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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 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
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CHANGES IN NATIONAL PROCEDURES
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Changes in the national genetic evaluation of female fertility traits are as
follows:
BEL (HOL)           Few bulls missing due to drop in daughters, changes in type of proofs caused by the program assigning them.
JPN (HOL)           Changes in information caused by additional records and modification of pedigree.
ISR (HOL)           Some bulls had slight reductions in the numbers of records, due to editing and parentage corrections.
DFS (HOL,JER,RDC)   Changes in type of proofs, Type of proof is based information from production.
                    When production information for foreign bulls comes, they might change type of proof for other traits
                    from unknown to XX, drops in information.
SVN (ALL)           Small changes in information due changes in data base related to the pedigree completeness as well as
                    phenotypic data improvement.
DEU (HOL,RDC)       Herd-years with uninformative NonReturn56, i.e., 100% NR56 are excluded.
                    Some traits are verified with the subsequent calving, e.g. interval first to last insemination,
                    insemination dates must match with calving dates and result in reasonable gestation length.
                    Thus there are always some bulls having number of herds/daughters/EDC decreased, being not
                    publishable anymore or in case number of herds drop below 10 herds, bulls are even not sent anymore.
POL (HOL)           Small decrease in number of herds and daughters due to data edits caused decrease of EDC.
USA (HOL,JER,RDC,BSW) Drops in observations due to data editings, for JER and RDC it causes few animals to not be included anymore.
ESP (HOL)           Base change
ZAF (HOL,JER)       Reliabilities estimated with Jamrozik et al. method.
CZE (HOL)           CC1, CC2: trimmed inseminations done before 2006, i.e. half year of data was trimmed compared to April run.
                    HCO: Decreases in information are caused only by backward corrections in insemination registry,
                    mostly due to pedigree checks.
DEA (BSW)           Drops in info causing changes in rel.


INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN
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Post-processing Windows:
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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
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More information can be read on https://interbull.org/ib/rg_procedure


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

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


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 2021).
Number of records for lactating cow's ability to conceive (cc2) by breed
--------------------------------------------------------------------------------------------
| Country | BSW | GUE | HOL | JER | RDC | SIM |
|---------|------|-----|-------|------|-------|-----|
| AUS | | 138 | 8372 | 1793 | 749 | |
| BEL | | | 1974 | | | |
| CAN | 172 | 47 | 9679 | 587 | 567 | |
| CHE | 2892 | | 3508 | | | |
| CZE | | | 3777 | | | |
| DEA | 4728 | | | | | |
| DEU | | | 24438 | | 298 | |
| DFS | | | 16680 | 2435 | 10260 | |
| ESP | | | 5933 | | | |
| EST | | | | | | |
| FRA | 409 | | 16780 | | | |
| FRM | | | | | | |
| GBR | 104 | 243 | 7187 | 587 | 421 | |
| HUN | | | | | | |
| IRL | | | 3058 | 206 | 68 | |
| ISR | | | 1530 | | | |
| ITA | 1864 | | 9568 | | | |
| JPN | | | 6216 | | | |
| KOR | | | | | | |
| LTU | | | | | | |
| LVA | | | | | | |
| NLD | 200 | | 15964 | 195 | 87 | |
| NOR | | | | | 3016 | |
| NZL | 65 | 59 | 8297 | 4865 | 1404 | |
| POL | | | 8135 | | | |
| PRT | | | | | | |
| SVK | | | | | | |
| SVN | | | | | | |
| URY | | | 1761 | | | |
| USA | 1139 | 772 | 40442 | 5010 | 745 | |
| ZAF | | | 1266 | 730 | 152 | |
| HRV | | | | | | |
| CAM | | | | | | |
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No.Records    11573         1259        194565        16408         17767
Pub. Proofs   10129         1032        154714        13676         17606              0
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW    hco
-----------------------------------------------------------------------------------------
          CAN     DEA     FRA     USA     CHE     NLD
CAN       9.86
DEA       0.85    9.90
FRA       0.77    0.85    0.90
USA       0.79    0.76    0.88    2.66
CHE       0.92    0.95    0.88    0.82   13.22
NLD       0.74    0.66    0.77    0.78    0.73    3.94


-----------------------------------------------------------------------------------------
BSW    crc
-----------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN       6.93
CHE       0.84   11.38
DEA       0.81    0.94   14.86
NLD       0.85    0.89    0.88    3.85
NZL       0.58    0.63    0.78    0.59    0.09
USA       0.78    0.84    0.82    0.81    0.56    8.02
GBR       0.73    0.73    0.69    0.78    0.65    0.74    3.78
FRA       0.84    0.96    0.95    0.90    0.65    0.84    0.76    1.80
ITA       0.83    0.81    0.81    0.83    0.67    0.79    0.77    0.84   17.06


-----------------------------------------------------------------------------------------
BSW    cc1
-----------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     USA     GBR     FRA
CAN       7.92
CHE       0.80   11.75
DEA       0.79    0.95   11.45
NLD       0.76    0.71    0.67    4.08
USA       0.75    0.68    0.67    0.88    2.85
GBR       0.74    0.80    0.76    0.72    0.67    0.03
FRA       0.73    0.69    0.67    0.90    0.90    0.71    0.96


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BSW    cc2
-----------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN       6.82
CHE       0.76   11.12
DEA       0.81    0.92   12.20
NLD       0.86    0.83    0.85    3.42
NZL       0.69    0.62    0.67    0.64    7.63
USA       0.84    0.84    0.85    0.83    0.65    2.45
GBR       0.79    0.79    0.84    0.79    0.71    0.83    3.78
FRA       0.85    0.86    0.88    0.87    0.65    0.84    0.82    0.96
ITA       0.83    0.70    0.83    0.83    0.60    0.85    0.79    0.81   22.25


-----------------------------------------------------------------------------------------
BSW    int
-----------------------------------------------------------------------------------------
          CAN     DEA     NLD     NZL     USA     GBR     ITA
CAN       7.28
DEA       0.84   14.16
NLD       0.88    0.90    3.37
NZL       0.70    0.80    0.68    7.33
USA       0.92    0.86    0.85    0.64    2.45
GBR       0.85    0.85    0.87    0.73    0.86    3.78
ITA       0.87    0.92    0.88    0.70    0.86    0.86   17.77
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--------------------------------------------------------------------------------
GUE    crc
--------------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      7.92
GBR      0.74    5.14
NZL      0.58    0.63    0.11
USA      0.79    0.78    0.56    6.79
AUS      0.72    0.83    0.88    0.66    6.96


--------------------------------------------------------------------------------
GUE    cc1
--------------------------------------------------------------------------------
         CAN     GBR     USA
CAN      7.57
GBR      0.74    0.03
USA      0.80    0.72    3.44


--------------------------------------------------------------------------------
GUE    cc2
--------------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      6.92
GBR      0.77    5.14
NZL      0.63    0.71    7.69
USA      0.86    0.83    0.66    2.72
AUS      0.69    0.69    0.72    0.74    9.94


--------------------------------------------------------------------------------
GUE    int
--------------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      7.81
GBR      0.84    5.14
NZL      0.64    0.71    7.69
USA      0.92    0.84    0.63    2.72
AUS      0.81    0.78    0.73    0.82    9.94

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HOL    hco
--------------------------------------------------------------------------------
         CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD     ITA     JPN
CAN      7.81
CZE      0.77    18.11
DEU      0.92    0.79    15.25
DFS      0.80    0.87    0.84    13.70
FRA      0.82    0.85    0.81    0.88    0.84
USA      0.84    0.87    0.84    0.88    0.89    2.38
POL      0.67    0.74    0.67    0.74    0.73    0.75    19.55
CHE      0.96    0.84    0.93    0.84    0.86    0.88    0.72    14.02
NLD      0.76    0.81    0.78    0.85    0.84    0.84    0.73    0.83    4.64
ITA      0.82    0.82    0.92    0.82    0.82    0.84    0.78    0.89    0.80    0.04
JPN      0.84    0.73    0.81    0.73    0.77    0.84    0.66    0.84    0.72    0.74    6.25

--------------------------------------------------------------------------------
HOL    crc
--------------------------------------------------------------------------------
         BEL     CAN     CHE     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     FRA
BEL      4.70
CAN      0.74    7.16
CHE      0.81    0.83    12.42
DEU      0.72    0.84    0.88    10.98
DFS      0.79    0.88    0.94    0.91    11.73
ESP      0.86    0.85    0.88    0.87    0.88    11.10
GBR      0.90    0.74    0.77    0.72    0.79    0.86    4.60
IRL      0.86    0.65    0.69    0.65    0.66    0.79    0.84    3.51
ITA      0.80    0.86    0.87    0.87    0.87    0.93    0.81    0.69    7.93
NLD      0.81    0.87    0.93    0.90    0.96    0.88    0.79    0.66    0.85    4.93
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NZL    0.60    0.57    0.58    0.52    0.57    0.63    0.63    0.55    0.72    0.55    0.08
USA    0.74    0.79    0.83    0.81    0.86    0.85    0.79    0.59    0.80    0.82    0.54    6.81
POL    0.76    0.88    0.90    0.86    0.85    0.90    0.75    0.70    0.94    0.84    0.63    0.76   13.81
FRA    0.77    0.85    0.94    0.92    0.94    0.90    0.79    0.68    0.90    0.94    0.61    0.83    0.89    1.18
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HOL    cc1

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        CAN     CHE     CZE     DEU     DFS     FRA     GBR     ISR     ITA     NLD     USA     POL     JPN
CAN     6.66
CHE     0.92   11.07
CZE     0.82    0.73   17.50
DEU     0.91    0.93    0.79   14.78
DFS     0.75    0.71    0.88    0.76   13.29
FRA     0.77    0.74    0.90    0.74    0.88    1.02
GBR     0.74    0.77    0.70    0.78    0.66    0.71    0.03
ISR     0.74    0.61    0.88    0.72    0.84    0.84    0.71    3.21
ITA     0.86    0.87    0.78    0.95    0.69    0.72    0.77    0.73    0.05
NLD     0.78    0.75    0.90    0.77    0.92    0.94    0.72    0.87    0.73    4.91
USA     0.80    0.71    0.95    0.74    0.87    0.88    0.66    0.90    0.76    0.88    2.79
POL     0.73    0.75    0.79    0.77    0.76    0.76    0.66    0.72    0.79    0.77    0.77   19.96
JPN     0.77    0.71    0.89    0.72    0.83    0.80    0.72    0.79    0.72    0.82    0.91    0.67    7.61
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HOL    cc2

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        BEL     CAN     CHE     CZE     DEU     DFS     ESP     FRA     GBR     IRL     ISR     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     JPN
BEL     4.70
CAN     0.80    6.09
CHE     0.80    0.88   11.17
CZE     0.65    0.86    0.86   17.50
DEU     0.82    0.93    0.91    0.91   13.49
DFS     0.83    0.85    0.87    0.81    0.94   12.92
ESP     0.84    0.87    0.83    0.81    0.91    0.86   11.09
FRA     0.83    0.88    0.91    0.83    0.92    0.85    0.89    0.98
GBR     0.89    0.79    0.74    0.65    0.81    0.82    0.85    0.80    4.60
IRL     0.84    0.81    0.81    0.67    0.82    0.81    0.84    0.82    0.84    3.51
ISR     0.60    0.69    0.68    0.85    0.79    0.74    0.73    0.72    0.61    0.66    3.20
ITA     0.76    0.85    0.87    0.90    0.91    0.84    0.88    0.85    0.78    0.78    0.85   15.45
NLD     0.83    0.89    0.90    0.85    0.95    0.92    0.89    0.92    0.81    0.82    0.77    0.85    4.57
NZL     0.74    0.62    0.54    0.53    0.62    0.62    0.64    0.62    0.71    0.73    0.54    0.55    0.62    4.99
USA     0.81    0.86    0.85    0.88    0.91    0.87    0.89    0.83    0.83    0.83    0.81    0.91    0.85    0.62    2.32
POL     0.83    0.78    0.73    0.62    0.78    0.78    0.81    0.78    0.83    0.81    0.60    0.78    0.78    0.70    0.80   13.26
ZAF     0.75    0.77    0.81    0.71    0.81    0.76    0.83    0.78    0.79    0.86    0.62    0.84    0.76    0.69    0.86    0.78   15.44
AUS     0.69    0.69    0.73    0.64    0.71    0.65    0.72    0.71    0.70    0.86    0.59    0.70    0.67    0.66    0.74    0.63    0.81    8.01
URY     0.79    0.77    0.67    0.61    0.76    0.77    0.77    0.76    0.79    0.79    0.53    0.65    0.77    0.79    0.76    0.80    0.76    0.67    1.41
JPN     0.84    0.83    0.84    0.76    0.84    0.84    0.88    0.83    0.86    0.85    0.66    0.86    0.83    0.63    0.92    0.89    0.87    0.73    0.78   18.42
```

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

HOL    int

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

```
        BEL     CAN     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     FRA     JPN
BEL     4.70
CAN     0.88    6.54
DEU     0.86    0.90   12.30
DFS     0.90    0.91    0.94   12.85
ESP     0.88    0.89    0.89    0.89   11.09
GBR     0.89    0.85    0.86    0.89    0.88    4.60
IRL     0.86    0.85    0.85    0.84    0.87    0.85    3.51
ITA     0.86    0.89    0.90    0.89    0.93    0.87    0.85   20.20
NLD     0.93    0.90    0.92    0.96    0.89    0.89    0.85    0.88    4.64
NZL     0.77    0.63    0.60    0.60    0.68    0.72    0.74    0.67    0.63    4.99
USA     0.84    0.93    0.91    0.89    0.91    0.85    0.84    0.92    0.86    0.59    2.32
POL     0.85    0.86    0.84    0.85    0.85    0.85    0.83    0.90    0.85    0.72    0.83   13.26
ZAF     0.83    0.85    0.86    0.84    0.87    0.84    0.87    0.87    0.84    0.72    0.88    0.84   15.44
AUS     0.81    0.81    0.81    0.80    0.84    0.81    0.87    0.81    0.77    0.66    0.80    0.80    0.84    8.01
URY     0.81    0.79    0.80    0.80    0.82    0.81    0.81    0.81    0.77    0.81    0.76    0.81    0.83    0.80    1.41
FRA     0.80    0.86    0.80    0.80    0.84    0.72    0.79    0.80    0.81    0.59    0.82    0.70    0.78    0.72    0.64    0.98
JPN     0.87    0.93    0.90    0.90    0.91    0.87    0.86    0.94    0.88    0.65    0.92    0.91    0.89    0.82    0.82    0.79   18.42
```

```
-------------------------------------------------------------------------------
JER     hco
-------------------------------------------------------------------------------
        CAN     DFS     USA     NLD
CAN     7.89
DFS     0.75    17.46
USA     0.82    0.87    2.75
NLD     0.75    0.86    0.82    4.27


-------------------------------------------------------------------------------
JER     crc
-------------------------------------------------------------------------------
        CAN     DFS     GBR     NLD     NZL     USA     IRL
CAN     6.77
DFS     0.84    13.51
GBR     0.69    0.84    4.06
NLD     0.86    0.88    0.75    3.90
NZL     0.54    0.65    0.73    0.55    0.07
USA     0.77    0.83    0.78    0.80    0.58    8.14
IRL     0.67    0.67    0.83    0.67    0.56    0.60    2.19


-------------------------------------------------------------------------------
JER     cc1
-------------------------------------------------------------------------------
        CAN     DFS     GBR     NLD     USA
CAN     6.91
DFS     0.72    15.49
GBR     0.77    0.67    0.03
NLD     0.77    0.88    0.71    3.80
USA     0.74    0.87    0.67    0.84    2.91


-------------------------------------------------------------------------------
JER     cc2
-------------------------------------------------------------------------------
        CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN     6.72
DFS     0.84    15.76
GBR     0.80    0.81    4.06
NLD     0.87    0.89    0.81    3.35
NZL     0.63    0.63    0.77    0.63    4.05
USA     0.84    0.84    0.82    0.84    0.67    2.60
ZAF     0.68    0.67    0.73    0.70    0.77    0.85    11.19
AUS     0.66    0.66    0.66    0.66    0.58    0.68    0.74    6.14
IRL     0.80    0.79    0.81    0.81    0.66    0.81    0.77    0.74    2.19


-------------------------------------------------------------------------------
JER     int
-------------------------------------------------------------------------------
        CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN     6.53
DFS     0.87    15.48
GBR     0.82    0.86    4.06
NLD     0.87    0.90    0.84    3.46
NZL     0.61    0.60    0.77    0.63    4.05
USA     0.87    0.86    0.84    0.83    0.66    2.60
ZAF     0.81    0.82    0.82    0.80    0.78    0.87    11.19
AUS     0.81    0.80    0.80    0.77    0.60    0.80    0.82    6.14
IRL     0.83    0.80    0.80    0.82    0.64    0.82    0.83    0.81    2.19


-------------------------------------------------------------------------------
RDC     hco
-------------------------------------------------------------------------------
        CAN     DEU     DFS     NOR     USA     NLD
CAN     7.62
DEU     0.91    14.14
DFS     0.76    0.81    12.33
NOR     0.87    0.89    0.86    16.53
USA     0.83    0.83    0.87    0.73    2.70
```

```
NLD        0.75    0.77    0.83    0.70    0.83    5.05

-------------------------------------------------------------------------------------
RDC     crc
-------------------------------------------------------------------------------------
           CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     IRL
CAN        6.50
DEU        0.84   10.07
DFS        0.86    0.90   12.70
GBR        0.77    0.72    0.73    4.12
NOR        0.86    0.84    0.86    0.68   13.86
NZL        0.62    0.55    0.54    0.67    0.62    0.11
USA        0.78    0.81    0.80    0.77    0.77    0.72    8.41
NLD        0.87    0.90    0.93    0.78    0.83    0.58    0.81    3.54
IRL        0.67    0.66    0.68    0.84    0.68    0.57    0.61    0.67    2.82

-------------------------------------------------------------------------------------
RDC     cc1
-------------------------------------------------------------------------------------
           CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN        7.06
DEU        0.90   13.41
DFS        0.73    0.79   13.08
GBR        0.74    0.79    0.70    0.03
NOR        0.79    0.87    0.92    0.74   13.92
NLD        0.79    0.79    0.90    0.72    0.75    4.22
USA        0.83    0.75    0.84    0.67    0.77    0.87    2.70

-------------------------------------------------------------------------------------
RDC     cc2
-------------------------------------------------------------------------------------
           CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN        6.81
DEU        0.92   11.15
DFS        0.84    0.94   12.86
GBR        0.80    0.82    0.81    4.14
NOR        0.85    0.86    0.89    0.81   13.92
NZL        0.64    0.64    0.63    0.68    0.66    6.74
USA        0.87    0.90    0.84    0.83    0.82    0.69    2.47
ZAF        0.73    0.80    0.78    0.71    0.73    0.72    0.85   17.58
NLD        0.89    0.95    0.90    0.82    0.83    0.64    0.85    0.75    3.65
AUS        0.67    0.69    0.65    0.69    0.66    0.67    0.70    0.73    0.67    7.40
IRL        0.81    0.83    0.82    0.83    0.81    0.72    0.83    0.83    0.83    0.81    2.82

-------------------------------------------------------------------------------------
RDC     int
-------------------------------------------------------------------------------------
           CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN        6.75
DEU        0.90   11.08
DFS        0.88    0.94   13.16
GBR        0.85    0.86    0.85    4.14
NOR        0.85    0.84    0.81    0.81   13.86
NZL        0.68    0.62    0.60    0.68    0.66    6.74
USA        0.92    0.90    0.85    0.85    0.81    0.69    2.48
ZAF        0.86    0.86    0.85    0.83    0.88    0.74    0.88   17.58
NLD        0.90    0.92    0.94    0.87    0.75    0.64    0.83    0.81    3.46
AUS        0.81    0.81    0.80    0.81    0.81    0.68    0.81    0.82    0.67    7.40
IRL        0.85    0.85    0.84    0.85    0.81    0.72    0.84    0.87    0.81    0.86    2.82

----------------------------------------------------------------------------------------------------
^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    91    52   103    95    29
 DEA    81     0   190   184   564   126
 FRA    45   141     0    70   159    73
 USA    94   143    53     0   199    47
 CHE    79   472   118   164     0    88
 NLD    26   120    60    43    84     0
 ------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 ------------------------------------------------------------------------------

 CAN     0   116  111   39    22  132   45    70  106
 CHE    98     0  578   97    30  264   57   160  431
 DEA    98   478    0  145    38  225   52   199  568
 NLD    34    90  135    0    27   57   36    79  124
 NZL    21    24   34   22     0   22   17    22   32
 USA   128   229  175   52    19    0   59    92  168
 GBR    39    40   38   27    13   50    0    44   62
 FRA    61   117  146   64    17   63   34     0  179
 ITA    93   367  453  102    25  118   41   134    0
 ------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  CHE  DEA  NLD  USA  GBR  FRA
 ------------------------------------------------------------------------------

 CAN     0   116  111   39   132   44   74
 CHE    98     0  577   96   264   58  169
 DEA    98   476    0  145   225   55  212
 NLD    34    90  135    0    57   36   84
 USA   128   229  175   52     0   61   97
 GBR    40    42   40   27    52    0   48
 FRA    65   125  158   70    69   39    0
 ------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 ------------------------------------------------------------------------------

 CAN     0   102   95   36    20  125   42    68   94
 CHE    83     0  568   97    30  319   57   169  431
 DEA    83   472    0  146    39  300   52   210  563
 NLD    32    90  135    0    28   80   36    84  124
 NZL    19    24   34   22     0   31   17    24   32
 USA   117   295  257   69    27    0   69   117  215
 GBR    35    40   38   27    13   60    0    46   62
 FRA    60   125  157   70    19   83   37     0  192
 ITA    82   367  450  102    25  150   41   146    0
 ------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEA  NLD  NZL  USA  GBR  ITA
 ------------------------------------------------------------------------------

 CAN     0    99   37   21   130   44  100
 DEA    86     0  145   39   299   52  659
 NLD    33   135    0   28    80   36  129
 NZL    20    34   22    0    31   17   33
 USA   122   257   69   27     0   69  236
 GBR    37    38   27   13    60    0   63
 ITA    87   576  107   26   168   41    0
 ------------------------------------------------------------------------------
GUE
--------
```

```
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
 ------------------------------------------------------------------------------
  CAN    0   16    3   39   18
  GBR   13    0   14   53   28
  NZL    2   12    0   10   26
  USA   38   50    7    0   19
  AUS   13   22   24   16    0
 ------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  USA
 ------------------------------------------------------------------------------
  CAN    0   17   39
  GBR   13    0   55
  USA   38   52    0
 ------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
 ------------------------------------------------------------------------------
  CAN    0   11    2   38   21
  GBR    8    0   14   83   32
  NZL    2   12    0   30   26
  USA   36   84   28    0   61
  AUS   17   26   26   58    0
 ------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
 ------------------------------------------------------------------------------
  CAN    0   11    2   38   21
  GBR    8    0   14   83   32
  NZL    2   12    0   30   26
  USA   36   84   28    0   61
  AUS   17   26   26   58    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 1033 2135 1262 1242 2774 1203  832 1283 1737 1092
  CZE  760    0 1752 1178 1190 1384 1095  499 1426 1270  784
  DEU 1692 1324    0 2454 2257 2818 2055 1141 2892 2568 1275
  DFS 1168  778 1816    0 1616 1578 1266  730 2085 1621  938
  FRA  918  721 1249  922    0 1626 1372  712 1886 1706 1105
  USA 3190 1107 2163 1402  962    0 1698  868 1743 2318 1405
  POL 1078  856 1770 1016  903 1736    0  519 1455 1413  781
  CHE  716  336 1010  644  635  783  399    0  889  770  466
  NLD 1259 1236 2519 1804 1229 1534 1282  862    0 1725 1014
  ITA 1494  908 1784 1289  992 1888 1097  698 1438    0 1150
  JPN  609  339  558  481  395  725  417  284  505  527    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  737  598 1171  831  870  836  511  803 1204  504  790  525  927
CAN   742    0  866 2268 1347 1493 1552  545 1802 1440  680 2892 1083 1344
CHE   596  753    0 1186  738  725  755  420  766  925  425  932  472  728
DEU  1197 1747 1057    0 2642 2177 2150  910 2631 3364  988 3060 1792 2492
DFS   777 1255  658 1917    0 1461 1561  753 1605 2120  834 1734 1141 1635
ESP   935 1266  659 1898 1259    0 1444  700 1668 1653  720 1755 1067 1666
GBR   820 1626  686 1627 1215 1317    0  990 1616 1805  939 1950  952 1578
IRL   506  545  425  797  633  720 1030    0  660  910  746  655  375  753
ITA   787 1541  693 1846 1284 1475 1282  586    0 1808  726 2461 1234 1712
NLD  1373 1422  901 3063 1892 1725 1580  860 1534    0 1058 2008 1299 1998
NZL   413  638  351  766  602  609  818  651  565  962    0  814  422  810
USA   756 3355  838 2265 1500 1494 1884  642 1949 1795  757    0 1525 1830
POL   427  922  347 1433  872  833  702  283  885 1092  314 1464    0 1258
FRA   918 1007  642 1377  915 1571 1015  614  990 1281  497 1066  778    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  865 1040 2263 1354 1349 1611  115 1810 1451 2947 1127 1236
CHE   752    0  473 1183  738  729  766   58  765  925  932  496  501
CZE   800  326    0 1666 1092 1104  950  107 1215 1360 1437 1050  758
DEU  1732 1053 1302    0 2642 2500 2192  157 2611 3350 3037 1923 1467
DFS  1259  658  785 1909    0 1640 1596  142 1604 2119 1739 1221  992
FRA  1022  647  677 1390  923    0 1601  115 1717 2010 1834 1311 1233
GBR  1690  700  654 1656 1244 1036    0  138 1664 1860 2015 1003 1081
ISR    81   35   80  124  104   65   97    0  140  146  149   97  101
ITA  1555  691  898 1826 1282 1003 1329  105    0 1804 2456 1292 1198
NLD  1434  901 1229 3045 1891 1301 1630  115 1530    0 2008 1404 1083
USA  3426  838 1157 2228 1500 1077 1969  141 1944 1795    0 1578 1604
POL   982  381  833 1646  986  838  761   70  955 1251 1541    0  778
JPN   715  325  369  640  542  456  569   46  589  586  871  423    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  724  598  545 1163  832  870  919  838  513   73  800 1206  504  941  518  329  724  334  514
CAN   729    0  856 1018 2197 1328 1480 1306 1525  531  112 1756 1407  665 3039 1044  439 1241  688 1147
CHE   596  734    0  473 1174  739  725  711  755  420   59  763  925  425 1047  458  271  639  302  465
CZE   430  768  326    0 1663 1092 1036 1095  939  435  107 1212 1360  508 1511  978  301  728  456  723
DEU  1187 1651 1038 1294    0 2634 2183 2456 2141  907  158 2591 3319  989 3580 1738  552 1663  751 1384
DFS   777 1226  659  785 1897    0 1469 1626 1565  753  144 1599 2123  839 2125 1117  506 1277  619  933
ESP   935 1239  659  828 1891 1266    0 1660 1447  701  128 1665 1658  724 2070 1045  514 1165  629 1077
FRA   906  965  624  669 1329  896 1552    0 1572  756  118 1687 1976  813 2516 1227  478 1285  578 1170
GBR   820 1585  686  643 1599 1215 1318 1004    0  991  138 1610 1808  941 2329  930  499 1409  644 1019
IRL   506  523  425  328  791  633  720  610 1030    0   96  658  913  748  819  368  334  743  364  446
ISR    43   78   35   80  123  104   98   64   95   76    0  139  148  107  174   94   59  104   79  100
ITA   786 1470  690  893 1786 1269 1470  961 1277  585  103    0 1796  725 2683 1199  471 1181  648 1133
NLD  1375 1372  901 1229 2985 1893 1728 1251 1581  861  115 1517    0 1062 2567 1263  499 1465  640 1017
NZL   413  615  351  372  758  603  614  492  818  652   87  568  966    0 1103  414  355 1203  512  558
USA   836 3418  937 1189 2475 1633 1757 1344 2128  743  158 2029 2228 1053    0 1525  629 1912 1075 1908
POL   416  872  335  732 1353  847  810  745  684  274   61  853 1046  305 1432    0  223  701  411  709
ZAF   274  403  222  201  423  373  470  330  438  293   38  375  415  287  605  151    0  471  309  404
AUS   625 1252  553  497 1222  927  936  867 1225  642   68  903 1267 1209 1906  499  411    0  631  871
URY   244  641  217  305  518  414  547  334  516  282   38  469  487  415 1312  311  254  488    0  532
JPN   312  591  276  321  536  463  495  392  485  270   37  498  495  264  744  346  254  445  258    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
--------------------------------------------------------------------------
```

```
   BEL     0   726  1161   832   870   838   513   799  1206   504   941   517   329   724   334   919   514
   CAN   733     0  2201  1336  1487  1534   537  1763  1417   670  3053  1047   443  1249   693  1314  1152
   DEU  1186  1660     0  2631  2182  2140   907  2590  3316   989  3574  1730   552  1663   750  2455  1384
   DFS   777  1237  1894     0  1469  1565   753  1599  2122   839  2123  1116   506  1277   618  1626   933
   ESP   935  1255  1891  1266     0  1447   701  1665  1657   724  2068  1045   514  1164   629  1659  1076
   GBR   820  1598  1599  1215  1318     0   991  1610  1808   941  2329   930   499  1409   643  1572  1019
   IRL   506   531   791   633   720  1030     0   658   913   748   819   368   334   743   364   756   446
   ITA   786  1483  1786  1269  1469  1277   585     0  1796   725  2683  1195   471  1181   648  1687  1133
   NLD  1375  1385  2984  1892  1728  1581   861  1517     0  1062  2567  1259   499  1465   640  1976  1017
   NZL   413   619   759   603   614   818   652   568   966     0  1103   414   355  1203   511   813   558
   USA   836  3449  2475  1633  1757  2128   743  2029  2228  1053     0  1523   629  1912  1075  2516  1908
   POL   416   878  1350   846   810   684   274   852  1046   305  1432     0   223   701   411  1227   708
   ZAF   274   410   423   373   470   438   293   375   415   287   605   151     0   471   309   478   404
   AUS   625  1258  1222   927   936  1225   642   903  1267  1209  1906   499   411     0   631  1285   871
   URY   244   647   518   414   547   516   282   469   487   415  1312   311   254   488     0   578   532
   FRA   906   974  1329   896  1552  1004   610   961  1251   492  1344   745   330   867   334     0  1170
   JPN   312   594   536   463   495   485   270   498   495   264   744   346   254   445   258   392     0
  --------------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   DFS   USA   NLD
 --------------------------------------------------------------------------------------
   CAN     0    88   313    27
   DFS    81     0   134    71
   USA   299   120     0    58
   NLD    21    68    59     0
 --------------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   DFS   GBR   NLD   NZL   USA   IRL
 --------------------------------------------------------------------------------------
   CAN     0    91   141    35   154   359    10
   DFS    83     0   161   123   140   149    48
   GBR   137   153     0    83   210   203    71
   NLD    29   120    75     0    73    79    29
   NZL   154   118   213    65     0   275   125
   USA   360   136   219    83   298     0    41
   IRL     9    44    73    29   140    43     0
 --------------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   DFS   GBR   NLD   USA
 --------------------------------------------------------------------------------------
   CAN     0    91   143    35   364
   DFS    83     0   161   122   149
   GBR   139   153     0    85   204
   NLD    30   119    78     0    79
   USA   367   136   220    83     0
 --------------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   DFS   GBR   NLD   NZL   USA   ZAF   AUS   IRL
 --------------------------------------------------------------------------------------
   CAN     0    89   139    35   149   368   127   212    10
   DFS    81     0   162   123   144   196   149   154    48
   GBR   133   153     0    83   212   229   168   212    71
   NLD    28   120    75     0    74    92    73    72    29
   NZL   146   120   213    66     0   374   208   436   125
   USA   368   170   252    98   447     0   307   490    46
   ZAF   125   130   170    69   217   320     0   238    39
   AUS   205   123   217    66   475   533   227     0    55
```

```
  IRL    9   44   73   29  140   48   40   53    0
 --------------------------------------------------------------------------------
JER
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
 --------------------------------------------------------------------------------
  CAN    0   90  140   35  151  371  129  214   10
  DFS   82    0  162  123  144  196  149  154   48
  GBR  135  153    0   83  212  229  168  212   71
  NLD   29  120   75    0   74   92   73   72   29
  NZL  150  120  213   66    0  374  208  436  125
  USA  374  170  252   98  447    0  307  490   46
  ZAF  128  130  170   69  217  320    0  238   39
  AUS  209  123  217   66  475  533  227    0   55
  IRL    9   44   73   29  140   48   40   53    0
 --------------------------------------------------------------------------------
RDC
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  NOR  USA  NLD
 --------------------------------------------------------------------------------
  CAN    0   10  164    7   96    6
  DEU   10    0   53   14   15   10
  DFS  170   44    0  120  152   52
  NOR    6   13   98    0   68   35
  USA   91   14  146   68    0   35
  NLD    6   10   49   35   33    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  166   69    7   71  136    6    4
  DEU   12    0   57   14   14   16   19   14    5
  DFS  172   45    0  100  140  173  175   54   19
  GBR   69   13   94    0   52   76   88   33   22
  NOR    6   13  112   55    0   42   74   41   57
  NZL   71   16  168   73   41    0   98   19   12
  USA  131   18  170   83   74  101    0   38   27
  NLD    6   14   51   32   41   19   36    0   12
  IRL    4    5   14   21   56   12   27   12    0
 --------------------------------------------------------------------------------
RDC
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  GBR  NOR  NLD  USA
 --------------------------------------------------------------------------------
  CAN    0   13  167   71    7    6  138
  DEU   12    0   56   14   14   14   19
  DFS  173   44    0  103  126   54  176
  GBR   71   13   97    0   55   37   92
  NOR    6   13  102   58    0   39   74
  NLD    6   14   51   36   39    0   38
  USA  133   18  171   87   74   36    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  159   65    7   70  159   72    6   69    4
  DEU   12    0   54   14   14   16   21    3   14   39    5
```

```
    DFS  165   43    0  100  126  174  196   57   54  205   19
    GBR   65   13   94    0   51   79  101   42   33   76   22
    NOR    6   13  102   54    0   41   77    0   39   65   57
    NZL   70   16  169   75   40    0  124   40   19  140   12
    USA  161   20  193   98   77  127    0   72   42  123   28
    ZAF   76    3   54   40    0   38   67    0    3   43    3
    NLD    6   14   51   32   39   19   40    3    0   28   12
    AUS   70   38  180   75   55  140  123   44   26    0   17
    IRL    4    5   14   21   56   12   28    3   12   16    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  160   66    7   70  160   72    6   69    4
    DEU   12    0   54   14   14   16   21    3   14   39    5
    DFS  166   43    0  100  140  174  197   57   54  205   19
    GBR   66   13   94    0   52   79  101   42   33   76   22
    NOR    6   13  112   55    0   42   77    0   41   69   57
    NZL   70   16  169   75   41    0  124   40   19  140   12
    USA  162   20  193   98   76  126    0   72   42  123   28
    ZAF   76    3   54   40    0   38   67    0    3   43    3
    NLD    6   14   51   32   41   19   40    3    0   28   12
    AUS   70   38  180   75   59  140  123   44   26    0   17
    IRL    4    5   14   21   56   12   28    3   12   16    0
  -----------------------------------------------------------------------------
SIM
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SIM
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