    0.76    0.80    0.76    2.39


------------------------------------------------------------------------------------
RDC     hco
------------------------------------------------------------------------------------
         CAN     DEU     DFS     NOR     USA     NLD
CAN      7.66
DEU      0.90   14.55
DFS      0.73    0.80   12.25
NOR      0.86    0.87    0.87   16.47
USA      0.83    0.82    0.83    0.73    2.80
NLD      0.81    0.83    0.78    0.66    0.78    5.97
```

```
--------------------------------------------------------------------------------
RDC    crc
--------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     IRL
CAN      6.51
DEU      0.83   10.16
DFS      0.85    0.90   12.68
GBR      0.77    0.71    0.70    4.16
NOR      0.84    0.81    0.85    0.62   14.02
NZL      0.59    0.59    0.55    0.65    0.58    0.11
USA      0.77    0.81    0.80    0.76    0.77    0.69    8.42
NLD      0.82    0.83    0.87    0.72    0.81    0.57    0.77    3.25
IRL      0.61    0.60    0.63    0.81    0.62    0.57    0.61    0.60    2.85

--------------------------------------------------------------------------------
RDC    cc1
--------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN      7.29
DEU      0.90   13.97
DFS      0.71    0.80   12.99
GBR      0.77    0.78    0.67    0.03
NOR      0.78    0.85    0.93    0.77   13.95
NLD      0.76    0.78    0.86    0.70    0.70    3.93
USA      0.82    0.75    0.78    0.67    0.74    0.79    2.76

--------------------------------------------------------------------------------
RDC    cc2
--------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.90
DEU      0.92   11.43
DFS      0.81    0.94   12.83
GBR      0.72    0.77    0.76    4.16
NOR      0.80    0.83    0.89    0.73   13.95
NZL      0.70    0.70    0.70    0.70    0.72    5.70
USA      0.87    0.89    0.81    0.79    0.73    0.70    2.53
ZAF      0.71    0.81    0.74    0.71    0.78    0.65    0.81   17.10
NLD      0.86    0.93    0.86    0.74    0.75    0.71    0.80    0.74    3.38
AUS      0.66    0.68    0.64    0.67    0.65    0.63    0.68    0.67    0.65    7.64
IRL      0.77    0.80    0.77    0.80    0.73    0.70    0.79    0.84    0.78    0.80    2.85

--------------------------------------------------------------------------------
RDC    int
--------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.66
DEU      0.90   11.24
DFS      0.88    0.94   13.17
GBR      0.82    0.85    0.81    4.16
NOR      0.78    0.77    0.70    0.71   14.02
NZL      0.67    0.68    0.67    0.68    0.69    5.70
USA      0.92    0.89    0.79    0.81    0.70    0.67    2.53
ZAF      0.82    0.85    0.78    0.75    0.82    0.68    0.83   17.10
NLD      0.87    0.89    0.91    0.83    0.78    0.67    0.79    0.79    3.06
AUS      0.72    0.71    0.69    0.71    0.71    0.67    0.72    0.74    0.67    7.64
IRL      0.82    0.82    0.78    0.80    0.71    0.68    0.79    0.85    0.79    0.81    2.85

------------------------------------------------------------------------------------------------------
^LAPPENDIX II. Number of common bulls
------------------------------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
common three quarter sib group above diagonal
       CAN  DEA  FRA  USA  CHE  NLD
 ------------------------------------------------------------------------------
  CAN    0  100   54  105  102   30
  DEA   88    0  195  197  600  138
```

```
   FRA   46  153    0   73  167   73
   USA   95  157   55    0  209   52
   CHE   85  506  128  175    0  100
   NLD   27  129   61   48   94    0
--------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
--------------------------------------------------------------------------------
   CAN    0  122  120   40   18  137   49   73  114
   CHE  103    0  612  108   27  274   65  169  460
   DEA  107  508    0  157   40  242   60  202  604
   NLD   35   99  144    0   25   64   35   78  131
   NZL   17   21   35   19    0   18   14   21   32
   USA  134  239  192   58   15    0   67   95  175
   GBR   46   50   46   31   11   65    0   47   71
   FRA   62  128  157   64   16   64   39    0  187
   ITA  100  394  491  106   26  123   53  147    0
--------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  CHE  DEA  NLD  USA  GBR  FRA
--------------------------------------------------------------------------------
   CAN    0  123  121   41  138   48   77
   CHE  104    0  609  107  274   67  177
   DEA  108  504    0  156  240   63  214
   NLD   36   99  144    0   63   35   82
   USA  135  239  190   58    0   69  100
   GBR   46   52   48   31   68    0   52
   FRA   66  135  168   69   70   45    0
--------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
--------------------------------------------------------------------------------
   CAN    0  110  107   36   15  133   46   70  102
   CHE   91    0  603  108   25  330   65  177  460
   DEA   95  501    0  157   35  315   60  213  599
   NLD   32   99  144    0   20   86   35   82  131
   NZL   14   19   30   14    0   25   11   18   27
   USA  125  306  272   75   21    0   77  120  222
   GBR   42   50   46   31    8   75    0   50   71
   FRA   61  135  167   69   13   84   43    0  199
   ITA   90  394  488  106   23  155   53  158    0
--------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEA  NLD  NZL  USA  GBR  ITA  SVN
--------------------------------------------------------------------------------
   CAN    0  112   38   15  138   48  109   26
   DEA   99    0  157   35  314   60  701   79
   NLD   34  144    0   20   87   35  136   39
   NZL   14   30   14    0   25   11   27    7
   USA  130  272   75   21    0   77  243   33
   GBR   44   46   31    8   75    0   72   17
   ITA   96  621  112   23  173   53    0   76
   SVN   24   75   39    7   30   14   74    0
--------------------------------------------------------------------------------
GUE
--------
GUE
```

```
 --------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  NZL  USA  AUS
 --------------------------------------------------------------------------------
  CAN     0   17    2   41   18
  GBR    14    0   14   56   28
  NZL     1   12    0   10   25
  USA    40   53    7    0   19
  AUS    13   22   23   16    0
 --------------------------------------------------------------------------------
GUE
 --------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  USA
 --------------------------------------------------------------------------------
  CAN     0   19   42
  GBR    15    0   59
  USA    41   56    0
 --------------------------------------------------------------------------------
GUE
 --------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  NZL  USA  AUS
 --------------------------------------------------------------------------------
  CAN     0   14    0   41   25
  GBR    11    0   13   86   35
  NZL     0   11    0   24   23
  USA    39   87   23    0   69
  AUS    21   29   23   66    0
 --------------------------------------------------------------------------------
GUE
 --------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  NZL  USA  AUS
 --------------------------------------------------------------------------------
  CAN     0   14    0   41   25
  GBR    11    0   13   86   35
  NZL     0   11    0   24   23
  USA    39   87   23    0   69
  AUS    21   29   23   66    0
 --------------------------------------------------------------------------------
HOL
 --------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  CZE  DEU  DFS  FRA  USA  POL  CHE  NLD  ITA  JPN
 --------------------------------------------------------------------------------
  CAN     0 1122 2332 1443 1317 3066 1424  855 1460 1917 1182
  CZE   837    0 1875 1273 1228 1516 1233  498 1522 1352  834
  DEU  1926 1443    0 2716 2371 3072 2389 1158 3187 2752 1355
  DFS  1372  869 2101    0 1702 1812 1492  753 2278 1709  998
  FRA  1000  763 1369 1011    0 1697 1526  721 1975 1682 1142
  USA  3545 1247 2490 1683 1041    0 2059  910 1964 2610 1510
  POL  1314  997 2143 1257 1068 2188    0  567 1692 1707  864
  CHE   780  351 1084  708  665  843  462    0  920  786  473
  NLD  1446 1320 2858 2005 1321 1770 1546  915    0 1824 1088
  ITA  1717 1016 2044 1466 1045 2251 1438  737 1581    0 1183
  JPN   684  377  628  539  431  819  478  309  567  582    0
 --------------------------------------------------------------------------------
HOL
 --------
 common bulls below diagonal
 common three quarter sib group above diagonal
         BEL  CAN  CHE  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  USA  POL  FRA
 --------------------------------------------------------------------------------
```

```
   BEL    0  806  633 1268  904  941  901  542  832 1288  534  867  613  992
   CAN  808    0  887 2485 1522 1658 1711  598 1948 1614  742 3266 1314 1419
   CHE  638  817    0 1199  760  759  780  454  786  972  448  971  536  736
   DEU 1298 1994 1134    0 2892 2389 2350  980 2753 3697 1069 3343 2165 2614
   DFS  849 1443  718 2177    0 1616 1696  806 1687 2331  898 1964 1352 1718
   ESP 1012 1477  711 2129 1454    0 1586  749 1762 1854  772 1965 1299 1838
   GBR  884 1794  749 1822 1359 1457    0 1064 1703 1990 1003 2172 1152 1649
   IRL  533  594  465  861  684  769 1112    0  656  979  800  729  442  791
   ITA  840 1732  735 2038 1437 1620 1419  605    0 1899  714 2700 1496 1675
   NLD 1467 1621  971 3454 2111 1951 1774  930 1675    0 1160 2233 1590 2106
   NZL  432  678  374  822  649  637  863  696  571 1048    0  897  487  836
   USA  826 3836  906 2611 1774 1763 2148  720 2263 2042  839    0 1864 1901
   POL  524 1193  418 1841 1109 1087  917  341 1191 1413  369 1890    0 1440
   FRA  979 1088  672 1505 1006 1769 1092  646 1037 1398  517 1145  962    0
   ------------------------------------------------------------------------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  CZE  DEU  DFS  FRA  GBR  ISR  ITA  NLD  USA  POL  JPN
   ------------------------------------------------------------------------
   CAN    0  889 1065 2484 1529 1424 1751  136 1956 1619 3311 1362 1321
   CHE  819    0  444 1197  760  741  790   62  786  972  971  560  504
   CZE  828  319    0 1655 1107 1048  955  119 1228 1390 1474 1192  751
   DEU 1988 1132 1332    0 2887 2632 2384  175 2734 3683 3320 2315 1547
   DFS 1451  718  846 2165    0 1722 1730  157 1686 2330 1968 1449 1057
   FRA 1102  680  654 1520 1012    0 1679  124 1677 2117 1907 1495 1273
   GBR 1846  763  684 1854 1387 1113    0  160 1742 2030 2239 1216 1148
   ISR   98   36   91  138  118   69  118    0  147  163  185  119  115
   ITA 1742  735  959 2021 1434 1045 1453  108    0 1895 2698 1559 1213
   NLD 1629  971 1281 3438 2110 1415 1818  129 1670    0 2234 1712 1156
   USA 3894  906 1231 2584 1774 1156 2228  180 2260 2043    0 1928 1711
   POL 1257  454  995 2076 1231 1026  996   90 1266 1581 1979    0  874
   JPN  795  345  394  711  602  497  615   50  644  653  963  498    0
   ------------------------------------------------------------------------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      BEL  CAN  CHE  CZE  DEU  DFS  ESP  FRA  GBR  IRL  ISR  ITA  NLD  NZL  USA  POL  ZAF  AUS  URY  JPN
   ------------------------------------------------------------------------
   BEL    0  797  633  550 1259  905  941  990  903  544   78  827 1290  514 1017  602  334  774  354  543
   CAN  796    0  879 1049 2423 1502 1644 1386 1686  587  133 1911 1589  687 3423 1277  445 1369  760 1230
   CHE  638  801    0  444 1185  761  759  731  780  454   63  782  972  426 1067  524  263  673  322  474
   CZE  442  805  319    0 1653 1107 1075 1039  946  433  119 1226 1390  480 1518 1113  279  716  466  721
   DEU 1288 1919 1119 1326    0 2877 2394 2591 2339  975  175 2699 3656 1017 3866 2107  559 1795  835 1470
   DFS  849 1414  719  846 2156    0 1624 1711 1700  806  159 1676 2334  860 2355 1328  512 1367  668 1004
   ESP 1012 1443  711  880 2121 1461    0 1836 1589  750  141 1754 1859  744 2282 1277  517 1253  688 1158
   FRA  974 1049  666  646 1465  992 1754    0 1646  792  126 1651 2090  820 2593 1408  481 1350  614 1215
   GBR  884 1757  749  678 1802 1359 1458 1083    0 1065  157 1694 1993  969 2550 1130  505 1531  719 1088
   IRL  533  575  465  331  855  684  769  641 1112    0  108  655  982  783  893  430  338  800  399  473
   ISR   47   91   36   91  136  118  106   67  113   83    0  146  165  113  210  113   60  120   89  112
   ITA  836 1680  731  954 1985 1426 1612 1014 1416  605  108    0 1884  677 2818 1454  438 1211  693 1157
   NLD 1469 1587  971 1281 3389 2112 1954 1373 1775  931  129 1662    0 1094 2794 1545  501 1565  712 1102
   NZL  411  624  355  362  768  611  614  495  835  681   93  544  985    0 1137  446  355 1237  540  575
   USA  906 3920 1002 1255 2841 1909 2031 1428 2393  821  197 2306 2477 1074    0 1869  636 2087 1205 2011
   POL  505 1138  402  883 1755 1079 1062  923  895  329   78 1143 1351  334 1859    0  231  828  494  804
   ZAF  281  409  222  200  429  379  476  336  444  297   39  361  415  283  612  159    0  476  315  411
   AUS  674 1398  599  509 1362 1013 1034  929 1361  693   78  972 1362 1231 2139  621  416    0  691  932
   URY  264  716  243  312  595  460  601  361  581  312   49  518  552  442 1470  381  267  540    0  580
   JPN  343  669  300  353  616  529  564  434  538  296   41  564  567  283  836  419  260  501  291    0
   ------------------------------------------------------------------------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      BEL  CAN  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  USA  POL  ZAF  AUS  URY  FRA  JPN  SVN
   ------------------------------------------------------------------------
   BEL    0  799 1257  905  941  903  544  826 1290  514 1017  601  334  774  354  990  543  153
```

```
   CAN   800      0 2428 1510 1650 1695   593 1918 1598   692 3436 1279   449 1377   766 1394 1235   198
   DEU  1287  1928     0 2875 2393 2339   975 2698 3654  1017 3862 2100   559 1795   835 2591 1470   311
   DFS   849  1424  2153     0 1624 1700   806 1676 2332   860 2354 1326   512 1367   668 1711 1004   237
   ESP  1012  1459  2121 1461     0 1589   750 1754 1857   744 2279 1277   517 1252   688 1835 1156   225
   GBR   884  1770  1802 1359 1458     0 1065 1694 1993   969 2550 1129   505 1531   718 1646 1088   192
   IRL   533   583   855  684  769 1112     0  655  981   783  893  430   338  800   399  792  473   105
   ITA   836  1692  1985 1426 1612 1416   605     0 1884   677 2818 1448   438 1211   693 1651 1157   238
   NLD  1469  1600  3388 2111 1954 1775   931 1662     0  1094 2793 1542   501 1565   712 2089 1101   252
   NZL   411   627   768  611  614  835   681  544  985     0 1137  446   355 1237   540  820  575   110
   USA   906  3950  2841 1909 2031 2393   821 2306 2477  1074    0 1866   636 2087  1205 2593 2011   227
   POL   505  1144  1751 1078 1062  895   329 1142 1351   334 1859    0   231  828   494 1408  803   233
   ZAF   281   416   429  379  476  444   297  361  415   283  612  159     0  476   315  481  411    67
   AUS   674  1403  1362 1013 1034 1361   693  972 1362  1231 2139  621   416    0   691 1350  932   150
   URY   264   722   595  460  601  581   312  518  552   442 1470  381   267  540     0  614  580    80
   FRA   974  1057  1465  992 1754 1083   641 1014 1373   495 1428  923   336  929   361    0 1215   189
   JPN   343   672   616  529  564  538   296  564  567   283  836  419   260  501   291  434     0   150
   SVN   119   150   303  185  201  141    82  201  220    77  182  194    47  104    42  138    79     0
-------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  USA  NLD
-------------------------------------------------------------------------------
  CAN    0  104  344   34
  DFS  100    0  157   90
  USA  334  147    0   73
  NLD   27   88   74    0
-------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  GBR  NLD  NZL  USA  IRL
-------------------------------------------------------------------------------
  CAN    0  108  158   42  170  402   14
  DFS  102    0  179  158  162  175   58
  GBR  159  175    0   95  226  225   79
  NLD   36  157   89    0   89   99   40
  NZL  172  139  231   81    0  300  150
  USA  405  165  244  101  323    0   46
  IRL   13   54   82   39  167   48    0
-------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  GBR  NLD  USA
-------------------------------------------------------------------------------
  CAN    0  108  159   42  406
  DFS  102    0  179  157  174
  GBR  159  175    0   95  225
  NLD   36  156   90    0   98
  USA  409  165  244  101    0
-------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
-------------------------------------------------------------------------------
  CAN    0  104  156   41  157  404  134  231   14
  DFS   98    0  180  158  157  225  159  169   58
  GBR  155  175    0   95  222  253  178  234   79
  NLD   34  157   89    0   84  113   78   80   40
  NZL  157  133  227   77    0  386  213  447  149
  USA  407  203  280  118  459    0  323  522   54
  ZAF  133  141  182   74  223  336    0  254   43
  AUS  226  140  242   73  495  568  242    0   64
```

```
   IRL   13   54   82   39  166   56   44   62    0
 ------------------------------------------------------------------------------
JER
 --------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
 ------------------------------------------------------------------------------
   CAN    0  106  157   41  159  409  136  233   14
   DFS  100    0  180  158  157  225  159  169   58
   GBR  157  175    0   95  222  253  178  234   79
   NLD   35  157   89    0   84  113   78   80   40
   NZL  160  133  227   77    0  386  213  447  149
   USA  414  203  280  118  459    0  323  522   54
   ZAF  135  141  182   74  223  336    0  254   43
   AUS  229  140  242   73  495  568  242    0   64
   IRL   13   54   82   39  166   56   44   62    0
 ------------------------------------------------------------------------------
RDC
 --------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  NOR  USA  NLD
 ------------------------------------------------------------------------------
   CAN    0   10  178    7  106    6
   DEU   10    0   63   16   18   12
   DFS  186   54    0  133  168   58
   NOR    6   15  112    0   73   41
   USA  100   17  161   73    0   39
   NLD    6   12   55   41   37    0
 ------------------------------------------------------------------------------
RDC
 --------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  GBR  NOR  NZL  USA  NLD  IRL
 ------------------------------------------------------------------------------
   CAN    0   13  181   80    7   71  150    6    4
   DEU   12    0   69   15   15   21   19   17    5
   DFS  188   57    0  119  146  182  193   61   20
   GBR   81   14  115    0   64   80  107   39   26
   NOR    6   14  119   67    0   48   82   45   62
   NZL   71   21  178   78   47    0  106   24   15
   USA  144   18  188  102   82  109    0   43   32
   NLD    6   17   58   38   45   24   41    0   14
   IRL    4    5   15   25   61   15   32   14    0
 ------------------------------------------------------------------------------
RDC
 --------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  GBR  NOR  NLD  USA
 ------------------------------------------------------------------------------
   CAN    0   13  181   82    7    6  150
   DEU   12    0   67   15   15   16   19
   DFS  188   55    0  123  134   61  193
   GBR   83   14  119    0   68   40  111
   NOR    6   14  111   72    0   43   82
   NLD    6   16   58   39   43    0   43
   USA  144   18  188  106   82   41    0
 ------------------------------------------------------------------------------
RDC
 --------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  GBR  NOR  NZL  USA  ZAF  NLD  AUS  IRL
 ------------------------------------------------------------------------------
   CAN    0   13  178   75    7   63  172   77    6   76    4
   DEU   12    0   66   15   15   17   23    3   16   45    5
```

```
 DFS  184   55    0  119  134  165  218   62   61  226   20
 GBR   75   14  115    0   63   74  120   47   39   87   26
 NOR    6   14  111   66    0   42   86    0   43   71   62
 NZL   64   17  161   71   41    0  111   39   18  141   15
 USA  176   21  218  118   86  113    0   77   47  139   33
 ZAF   81    3   59   43    0   37   72    0    3   46    3
 NLD    6   16   58   38   43   18   45    3    0   35   14
 AUS   78   43  203   85   60  143  141   48   33    0   20
 IRL    4    5   15   25   61   15   33    3   14   19    0
 ----------------------------------------------------------------------------
```

RDC
----

 common bulls below diagonal
 common three quarter sib group above diagonal
```
        CAN  DEU  DFS  GBR  NOR  NZL  USA  ZAF  NLD  AUS  IRL
 ----------------------------------------------------------------------------
 CAN    0   13  178   76    7   63  172   77    6   76    4
 DEU   12    0   66   15   15   17   23    3   16   45    5
 DFS  184   55    0  119  146  165  218   62   61  226   20
 GBR   76   14  115    0   64   74  120   47   39   87   26
 NOR    6   14  119   67    0   43   86    0   45   75   62
 NZL   64   17  161   71   42    0  111   39   18  141   15
 USA  176   21  218  118   86  113    0   77   47  139   33
 ZAF   81    3   59   43    0   37   72    0    3   46    3
 NLD    6   16   58   38   45   18   45    3    0   35   14
 AUS   78   43  203   85   64  143  141   48   33    0   20
 IRL    4    5   15   25   61   15   33    3   14   19    0
 ----------------------------------------------------------------------------
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