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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:
ISR (HOL)       Slight reductions for a few bulls in number of daughters due to edits
                and paternity corrections
SVN (ALL)       Some changes in information due to changes in data base related to the pedigree
                completness and phenotypic data improvement
FRA (ALL)       Some drops in information due to corrections made in pedigree
AUS (ALL)       Decrease in information as a result of data clean up such as pedigree changes, causing also
                changes in type of proofs. Change of status of bull which leads to a good number of bulls
                no longer being qualified. Decreases in EDC due to rounding
DEU (HOL, RDC)  Herd-years with uninformative NonReturn56, i.e., 100% NR56 ae 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)       Decrease in information due to data edits
JPN (HOL)       Drops in information due to parentage checks
BEL (HOL)       Some decrease in information due to pedigree corrections
ESP (HOL)       Decrease in information due to data editing
USA (ALL)       drops in information due to pedigree corrections and herd-year minimum edits
ZAF (HOL)       Some fluctuations in reliability due to the use of apax
CHE (HOL)       In-depth corrections and renewal of the database table containing bull information by
                one of our breeding associations lead to changes in status of bulls and type of proof
                as well as a fewer number of EBV delivered. Slight changes in number of daughters, number
                of herds and EDC are due to manual edits in the database.
GBR (HOL)       Loss of information due to data changes that occurred in one of the major data providers
                providing highest proportion of the HOL data, it affects more SCS/mas as such traits are
                recorded by farmers voluntarily and suffered more from data changes
CZE (HOL)       Daughters decrease in some bulls are due to pedigree or phenotype corrections
NZL (ALL)       Daughter counts â\200\223 affects all traits. New Zealand has continuous DNA parentage testing
                so daughters will always change
                Herd Count â\200\223 affects all traits. Affected by continuous DNA parentage testing.
                EDCs â\200\223 affects all traits. Affected by continuous DNA parentage testing and a bug was
                found in the EDC calculation so a fix was applied
NZL (ALL)       As above plus: completely new model estimating the trait Calving Season Day
                (CSD123=calving season day - number of days from the planned start of calving date to
                calving for a given herd-year) instead Conception Rate at 42 days (CR42), changes have
                made to improve the quality of the data inputted by removing any records where there
                wasn't a 2 year old calving, this has affected herd and daughter counts. Change in
                direction of scale. New trait has been submitted for cc2 and int. The following changes
                on extraction of data were also applied:season of calving has been added to the extracts
                to separate Autumn and Spring calving records, we have also excluding extreme Short
                Gestation Length bulls progeny as they looked like they were really good Fertility bulls
                it was just they were short gestation length, we have also removed records where the cow
                had not calved the supsequent year.
DFS (ALL)       Changes in the model: included inbreeding (A inverse, and inbreeding depression) and the breed of the semen sire to the model (CR).
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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


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

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

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

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

NEXT ROUTINE INTERNATIONAL EVALUATION

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

NEXT TEST INTERNATIONAL EVALUATION

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

PUBLICATION OF INTERBULL ROUTINE RUN

Results were distributed by the Interbull Centre to designated
representatives in each country. The international evaluation file comprised
international proofs expressed on the base and unit of each country included
in the analysis. Such records readily provide more information on bull
performance in various countries, thereby minimizing the need to resort to
conversions.

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

PUBLICATION OF INTERBULL TEST RUN

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

^LTable 1. National evaluation data considered in the Interbull
evaluation for fertility (December Routine Evaluation 2021).
Number of records for lactating cow's ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		141	8448	1811	754	
BEL			1997			
CAN	173	47	9763	594	574	
CHE	2907		3109			
CZE			3813			
DEA	4773					
DEU			24616		298	
DFS			16773	2448	10305	
ESP			6088			
EST						

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FRA              420                          16874
FRM
GBR              104           242             7269            593            431
HUN
IRL                                            3063            206             68
ISR                                            1559
ITA             1883                           9657
JPN                                            6284
KOR
LTU
LVA
NLD              203                          16067            200             87
NOR                                                                         3037
NZL               49            49             7897           4633           1278
POL                                            8270
PRT
SVK
SVN
URY                                            1805
USA             1147           774            40748           5072            751
ZAF                                            1268            732            153
HRV
CAM
===========================================================================================
No.Records     11659          1253           195368          16289          17736
Pub. Proofs    10179          1038           155046          13673          17639              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          10.02
DEA           0.86    9.93
FRA           0.77    0.85    0.90
USA           0.79    0.78    0.88    2.66
CHE           0.91    0.95    0.87    0.82   13.22
NLD           0.73    0.65    0.72    0.74    0.66    3.96


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BSW     crc
-----------------------------------------------------------------------------------
               CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN           6.96
CHE           0.83   11.44
DEA           0.80    0.94   14.89
NLD           0.85    0.89    0.89    3.90
NZL           0.60    0.62    0.74    0.61    0.12
USA           0.78    0.84    0.82    0.81    0.61    7.99
GBR           0.72    0.72    0.66    0.77    0.63    0.74    3.89
FRA           0.83    0.96    0.95    0.91    0.64    0.84    0.75    1.79
ITA           0.83    0.80    0.80    0.82    0.66    0.79    0.76    0.83   16.96


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BSW     ccl
-----------------------------------------------------------------------------------
               CAN     CHE     DEA     NLD     USA     GBR     FRA
CAN           8.00
CHE           0.81   11.78
DEA           0.78    0.94   11.46
NLD           0.77    0.71    0.67    4.06
USA           0.75    0.68    0.67    0.86    2.88
GBR           0.75    0.80    0.77    0.73    0.67    0.03
FRA           0.73    0.69    0.67    0.88    0.89    0.71    0.96


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BSW     cc2
------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN      6.92
CHE      0.76   11.13
DEA      0.79    0.92   12.20
NLD      0.85    0.84    0.84    3.43
NZL      0.70    0.66    0.73    0.70    5.89
USA      0.83    0.83    0.85    0.82    0.70    2.47
GBR      0.76    0.80    0.84    0.78    0.70    0.83    3.89
FRA      0.84    0.87    0.88    0.87    0.70    0.84    0.80    0.96
ITA      0.82    0.70    0.81    0.83    0.67    0.83    0.78    0.79   22.08


------------------------------------------------------------------------------------
BSW     int
------------------------------------------------------------------------------------
          CAN     DEA     NLD     NZL     USA     GBR     ITA
CAN      7.39
DEA      0.82   14.18
NLD      0.88    0.90    3.40
NZL      0.68    0.79    0.69    5.89
USA      0.91    0.86    0.84    0.67    2.47
GBR      0.84    0.81    0.86    0.67    0.85    3.89
ITA      0.86    0.92    0.88    0.68    0.83    0.84   17.60


------------------------------------------------------------------------------------
GUE     crc
------------------------------------------------------------------------------------
          CAN     GBR     NZL     USA     AUS
CAN      7.89
GBR      0.74    5.13
NZL      0.60    0.63    0.12
USA      0.78    0.77    0.61    6.83
AUS      0.70    0.80    0.90    0.66    6.96


------------------------------------------------------------------------------------
GUE     cc1
------------------------------------------------------------------------------------
          CAN     GBR     USA
CAN      7.67
GBR      0.75    0.03
USA      0.80    0.72    3.45


------------------------------------------------------------------------------------
GUE     cc2
------------------------------------------------------------------------------------
          CAN     GBR     NZL     USA     AUS
CAN      6.98
GBR      0.73    5.13
NZL      0.69    0.70    5.79
USA      0.85    0.82    0.70    2.76
AUS      0.68    0.68    0.69    0.73    9.83


------------------------------------------------------------------------------------
GUE     int
------------------------------------------------------------------------------------
          CAN     GBR     NZL     USA     AUS
CAN      7.79
GBR      0.83    5.13
NZL      0.67    0.67    5.79
USA      0.91    0.82    0.67    2.76
AUS      0.76    0.73    0.72    0.77    9.83


------------------------------------------------------------------------------------
HOL     hco
------------------------------------------------------------------------------------
          CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD     ITA     JPN
CAN      7.80
CZE      0.77   18.14
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DEU     0.91    0.79    15.23
DFS     0.80    0.86    0.84    13.53
FRA     0.81    0.83    0.81    0.88    0.84
USA     0.84    0.86    0.84    0.87    0.89    2.37
POL     0.65    0.65    0.65    0.65    0.64    0.67    19.47
CHE     0.96    0.82    0.93    0.82    0.85    0.87    0.66    13.78
NLD     0.75    0.77    0.78    0.84    0.82    0.82    0.64    0.80    4.62
ITA     0.81    0.80    0.92    0.78    0.79    0.82    0.73    0.89    0.75    0.04
JPN     0.84    0.72    0.82    0.72    0.78    0.84    0.65    0.85    0.71    0.74    6.24


-------------------------------------------------------------------------------
HOL    crc
-------------------------------------------------------------------------------
        BEL     CAN     CHE     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     FRA
BEL     4.72
CAN     0.75    7.15
CHE     0.81    0.83    12.31
DEU     0.72    0.84    0.87    10.99
DFS     0.79    0.87    0.94    0.91    11.63
ESP     0.87    0.81    0.82    0.82    0.82    11.07
GBR     0.90    0.74    0.77    0.72    0.79    0.88    4.59
IRL     0.85    0.63    0.68    0.63    0.64    0.83    0.83    3.52
ITA     0.80    0.86    0.87    0.87    0.87    0.87    0.81    0.68    7.90
NLD     0.82    0.87    0.93    0.90    0.96    0.82    0.79    0.64    0.85    4.91
NZL     0.62    0.59    0.61    0.57    0.62    0.59    0.63    0.55    0.71    0.59    0.09
USA     0.74    0.78    0.82    0.81    0.86    0.80    0.79    0.59    0.80    0.82    0.61    6.83
POL     0.75    0.88    0.89    0.85    0.84    0.84    0.75    0.68    0.95    0.84    0.67    0.76    13.75
FRA     0.77    0.85    0.94    0.92    0.94    0.83    0.79    0.66    0.90    0.94    0.62    0.83    0.88    1.18


-------------------------------------------------------------------------------
HOL    cc1
-------------------------------------------------------------------------------
        CAN     CHE     CZE     DEU     DFS     FRA     GBR     ISR     ITA     NLD     USA     POL     JPN
CAN     6.65
CHE     0.92    10.95
CZE     0.82    0.74    17.56
DEU     0.91    0.92    0.80    14.76
DFS     0.75    0.70    0.88    0.77    13.15
FRA     0.77    0.75    0.90    0.75    0.88    1.02
GBR     0.75    0.77    0.70    0.78    0.66    0.72    0.03
ISR     0.75    0.64    0.89    0.74    0.85    0.86    0.73    3.22
ITA     0.87    0.86    0.79    0.95    0.70    0.72    0.78    0.75    0.05
NLD     0.79    0.76    0.90    0.78    0.92    0.94    0.73    0.88    0.74    4.86
USA     0.80    0.71    0.95    0.74    0.86    0.87    0.66    0.91    0.76    0.88    2.80
POL     0.72    0.75    0.76    0.76    0.69    0.69    0.66    0.69    0.80    0.71    0.71    19.76
JPN     0.77    0.73    0.89    0.74    0.83    0.81    0.74    0.82    0.73    0.82    0.91    0.67    7.61


-------------------------------------------------------------------------------
HOL    cc2
-------------------------------------------------------------------------------
        BEL     CAN     CHE     CZE     DEU     DFS     ESP     FRA     GBR     IRL     ISR     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     JPN
BEL     4.72
CAN     0.78    6.07
CHE     0.81    0.89    10.99
CZE     0.66    0.87    0.86    17.56
DEU     0.81    0.93    0.92    0.91    13.49
DFS     0.82    0.85    0.88    0.82    0.94    12.79
ESP     0.85    0.81    0.84    0.82    0.85    0.81    11.06
FRA     0.82    0.88    0.92    0.84    0.92    0.86    0.83    0.97
GBR     0.89    0.76    0.74    0.66    0.79    0.81    0.88    0.78    4.59
IRL     0.84    0.79    0.82    0.68    0.81    0.79    0.85    0.82    0.83    3.52
ISR     0.62    0.71    0.71    0.87    0.81    0.76    0.76    0.74    0.63    0.67    3.22
ITA     0.76    0.85    0.87    0.90    0.92    0.84    0.88    0.85    0.78    0.78    0.86    15.40
NLD     0.82    0.89    0.90    0.85    0.95    0.92    0.82    0.92    0.79    0.81    0.78    0.86    4.53
NZL     0.71    0.69    0.63    0.63    0.69    0.69    0.67    0.69    0.69    0.69    0.61    0.63    0.69    4.63
USA     0.81    0.86    0.85    0.88    0.91    0.87    0.88    0.82    0.83    0.82    0.82    0.92    0.85    0.69    2.34
POL     0.82    0.75    0.73    0.62    0.75    0.75    0.84    0.75    0.82    0.80    0.61    0.79    0.75    0.69    0.80    13.20
ZAF     0.76    0.77    0.82    0.72    0.81    0.76    0.85    0.78    0.79    0.86    0.64    0.84    0.76    0.64    0.87    0.80    15.42
AUS     0.69    0.69    0.73    0.63    0.70    0.65    0.72    0.71    0.69    0.85    0.60    0.70    0.66    0.62    0.73    0.62    0.80    8.01
```

```
URY    0.76   0.74   0.66   0.61   0.74   0.74   0.73   0.74   0.76   0.75   0.54   0.64   0.74   0.72   0.74   0.77   0.77   0.67   1.40
JPN    0.84   0.83   0.85   0.77   0.84   0.85   0.90   0.82   0.86   0.85   0.69   0.87   0.82   0.69   0.92   0.89   0.88   0.72   0.76   18.38


-----------------------------------------------------------------------------
HOL    int
-----------------------------------------------------------------------------
        BEL    CAN    DEU    DFS    ESP    GBR    IRL    ITA    NLD    NZL    USA    POL    ZAF    AUS    URY    FRA    JPN
BEL    4.71
CAN    0.88   6.53
DEU    0.86   0.91   12.31
DFS    0.90   0.91   0.95   12.74
ESP    0.88   0.87   0.87   0.87   11.06
GBR    0.89   0.84   0.86   0.89   0.90   4.59
IRL    0.86   0.84   0.84   0.83   0.87   0.84   3.52
ITA    0.86   0.89   0.90   0.89   0.93   0.87   0.84   20.14
NLD    0.93   0.91   0.92   0.96   0.87   0.88   0.84   0.88   4.61
NZL    0.72   0.66   0.66   0.66   0.67   0.66   0.66   0.66   0.66   4.63
USA    0.83   0.93   0.91   0.89   0.90   0.84   0.83   0.92   0.86   0.66   2.34
POL    0.84   0.86   0.82   0.84   0.86   0.83   0.81   0.90   0.84   0.68   0.82   13.21
ZAF    0.81   0.85   0.85   0.83   0.88   0.83   0.87   0.87   0.83   0.66   0.88   0.85   15.42
AUS    0.77   0.78   0.77   0.75   0.77   0.77   0.86   0.76   0.73   0.66   0.77   0.75   0.83   8.01
URY    0.78   0.75   0.75   0.75   0.76   0.76   0.78   0.77   0.73   0.73   0.73   0.79   0.82   0.76   1.40
FRA    0.81   0.86   0.81   0.81   0.81   0.73   0.80   0.81   0.82   0.66   0.82   0.70   0.78   0.72   0.65   0.97
JPN    0.86   0.93   0.90   0.90   0.92   0.87   0.85   0.94   0.88   0.66   0.92   0.91   0.89   0.78   0.79   0.79   18.38


-----------------------------------------------------------------------------
JER    hco
-----------------------------------------------------------------------------
        CAN    DFS    USA    NLD
CAN    7.87
DFS    0.75   17.20
USA    0.81   0.85   2.74
NLD    0.75   0.83   0.77   4.29


-----------------------------------------------------------------------------
JER    crc
-----------------------------------------------------------------------------
        CAN    DFS    GBR    NLD    NZL    USA    IRL
CAN    6.77
DFS    0.83   13.45
GBR    0.67   0.84   4.02
NLD    0.85   0.87   0.73   3.87
NZL    0.55   0.71   0.68   0.57   0.07
USA    0.77   0.83   0.79   0.80   0.66   8.21
IRL    0.65   0.65   0.81   0.64   0.56   0.60   2.20


-----------------------------------------------------------------------------
JER    cc1
-----------------------------------------------------------------------------
        CAN    DFS    GBR    NLD    USA
CAN    6.89
DFS    0.72   15.35
GBR    0.77   0.67   0.03
NLD    0.77   0.86   0.71   3.80
USA    0.75   0.86   0.67   0.81   2.91


-----------------------------------------------------------------------------
JER    cc2
-----------------------------------------------------------------------------
        CAN    DFS    GBR    NLD    NZL    USA    ZAF    AUS    IRL
CAN    6.67
DFS    0.83   15.56
GBR    0.76   0.78   4.02
NLD    0.87   0.88   0.78   3.31
NZL    0.70   0.70   0.69   0.70   4.01
USA    0.82   0.83   0.81   0.82   0.71   2.62
ZAF    0.68   0.67   0.73   0.69   0.77   0.85   11.20
AUS    0.65   0.66   0.65   0.66   0.62   0.67   0.74   6.13
IRL    0.78   0.76   0.78   0.79   0.70   0.79   0.77   0.73   2.20
```

```
--------------------------------------------------------------------------------
JER    int
--------------------------------------------------------------------------------

         CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN      6.48
DFS      0.87   15.28
GBR      0.80    0.85    4.02
NLD      0.87    0.90    0.83    3.41
NZL      0.67    0.67    0.68    0.67    4.01
USA      0.86    0.85    0.82    0.81    0.71    2.62
ZAF      0.78    0.78    0.79    0.77    0.77    0.86   11.20
AUS      0.76    0.76    0.76    0.74    0.66    0.76    0.79    6.13
IRL      0.81    0.77    0.78    0.80    0.67    0.78    0.81    0.78    2.20


--------------------------------------------------------------------------------
RDC    hco
--------------------------------------------------------------------------------

         CAN     DEU     DFS     NOR     USA     NLD
CAN      7.59
DEU      0.91   14.05
DFS      0.74    0.81   12.25
NOR      0.87    0.89    0.86   16.36
USA      0.83    0.83    0.86    0.73    2.79
NLD      0.74    0.77    0.79    0.68    0.79    5.09


--------------------------------------------------------------------------------
RDC    crc
--------------------------------------------------------------------------------

         CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     IRL
CAN      6.46
DEU      0.84   10.03
DFS      0.85    0.90   12.66
GBR      0.77    0.72    0.72    4.16
NOR      0.85    0.83    0.86    0.66   13.80
NZL      0.57    0.58    0.55    0.65    0.57    0.11
USA      0.78    0.81    0.80    0.76    0.77    0.70    8.39
NLD      0.87    0.90    0.93    0.77    0.82    0.59    0.81    3.59
IRL      0.64    0.63    0.65    0.82    0.64    0.57    0.61    0.64    2.82


--------------------------------------------------------------------------------
RDC    cc1
--------------------------------------------------------------------------------

         CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN      7.01
DEU      0.90   13.36
DFS      0.73    0.80   12.98
GBR      0.75    0.79    0.69    0.03
NOR      0.78    0.87    0.92    0.75   13.85
NLD      0.79    0.79    0.89    0.72    0.73    4.21
USA      0.83    0.75    0.82    0.67    0.76    0.86    2.74


--------------------------------------------------------------------------------
RDC    cc2
--------------------------------------------------------------------------------

         CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.78
DEU      0.92   11.13
DFS      0.83    0.94   12.78
GBR      0.76    0.79    0.79    4.17
NOR      0.83    0.85    0.89    0.78   13.85
NZL      0.70    0.70    0.70    0.71    0.72    5.74
USA      0.87    0.90    0.83    0.81    0.79    0.70    2.50
ZAF      0.73    0.81    0.77    0.71    0.76    0.65    0.84   17.66
NLD      0.88    0.95    0.89    0.79    0.81    0.72    0.84    0.75    3.64
AUS      0.67    0.69    0.64    0.68    0.65    0.63    0.69    0.70    0.66    7.37
IRL      0.79    0.82    0.79    0.82    0.78    0.70    0.81    0.84    0.81    0.81    2.82

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

```
RDC     int
-------------------------------------------------------------------------------------------
          CAN      DEU      DFS      GBR      NOR      NZL      USA      ZAF      NLD      AUS      IRL
CAN      6.71
DEU      0.90    11.02
DFS      0.88     0.94    13.11
GBR      0.84     0.86     0.83     4.17
NOR      0.82     0.81     0.76     0.77    13.80
NZL      0.68     0.68     0.67     0.69     0.69     5.74
USA      0.92     0.90     0.83     0.83     0.77     0.67     2.51
ZAF      0.85     0.85     0.82     0.80     0.86     0.68     0.86    17.66
NLD      0.90     0.92     0.94     0.86     0.75     0.68     0.83     0.81     3.48
AUS      0.77     0.77     0.76     0.77     0.77     0.67     0.77     0.79     0.67     7.37
IRL      0.84     0.84     0.82     0.83     0.77     0.68     0.82     0.86     0.81     0.84     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   92   53  103   96   30
  DEA   82    0  192  186  565  128
  FRA   45  143    0   71  161   74
  USA   94  145   53    0  200   49
  CHE   80  473  120  165    0   92
  NLD   27  121   61   45   88    0
 --------------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 --------------------------------------------------------------------------------------
  CAN    0  118  112   39   16  133   48   71  108
  CHE  100    0  588   98   25  265   63  162  438
  DEA   98  486    0  148   36  230   59  200  576
  NLD   34   91  137    0   24   57   37   80  125
  NZL   15   19   31   18    0   16   13   20   29
  USA  129  230  179   52   13    0   66   92  170
  GBR   45   48   44   32   10   64    0   46   68
  FRA   61  119  147   64   15   63   38    0  182
  ITA   95  374  462  102   23  119   49  137    0
 --------------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  USA  GBR  FRA
 --------------------------------------------------------------------------------------
  CAN    0  118  113   39  134   48   75
  CHE  100    0  587   97  265   66  171
  DEA   99  484    0  148  229   63  213
  NLD   34   91  137    0   57   37   85
  USA  130  230  178   52    0   69   98
  GBR   46   51   47   32   68    0   51
  FRA   65  127  159   70   69   44    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   96   36   13  126   45   68   95
  CHE   83    0  579   98   21  320   63  171  437
```

```
 DEA   84  480    0  149   28  304   59  212  571
 NLD   32   91  137    0   20   80   37   85  125
 NZL   12   15   23   14    0   23   10   17   23
 USA  118  296  260   69   19    0   76  118  216
 GBR   41   48   44   32    7   74    0   49   68
 FRA   60  127  158   70   12   83   42    0  195
 ITA   83  374  458  102   19  151   49  149    0
------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DEA  NLD  NZL  USA  GBR  ITA
------------------------------------------------------------------------
 CAN     0  101   38   13  131   47  102
 DEA    88    0  148   28  303   59  666
 NLD    34  137    0   20   80   37  130
 NZL    12   23   14    0   23   10   23
 USA   123  260   69   19    0   76  237
 GBR    43   44   32    7   74    0   70
 ITA    89  582  108   19  169   51    0
------------------------------------------------------------------------
GUE
--------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  NZL  USA  AUS
------------------------------------------------------------------------
 CAN     0   16    2   39   18
 GBR    13    0   14   53   28
 NZL     1   12    0   10   25
 USA    38   50    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   17   39
 GBR    13    0   56
 USA    38   53    0
------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  NZL  USA  AUS
------------------------------------------------------------------------
 CAN     0   11    0   38   22
 GBR     8    0   13   83   32
 NZL     0   11    0   24   23
 USA    36   84   23    0   62
 AUS    18   26   23   60    0
------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  GBR  NZL  USA  AUS
------------------------------------------------------------------------
 CAN     0   11    0   38   22
 GBR     8    0   13   83   32
 NZL     0   11    0   24   23
 USA    36   84   23    0   62
 AUS    18   26   23   60    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 1050 2182 1283 1256 2828 1244  799 1314 1779 1113
 CZE   772    0 1770 1184 1195 1411 1116  481 1440 1287  795
 DEU  1735 1338    0 2481 2280 2871 2105 1092 2942 2615 1292
 DFS  1191  784 1848    0 1633 1599 1292  703 2113 1642  944
 FRA   929  727 1271  943    0 1639 1398  689 1905 1720 1110
 USA  3260 1129 2227 1435  976    0 1756  849 1783 2372 1428
 POL  1119  878 1823 1050  927 1809    0  518 1498 1455  793
 CHE   720  337 1018  649  630  790  405    0  876  760  450
 NLD  1292 1247 2565 1829 1251 1576 1324  870    0 1763 1030
 ITA  1539  924 1829 1313 1010 1961 1144  703 1474    0 1164
 JPN   622  344  570  489  402  739  427  288  515  536    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  745  589 1184  838  882  843  512  811 1216  507  799  541  936
 CAN   753    0  828 2304 1369 1526 1580  548 1832 1471  684 2955 1116 1356
 CHE   596  754    0 1126  710  708  730  415  757  913  417  914  474  701
 DEU  1213 1789 1058    0 2675 2215 2184  912 2678 3420  990 3106 1846 2515
 DFS   787 1280  664 1954    0 1489 1575  755 1625 2152  835 1760 1174 1647
 ESP   955 1316  666 1948 1306    0 1472  704 1709 1689  727 1788 1113 1712
 GBR   829 1662  694 1653 1233 1343    0  996 1649 1838  943 1984  982 1587
 IRL   506  548  427  798  637  726 1037    0  664  912  745  660  382  755
 ITA   802 1576  703 1892 1311 1528 1316  591    0 1835  724 2499 1276 1725
 NLD  1391 1455  909 3124 1927 1781 1610  862 1568    0 1065 2044 1344 2021
 NZL   409  627  346  754  591  600  809  644  555  961    0  818  427  801
 USA   768 3441  846 2331 1531 1547 1929  648 2001 1830  752    0 1572 1842
 POL   451  962  356 1489  912  884  733  289  931 1150  315 1521    0 1292
 FRA   930 1018  634 1401  935 1622 1028  614 1007 1310  490 1079  813    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  829 1054 2292 1375 1367 1636  122 1837 1475 3004 1159 1253
 CHE   755    0  463 1124  710  708  740   58  756  913  914  495  476
 CZE   813  327    0 1687 1102 1116  966  110 1231 1380 1455 1073  765
 DEU  1771 1055 1323    0 2671 2530 2227  162 2656 3399 3076 1997 1480
 DFS  1285  664  797 1946    0 1656 1610  145 1624 2151 1764 1258 1005
 FRA  1038  644  690 1420  948    0 1618  118 1735 2040 1852 1347 1243
 GBR  1724  706  664 1699 1266 1056    0  142 1692 1888 2047 1032 1095
 ISR    87   35   83  130  107   67  102    0  145  152  158  103  103
 ITA  1585  701  913 1870 1308 1024 1365  109    0 1830 2495 1335 1213
 NLD  1461  909 1247 3101 1926 1337 1665  119 1563    0 2045 1456 1095
 USA  3506  846 1178 2291 1531 1097 2014  152 1996 1830    0 1626 1623
 POL  1022  389  855 1723 1026  872  793   73  996 1304 1599    0  797
 JPN   732  327  377  653  557  467  577   47  605  602  888  441    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  732  589  554 1176  839  882  932  845  514   74  809 1218  484  949  535  330  736  346  518
 CAN   740    0  817 1028 2223 1348 1511 1325 1549  535  118 1784 1432  626 3086 1081  440 1268  703 1161
 CHE   596  733    0  463 1117  711  708  698  730  415   59  752  913  394 1011  460  263  628  301  446
```

CZE	443	779	327	0	1682	1101	1063	1106	954	436	110	1229	1380	479	1529	1000	302	737	472	731
DEU	1203	1686	1045	1314	0	2663	2217	2488	2174	909	163	2634	3371	935	3624	1798	554	1690	774	1402
DFS	787	1253	665	797	1936	0	1496	1642	1580	755	147	1620	2155	794	2149	1150	507	1294	632	947
ESP	955	1288	666	855	1940	1312	0	1711	1475	705	132	1707	1694	698	2108	1094	515	1184	647	1096
FRA	920	984	627	679	1357	915	1607	0	1587	759	121	1708	2005	783	2537	1265	479	1299	594	1181
GBR	829	1620	694	654	1634	1233	1344	1020	0	907	142	1640	1841	907	2362	963	500	1431	662	1030
IRL	506	528	427	329	792	637	726	611	1037	0	96	662	915	727	824	373	334	750	374	447
ISR	45	84	35	83	129	107	102	65	101	78	0	144	154	102	183	98	59	109	83	101
ITA	799	1503	695	909	1835	1296	1520	982	1307	589	107	0	1823	687	2724	1242	472	1203	666	1148
NLD	1393	1403	909	1247	3051	1928	1784	1284	1611	863	119	1549	0	1002	2603	1308	501	1491	661	1034
NZL	389	568	329	350	697	556	578	468	778	628	86	534	902	0	1050	389	352	1162	501	542
USA	848	3488	941	1208	2539	1665	1814	1367	2172	748	169	2080	2261	983	0	1572	630	1948	1106	1930
POL	437	910	341	752	1413	885	862	785	712	278	62	896	1101	289	1487	0	224	729	434	732
ZAF	275	404	222	202	424	373	471	333	439	293	38	376	416	280	605	152	0	472	311	405
AUS	636	1286	555	506	1251	942	960	881	1251	648	70	927	1291	1153	1955	517	412	0	648	886
URY	254	654	226	316	532	425	563	340	533	289	43	483	504	402	1353	325	259	496	0	551
JPN	318	606	283	332	553	478	511	399	495	272	38	512	514	258	763	360	255	458	273	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	734	1174	839	882	845	514	808	1218	484	949	534	330	736	346	932	518
CAN	744	0	2227	1356	1518	1558	541	1791	1442	631	3100	1084	444	1276	708	1333	1166
DEU	1202	1695	0	2660	2216	2173	909	2633	3368	935	3618	1791	554	1690	773	2487	1402
DFS	787	1263	1933	0	1496	1580	755	1620	2154	794	2147	1149	507	1294	631	1642	947
ESP	955	1304	1940	1312	0	1475	705	1706	1693	698	2106	1094	515	1183	647	1710	1095
GBR	829	1633	1634	1233	1344	0	997	1640	1841	907	2362	963	500	1431	661	1587	1030
IRL	506	536	792	637	726	1037	0	662	915	727	824	373	334	750	374	759	447
ITA	799	1515	1835	1296	1519	1307	589	0	1823	687	2724	1238	472	1203	666	1708	1148
NLD	1393	1416	3050	1927	1784	1611	863	1549	0	1002	2603	1305	501	1491	661	2005	1034
NZL	389	571	697	556	578	778	628	534	902	0	1050	389	352	1162	501	783	542
USA	848	3518	2539	1665	1814	2172	748	2080	2261	983	0	1570	630	1948	1106	2537	1930
POL	437	916	1410	884	862	712	278	895	1101	289	1487	0	224	729	434	1265	731
ZAF	275	411	424	373	471	439	293	376	416	280	605	152	0	472	311	479	405
AUS	636	1291	1251	942	960	1251	648	927	1291	1153	1955	517	412	0	648	1299	886
URY	254	660	532	425	563	533	289	483	504	402	1353	325	259	496	0	594	551
FRA	920	992	1357	915	1607	1020	611	982	1284	468	1367	785	333	881	340	0	1181
JPN	318	609	553	478	511	495	272	512	514	258	763	360	255	458	273	399	0

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

	CAN	DFS	USA	NLD
CAN	0	88	321	27
DFS	82	0	138	71
USA	309	125	0	63
NLD	21	68	62	0

JER
----

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	NZL	USA	IRL
CAN	0	94	143	35	152	364	10
DFS	86	0	166	128	145	154	49
GBR	144	161	0	85	208	205	71
NLD	31	125	79	0	71	82	29
NZL	152	122	217	64	0	271	124
USA	367	140	224	86	295	0	41
IRL	9	45	73	29	140	43	0

JER

```
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DFS  GBR  NLD  USA
 ------------------------------------------------------------------------------

  CAN    0   94  146   35  371
  DFS   86    0  166  127  153
  GBR  147  161    0   86  207
  NLD   31  124   81    0   82
  USA  374  140  226   86    0
 ------------------------------------------------------------------------------

JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
 ------------------------------------------------------------------------------

  CAN    0   92  141   35  138  372  127  214   10
  DFS   84    0  167  128  143  202  151  158   49
  GBR  140  161    0   85  202  232  170  218   71
  NLD   29  125   79    0   70   95   74   73   29
  NZL  139  119  212   64    0  358  202  417  124
  USA  372  176  258  102  431    0  308  499   46
  ZAF  125  132  174   70  212  321    0  243   39
  AUS  207  127  226   67  461  541  231    0   56
  IRL    9   45   73   29  140   48   40   54    0
 ------------------------------------------------------------------------------

JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
 ------------------------------------------------------------------------------

  CAN    0   93  142   35  140  375  129  216   10
  DFS   85    0  167  128  143  202  151  158   49
  GBR  142  161    0   85  202  232  170  218   71
  NLD   30  125   79    0   70   96   74   73   29
  NZL  142  119  212   64    0  358  202  417  124
  USA  378  176  258  102  431    0  308  499   46
  ZAF  128  132  174   70  212  321    0  243   39
  AUS  211  127  226   67  461  541  231    0   56
  IRL    9   45   73   29  140   48   40   54    0
 ------------------------------------------------------------------------------

RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  NOR  USA  NLD
 ------------------------------------------------------------------------------
  CAN    0   10  169    7  100    6
  DEU   10    0   54   14   15   10
  DFS  176   45    0  122  155   52
  NOR    6   13  100    0   67   35
  USA   94   14  148   67    0   35
  NLD    6   10   49   35   33    0
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RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEU  DFS  GBR  NOR  NZL  USA  NLD  IRL
 ------------------------------------------------------------------------------
  CAN    0   13  170   72    7   68  138    6    4
  DEU   12    0   57   14   14   16   20   14    5
  DFS  176   45    0  104  142  166  178   54   19
  GBR   73   13  100    0   54   74   92   36   22
  NOR    6   13  114   57    0   42   75   41   57
  NZL   68   16  161   73   41    0   98   20   13
  USA  133   19  172   89   74   99    0   39   28
  NLD    6   14   51   35   41   20   37    0   12
```

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   IRL    4    5   14   21   56   13   28   12    0
------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DEU  DFS  GBR  NOR  NLD  USA
------------------------------------------------------------------------------
   CAN    0   13  170   74    7    6  138
   DEU   12    0   57   14   14   14   20
   DFS  176   45    0  105  129   54  178
   GBR   75   13  101    0   55   37   94
   NOR    6   13  105   58    0   39   75
   NLD    6   14   51   36   39    0   39
   USA  133   19  172   91   74   37    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  165   68    7   58  162   73    6   70    4
   DEU   12    0   55   14   14   15   21    2   14   40    5
   DFS  171   44    0  104  129  155  199   58   54  208   19
   GBR   69   13  100    0   53   67  107   43   36   78   22
   NOR    6   13  105   56    0   36   78    0   39   65   57
   NZL   59   15  151   65   35    0  100   35   16  127   12
   USA  164   20  197  106   78  102    0   73   43  125   29
   ZAF   77    2   55   40    0   33   68    0    3   42    3
   NLD    6   14   51   35   39   16   41    3    0   28   12
   AUS   71   39  184   77   55  128  125   43   26    0   17
   IRL    4    5   14   21   56   12   29    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  165   69    7   58  162   73    6   70    4
   DEU   12    0   55   14   14   15   21    2   14   40    5
   DFS  171   44    0  104  142  155  200   58   54  208   19
   GBR   70   13  100    0   54   67  107   43   36   78   22
   NOR    6   13  114   57    0   37   78    0   41   70   57
   NZL   59   15  151   65   36    0  100   35   16  127   12
   USA  164   20  197  106   77  101    0   73   43  125   29
   ZAF   77    2   55   40    0   33   68    0    3   42    3
   NLD    6   14   51   35   41   16   41    3    0   28   12
   AUS   71   39  184   77   60  128  125   43   26    0   17
   IRL    4    5   14   21   56   12   29    3   12   16    0
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SIM
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