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

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

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

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


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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SVN     T5=IT   CI=Calving interval (days)

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CHANGES IN NATIONAL PROCEDURES
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Changes in the national genetic evaluation of female fertility traits are as
follows:

BEL (HOL)       Inclusion of inbreeding effect in the model.
AUS (ALL)       Drops in information due to data clean up such as pedigree changes, status
                change of a bull which leads to a good number of bulls no longer qualifying.
                Base change for RDC
SVN (HOL,BSW)   Reduced the performance data to 2010-2022 and estimated variance
                components for all traits
JPN (HOL)       Some decrease in information due to pedigree correction
DEU (HOL)       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.
ESP (HOL)       Database update from regional milk recording organizations, affecting several bulls but very slight change in information per bull.
NZL (RDC,JER,HOL)  Continuous DNA parentage testing affecting number of daughters, herds and EDCs. EDC also affected by changes in phenotype records.
CHE (BSW,HOL)   Drops in information due to manual edits in database. The change of herd-year-season assignment of certain data records might also explain small
                changes in EDC and reliabilities for some bulls.
ITA (HOL)       Drop in information due to data editing
GBR (ALL)       Minor changes in data due re-extraction at each run and changes introduced by data providers
CZE (HOL)       Cut all inseminations for cc1/cc2 made before 1.7.2007, causing decrease in information.



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
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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

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

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

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

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




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

NEXT TEST INTERNATIONAL EVALUATION

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

PUBLICATION OF INTERBULL 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 2022).
Number of records for lactating cow's ability to conceive (cc2) by breed
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Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		145	8637	1842	780	
BEL			2060			
CAN	182	48	10080	624	584	
CHE	2960		3216			
CZE			3652			
DEA	4880					
DEU			25230		307	
DFS			17103	2478	10475	
ESP			6396			
EST						
FRA	432		17096			
FRM						
GBR	108	247	7491	611	449	
HUN						
IRL			3187	227	71	
ISR			1620			
ITA	1926		9514			
JPN			6484			
KOR						
LTU						
LVA						
NLD	215		16422	231	92	
NOR					3096	
NZL	55	49	8463	4881	1325	
POL			8657			
PRT						
SVK						
SVN						
URY			1889			
USA	1180	791	41638	5228	786	
ZAF			1275	742	156	

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HRV
CAM
=========================================================================================
No.Records    11938         1280          200110        16864         18121
Pub. Proofs   10546         1062          157261        14014         17929                 0
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW    hco
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        CAN     DEA     FRA     USA     CHE     NLD
CAN     9.43
DEA     0.86    9.92
FRA     0.77    0.86    0.89
USA     0.78    0.79    0.88    2.65
CHE     0.91    0.94    0.87    0.81   13.25
NLD     0.78    0.63    0.73    0.74    0.64    4.52


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BSW    crc
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        CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN     6.88
CHE     0.82   11.40
DEA     0.78    0.95   14.94
NLD     0.85    0.89    0.90    3.88
NZL     0.61    0.61    0.71    0.62    0.12
USA     0.78    0.84    0.82    0.80    0.60    8.03
GBR     0.71    0.70    0.63    0.76    0.63    0.73    3.84
FRA     0.82    0.96    0.95    0.91    0.63    0.84    0.74    1.78
ITA     0.82    0.78    0.79    0.81    0.65    0.79    0.75    0.82   16.43


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BSW    cc1
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        CAN     CHE     DEA     NLD     USA     GBR     FRA
CAN     7.67
CHE     0.82   11.78
DEA     0.78    0.94   11.42
NLD     0.77    0.71    0.67    4.09
USA     0.75    0.68    0.67    0.85    2.87
GBR     0.77    0.80    0.78    0.73    0.67    0.03
FRA     0.74    0.69    0.67    0.87    0.88    0.71    0.96


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BSW    cc2
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        CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN     6.63
CHE     0.77   11.12
DEA     0.78    0.93   12.25
NLD     0.85    0.84    0.83    3.40
NZL     0.70    0.66    0.73    0.70    6.24
USA     0.82    0.83    0.84    0.81    0.70    2.48
GBR     0.72    0.81    0.82    0.75    0.70    0.82    3.84
FRA     0.84    0.87    0.87    0.86    0.70    0.82    0.79    0.96
ITA     0.80    0.70    0.79    0.82    0.67    0.81    0.77    0.77   21.63


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BSW    int
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        CAN     DEA     NLD     NZL     USA     GBR     ITA     SVN
CAN     7.17
DEA     0.80   14.25
NLD     0.87    0.91    3.35
NZL     0.68    0.80    0.69    6.24
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USA      0.91    0.84    0.82    0.67    2.48
GBR      0.83    0.75    0.85    0.67    0.83    3.84
ITA      0.85    0.92    0.88    0.68    0.81    0.82   17.55
SVN      0.72    0.68    0.73    0.71    0.71    0.75    0.72   20.26

------------------------------------------------------------------------
GUE    crc
------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      8.09
GBR      0.74    4.85
NZL      0.61    0.63    0.12
USA      0.78    0.77    0.61    6.79
AUS      0.68    0.79    0.89    0.66    6.97

------------------------------------------------------------------------
GUE    cc1
------------------------------------------------------------------------
         CAN     GBR     USA
CAN      7.45
GBR      0.77    0.03
USA      0.81    0.72    3.47

------------------------------------------------------------------------
GUE    cc2
------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      6.97
GBR      0.71    4.85
NZL      0.69    0.70    5.88
USA      0.85    0.81    0.70    2.79
AUS      0.68    0.68    0.69    0.72    9.88

------------------------------------------------------------------------
GUE    int
------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      7.76
GBR      0.83    4.85
NZL      0.67    0.67    5.88
USA      0.91    0.81    0.67    2.79
AUS      0.73    0.71    0.72    0.74    9.88

------------------------------------------------------------------------
HOL    hco
------------------------------------------------------------------------
         CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD     ITA     JPN
CAN      7.78
CZE      0.77   17.91
DEU      0.91    0.80   15.18
DFS      0.79    0.84    0.84   13.54
FRA      0.81    0.81    0.82    0.89    0.83
USA      0.84    0.85    0.84    0.87    0.89    2.38
POL      0.64    0.55    0.64    0.55    0.55    0.58   19.50
CHE      0.96    0.80    0.93    0.79    0.84    0.87    0.57   13.69
NLD      0.79    0.77    0.82    0.86    0.83    0.83    0.53    0.80    5.07
ITA      0.81    0.78    0.92    0.74    0.76    0.80    0.65    0.88    0.73    0.04
JPN      0.85    0.72    0.84    0.72    0.78    0.84    0.63    0.85    0.74    0.73    6.24

------------------------------------------------------------------------
HOL    crc
------------------------------------------------------------------------
         BEL     CAN     CHE     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     FRA
BEL      4.65
CAN      0.75    7.24
CHE      0.81    0.83   12.27
DEU      0.72    0.84    0.87   10.95
DFS      0.79    0.87    0.94    0.92   11.61
ESP      0.86    0.81    0.84    0.82    0.83   11.01
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GBR    0.90    0.74    0.77    0.72    0.79    0.88    4.59
IRL    0.85    0.60    0.67    0.60    0.62    0.81    0.82    3.56
ITA    0.80    0.86    0.86    0.86    0.86    0.88    0.81    0.67    7.74
NLD    0.82    0.87    0.93    0.90    0.96    0.83    0.79    0.62    0.85    4.87
NZL    0.60    0.60    0.60    0.58    0.62    0.62    0.63    0.55    0.69    0.59    0.09
USA    0.74    0.78    0.82    0.82    0.86    0.80    0.78    0.59    0.80    0.82    0.60    6.85
POL    0.76    0.90    0.89    0.85    0.84    0.85    0.75    0.67    0.95    0.83    0.67    0.76   13.38
FRA    0.78    0.85    0.94    0.92    0.94    0.84    0.79    0.65    0.90    0.94    0.62    0.82    0.88    1.18

-------------------------------------------------------------------------------
HOL    cc1
-------------------------------------------------------------------------------
       CAN     CHE     CZE     DEU     DFS     FRA     GBR     ISR     ITA     NLD     USA     POL     JPN
CAN    6.62
CHE    0.92   10.92
CZE    0.83    0.75   17.48
DEU    0.91    0.92    0.80   14.72
DFS    0.75    0.70    0.88    0.78   13.17
FRA    0.78    0.75    0.91    0.76    0.89    1.01
GBR    0.76    0.77    0.70    0.78    0.66    0.72    0.03
ISR    0.78    0.68    0.91    0.76    0.87    0.88    0.74    3.25
ITA    0.87    0.86    0.80    0.94    0.71    0.74    0.78    0.78    0.05
NLD    0.79    0.76    0.90    0.80    0.92    0.94    0.73    0.89    0.75    4.78
USA    0.80    0.71    0.95    0.75    0.85    0.87    0.67    0.92    0.78    0.87    2.81
POL    0.72    0.75    0.72    0.75    0.61    0.62    0.66    0.67    0.79    0.65    0.65   19.67
JPN    0.78    0.75    0.89    0.76    0.83    0.82    0.76    0.84    0.75    0.82    0.91    0.66    7.58

-------------------------------------------------------------------------------
HOL    cc2
-------------------------------------------------------------------------------
       BEL     CAN     CHE     CZE     DEU     DFS     ESP     FRA     GBR     IRL     ISR     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     JPN
BEL    4.65
CAN    0.76    6.04
CHE    0.82    0.90   10.97
CZE    0.66    0.87    0.86   17.48
DEU    0.80    0.93    0.93    0.91   13.49
DFS    0.82    0.85    0.88    0.83    0.95   12.84
ESP    0.85    0.80    0.86    0.85    0.86    0.82   11.00
FRA    0.82    0.88    0.93    0.84    0.93    0.86    0.84    0.97
GBR    0.89    0.72    0.74    0.66    0.77    0.80    0.84    0.75    4.58
IRL    0.84    0.77    0.83    0.70    0.81    0.77    0.85    0.82    0.82    3.56
ISR    0.66    0.75    0.75    0.89    0.84    0.79    0.81    0.78    0.66    0.69    3.25
ITA    0.76    0.86    0.86    0.90    0.92    0.84    0.89    0.86    0.79    0.79    0.88   15.12
NLD    0.81    0.89    0.90    0.86    0.96    0.92    0.83    0.92    0.76    0.80    0.81    0.86    4.43
NZL    0.70    0.69    0.63    0.63    0.69    0.69    0.66    0.69    0.69    0.69    0.62    0.63    0.69    4.58
USA    0.81    0.86    0.86    0.88    0.90    0.86    0.88    0.81    0.83    0.82    0.82    0.91    0.84    0.69    2.35
POL    0.81    0.72    0.73    0.63    0.72    0.73    0.80    0.72    0.81    0.78    0.64    0.79    0.72    0.69    0.79   12.84
ZAF    0.77    0.78    0.83    0.73    0.82    0.76    0.84    0.79    0.79    0.87    0.67    0.85    0.76    0.63    0.87    0.82   15.45
AUS    0.69    0.68    0.73    0.63    0.70    0.64    0.71    0.71    0.69    0.84    0.63    0.69    0.66    0.62    0.72    0.62    0.79    8.40
URY    0.73    0.71    0.65    0.62    0.71    0.71    0.68    0.71    0.72    0.73    0.58    0.64    0.71    0.71    0.71    0.73    0.78    0.67    1.41
JPN    0.84    0.82    0.86    0.78    0.84    0.85    0.87    0.81    0.87    0.86    0.72    0.88    0.80    0.69    0.92    0.90    0.89    0.71    0.74   18.30

-------------------------------------------------------------------------------
HOL    int
-------------------------------------------------------------------------------
       BEL     CAN     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     FRA     JPN     SVN
BEL    4.65
CAN    0.88    6.52
DEU    0.86    0.91   12.30
DFS    0.90    0.91    0.95   12.75
ESP    0.89    0.87    0.87    0.87   11.00
GBR    0.89    0.83    0.86    0.89    0.89    4.58
IRL    0.85    0.83    0.83    0.81    0.87    0.83    3.56
ITA    0.86    0.89    0.90    0.89    0.93    0.87    0.83   19.73
NLD    0.93    0.91    0.92    0.96    0.88    0.88    0.83    0.88    4.54
NZL    0.70    0.66    0.66    0.66    0.67    0.66    0.66    0.66    0.66    4.58
USA    0.82    0.93    0.91    0.88    0.89    0.83    0.82    0.91    0.85    0.66    2.35
POL    0.81    0.86    0.80    0.82    0.85    0.82    0.79    0.90    0.82    0.68   12.84
ZAF    0.80    0.85    0.85    0.81    0.88    0.81    0.87    0.87    0.82    0.66    0.88    0.85   15.45
```

```
AUS    0.73   0.74   0.72   0.70   0.74   0.72   0.85   0.72   0.69   0.66   0.74   0.70   0.81   8.40
URY    0.74   0.71   0.70   0.70   0.71   0.71   0.75   0.73   0.70   0.72   0.69   0.73   0.81   0.71   1.41
FRA    0.81   0.87   0.81   0.81   0.83   0.73   0.80   0.81   0.83   0.66   0.81   0.70   0.79   0.72   0.66   0.97
JPN    0.86   0.93   0.90   0.90   0.91   0.87   0.85   0.94   0.88   0.66   0.92   0.90   0.89   0.74   0.75   0.80   18.30
SVN    0.88   0.75   0.77   0.84   0.75   0.79   0.76   0.81   0.85   0.66   0.72   0.67   0.65   0.67   0.67   0.80   0.75   20.33
```

JER   hco

```
       CAN    DFS    USA    NLD
CAN    7.88
DFS    0.74   17.19
USA    0.78   0.83   2.72
NLD    0.82   0.83   0.73   4.74
```

JER   crc

```
       CAN    DFS    GBR    NLD    NZL    USA    IRL
CAN    6.79
DFS    0.82   13.42
GBR    0.66   0.84   3.97
NLD    0.85   0.88   0.72   3.90
NZL    0.56   0.70   0.66   0.57   0.07
USA    0.77   0.83   0.79   0.80   0.66   8.26
IRL    0.63   0.63   0.80   0.62   0.56   0.60   2.33
```

JER   cc1

```
       CAN    DFS    GBR    NLD    USA
CAN    7.04
DFS    0.71   15.30
GBR    0.78   0.67   0.03
NLD    0.77   0.84   0.71   3.72
USA    0.75   0.83   0.67   0.77   2.89
```

JER   cc2

```
       CAN    DFS    GBR    NLD    NZL    USA    ZAF    AUS    IRL
CAN    6.77
DFS    0.81   15.52
GBR    0.72   0.75   3.97
NLD    0.85   0.88   0.75   3.23
NZL    0.70   0.70   0.69   0.70   3.96
USA    0.81   0.81   0.79   0.80   0.70   2.62
ZAF    0.67   0.66   0.73   0.69   0.76   0.85   11.23
AUS    0.65   0.65   0.65   0.65   0.62   0.66   0.72   6.39
IRL    0.76   0.75   0.77   0.78   0.70   0.77   0.77   0.73   2.33
```

JER   int

```
       CAN    DFS    GBR    NLD    NZL    USA    ZAF    AUS    IRL
CAN    6.46
DFS    0.85   15.27
GBR    0.77   0.83   3.97
NLD    0.86   0.90   0.81   3.37
NZL    0.67   0.67   0.67   0.67   3.96
USA    0.84   0.83   0.79   0.80   0.70   2.62
ZAF    0.73   0.73   0.75   0.74   0.77   0.85   11.23
AUS    0.72   0.71   0.71   0.70   0.66   0.71   0.75   6.39
IRL    0.80   0.75   0.76   0.79   0.67   0.77   0.80   0.76   2.33
```

RDC   hco

```
       CAN    DEU    DFS    NOR    USA    NLD
```

```
CAN       7.61
DEU       0.90   14.58
DFS       0.73    0.80   12.24
NOR       0.86    0.88    0.87   16.45
USA       0.83    0.82    0.84    0.72    2.77
NLD       0.81    0.83    0.78    0.66    0.79    5.58

-------------------------------------------------------------------------------------
RDC    crc
-------------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     IRL
CAN       6.47
DEU       0.84   10.14
DFS       0.85    0.90   12.67
GBR       0.77    0.72    0.70    4.10
NOR       0.84    0.82    0.85    0.63   13.97
NZL       0.58    0.59    0.55    0.64    0.58    0.11
USA       0.78    0.81    0.80    0.76    0.77    0.69    8.28
NLD       0.87    0.89    0.93    0.76    0.84    0.59    0.81    3.65
IRL       0.62    0.61    0.63    0.81    0.62    0.57    0.61    0.62    2.83

-------------------------------------------------------------------------------------
RDC    cc1
-------------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN       7.12
DEU       0.90   13.76
DFS       0.71    0.80   12.99
GBR       0.76    0.78    0.68    0.03
NOR       0.76    0.85    0.92    0.76   13.90
NLD       0.79    0.80    0.88    0.72    0.72    3.99
USA       0.83    0.75    0.79    0.67    0.75    0.83    2.75

-------------------------------------------------------------------------------------
RDC    cc2
-------------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN       6.78
DEU       0.92   11.32
DFS       0.82    0.94   12.82
GBR       0.73    0.77    0.77    4.10
NOR       0.80    0.84    0.89    0.74   13.90
NZL       0.70    0.70    0.70    0.71    0.72    5.68
USA       0.87    0.89    0.81    0.79    0.74    0.70    2.52
ZAF       0.72    0.81    0.75    0.71    0.78    0.65    0.82   17.35
NLD       0.88    0.95    0.88    0.76    0.78    0.71    0.83    0.76    3.45
AUS       0.67    0.68    0.64    0.67    0.65    0.63    0.68    0.68    0.66    7.59
IRL       0.78    0.81    0.77    0.81    0.74    0.70    0.80    0.84    0.80    0.80    2.83

-------------------------------------------------------------------------------------
RDC    int
-------------------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN       6.63
DEU       0.90   11.20
DFS       0.88    0.94   13.15
GBR       0.82    0.85    0.82    4.10
NOR       0.79    0.78    0.71    0.72   13.97
NZL       0.67    0.68    0.67    0.68    0.69    5.68
USA       0.92    0.90    0.80    0.81    0.72    0.67    2.52
ZAF       0.82    0.85    0.79    0.76    0.83    0.68    0.84   17.35
NLD       0.90    0.92    0.93    0.86    0.78    0.68    0.83    0.81    3.40
AUS       0.73    0.73    0.71    0.72    0.72    0.67    0.73    0.75    0.67    7.59
IRL       0.82    0.83    0.79    0.81    0.72    0.68    0.79    0.86    0.81    0.82    2.83

-----------------------------------------------------------------------------------------------------
^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   95   53  104   99   30
 DEA   85    0  197  194  587  134
 FRA   45  149    0   72  167   74
 USA   95  152   54    0  206   53
 CHE   83  493  126  172    0   97
 NLD   27  126   60   49   91    0
--------------------------------------------------------------------------------

BSW
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
--------------------------------------------------------------------------------
 CAN    0  122  119   40   18  136   49   73  113
 CHE  103    0  600  104   27  270   65  167  453
 DEA  106  497    0  153   40  237   62  207  591
 NLD   35   95  142    0   25   64   38   79  128
 NZL   17   21   35   19    0   18   14   21   31
 USA  132  235  188   59   15    0   67   94  172
 GBR   46   50   47   33   11   65    0   48   70
 FRA   62  124  155   63   16   64   40    0  188
 ITA   99  387  476  104   25  120   52  143    0
--------------------------------------------------------------------------------

BSW
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  CHE  DEA  NLD  USA  GBR  FRA
--------------------------------------------------------------------------------
 CAN    0  123  120   41  137   48   77
 CHE  104    0  599  103  270   67  176
 DEA  107  495    0  152  237   65  220
 NLD   36   95  141    0   64   38   84
 USA  134  235  188   59    0   69   99
 GBR   46   52   49   33   68    0   53
 FRA   66  132  167   69   70   46    0
--------------------------------------------------------------------------------

BSW
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
--------------------------------------------------------------------------------
 CAN    0  109  104   36   15  130   46   70  100
 CHE   90    0  592  104   25  326   65  176  453
 DEA   92  491    0  154   35  310   62  218  588
 NLD   32   95  142    0   20   87   38   84  128
 NZL   14   19   30   14    0   25   11   18   26
 USA  122  302  267   76   21    0   77  119  219
 GBR   42   50   47   33    8   75    0   51   70
 FRA   61  132  165   69   13   84   44    0  200
 ITA   88  387  475  104   22  152   52  154    0
--------------------------------------------------------------------------------

BSW
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DEA  NLD  NZL  USA  GBR  ITA  SVN
--------------------------------------------------------------------------------
 CAN    0  109   38   15  135   48  107   26
 DEA   96    0  153   35  309   62  686   77
 NLD   34  142    0   20   87   38  133   38
 NZL   14   30   14    0   25   11   26    7
 USA  127  267   76   21    0   77  240   31
```

```
   GBR    44    47    33     8    75     0    72    17
   ITA    94   606   110    22   170    53     0    74
   SVN    24    73    39     7    28    14    72     0
   ------------------------------------------------------------------------------
GUE
--------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   GBR   NZL   USA   AUS
   ------------------------------------------------------------------------------
   CAN     0    17     2    40    18
   GBR    14     0    14    54    28
   NZL     1    12     0    10    25
   USA    39    51     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    18    40
   GBR    14     0    58
   USA    39    55     0
   ------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   GBR   NZL   USA   AUS
   ------------------------------------------------------------------------------
   CAN     0    12     0    39    23
   GBR     9     0    13    83    33
   NZL     0    11     0    24    23
   USA    37    85    23     0    65
   AUS    19    27    23    63     0
   ------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   GBR   NZL   USA   AUS
   ------------------------------------------------------------------------------
   CAN     0    12     0    39    23
   GBR     9     0    13    83    33
   NZL     0    11     0    24    23
   USA    37    85    23     0    65
   AUS    19    27    23    63     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  1097  2265  1362  1294  2972  1330   827  1415  1859  1159
   CZE   813     0  1837  1236  1212  1473  1183   490  1496  1322   820
   DEU  1845  1406     0  2594  2339  2979  2253  1130  3100  2686  1332
   DFS  1287   835  1972     0  1673  1706  1393   732  2210  1666   975
   FRA   972   748  1330   982     0  1675  1476   710  1955  1697  1129
   USA  3435  1197  2375  1564  1014     0  1897   882  1901  2504  1482
   POL  1224   954  1987  1157  1015  1985     0   546  1613  1567   831
   CHE   748   344  1057   682   654   819   439     0   910   776   466
   NLD  1395  1302  2758  1934  1298  1703  1459   903     0  1810  1068
   ITA  1645   975  1939  1393  1027  2118  1278   728  1542     0  1177
   JPN   662   366   605   519   421   790   454   300   545   565     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  782  615 1235  878  920  881  528  825 1261  523  837  583  977
   CAN  784    0  869 2423 1458 1606 1667  573 1906 1568  722 3157 1218 1395
   CHE  620  799    0 1166  740  739  766  435  774  954  436  948  507  725
   DEU 1259 1926 1104    0 2797 2326 2291  948 2724 3604 1041 3264 2011 2578
   DFS  822 1376  693 2075    0 1555 1654  781 1651 2262  874 1875 1260 1691
   ESP  990 1409  689 2051 1383    0 1551  726 1748 1796  753 1892 1217 1786
   GBR  861 1751  732 1770 1314 1419    0 1031 1695 1944  987 2099 1072 1633
   IRL  521  574  448  836  662  748 1077    0  660  947  768  693  409  773
   ITA  828 1685  725 1972 1376 1581 1392  597    0 1887  732 2622 1381 1693
   NLD 1438 1567  951 3341 2036 1876 1722  901 1641    0 1122 2173 1489 2081
   NZL  420  665  364  802  627  625  849  667  570 1016    0  868  458  823
   USA  799 3698  889 2513 1671 1669 2065  685 2159 1973  806    0 1714 1879
   POL  492 1083  388 1674 1010  987  834  312 1060 1299  344 1705    0 1368
   FRA  964 1059  659 1465  977 1703 1073  632 1018 1366  506 1120  890    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  868 1059 2421 1462 1403 1708  130 1917 1576 3211 1262 1297
   CHE  799    0  445 1165  740  731  768   60  773  954  948  533  495
   CZE  824  316    0 1644 1089 1060  950  115 1223 1379 1456 1132  755
   DEU 1915 1101 1306    0 2798 2589 2332  168 2714 3594 3238 2165 1523
   DFS 1381  693  816 2070    0 1698 1683  152 1653 2261 1879 1356 1036
   FRA 1076  667  656 1480  986    0 1658  122 1700 2097 1889 1426 1265
   GBR 1796  740  670 1797 1338 1093    0  150 1726 1980 2167 1132 1128
   ISR   94   36   88  134  113   68  109    0  145  159  173  111  108
   ITA 1698  723  936 1960 1374 1033 1425  107    0 1886 2618 1444 1223
   NLD 1575  951 1259 3324 2035 1389 1759  125 1638    0 2173 1607 1140
   USA 3766  889 1202 2477 1671 1136 2143  168 2155 1973    0 1778 1674
   POL 1141  423  925 1906 1130  950  905   80 1129 1461 1793    0  841
   JPN  773  341  387  694  590  491  604   48  633  638  936  478    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  770  615  546 1226  879  920  974  883  530   76  820 1263  508  987  573  333  764  350  531
   CAN  771    0  854 1038 2338 1431 1590 1367 1637  562  124 1857 1526  679 3278 1181  443 1334  743 1208
   CHE  620  776    0  445 1156  741  739  724  766  435   61  770  954  423 1044  495  264  660  315  463
   CZE  435  794  316    0 1639 1089 1058 1051  940  422  115 1216 1379  479 1504 1056  280  713  468  727
   DEU 1250 1826 1091 1299    0 2787 2328 2552 2280  944  169 2676 3554 1010 3780 1950  558 1753  815 1443
   DFS  822 1344  694  816 2057    0 1563 1688 1658  781  154 1646 2265  852 2265 1237  511 1341  654  980
   ESP  990 1378  689  852 2041 1390    0 1789 1554  727  139 1745 1801  734 2210 1195  517 1234  672 1135
   FRA  957 1025  656  648 1429  965 1694    0 1630  777  125 1678 2073  812 2581 1341  481 1337  607 1207
   GBR  861 1709  732  662 1748 1314 1420 1067    0 1032  151 1685 1947  963 2479 1048  504 1500  691 1072
   IRL  521  556  448  324  827  662  748  628 1077    0   99  657  950  758  858  398  336  775  385  459
   ISR   46   87   36   88  133  113  103   67  107   78    0  144  161  112  198  105   60  115   89  107
   ITA  824 1620  720  930 1919 1367 1578 1003 1387  596  107    0 1872  709 2786 1337  455 1215  689 1159
   NLD 1440 1512  951 1259 3264 2037 1879 1351 1723  902  125 1626    0 1088 2735 1444  504 1541  692 1080
   NZL  405  616  353  360  762  606  606  487  830  658   92  557  982    0 1126  433  353 1227  529  568
   USA  879 3749  983 1224 2732 1804 1937 1412 2311  785  185 2223 2407 1064    0 1713  635 2038 1163 1981
   POL  478 1033  372  815 1590  979  959  860  815  303   69 1016 1240  322 1663    0  230  786  469  773
   ZAF  279  407  222  200  428  378  474  336  443  295   39  371  420  281  611  158    0  476  315  410
   AUS  661 1363  584  504 1321  987 1006  914 1324  673   73  961 1341 1217 2076  575  416    0  676  916
   URY  259  704  237  318  575  452  587  356  558  298   48  509  541  429 1429  360  267  535    0  569
   JPN  332  651  295  350  596  516  546  426  527  284   40  548  552  277  814  400  259  486  288    0
   --------------------------------------------------------------------------
```

```
HOL
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
       BEL  CAN  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  USA  POL  ZAF  AUS  URY  FRA  JPN  SVN
     ----------------------------------------------------------------------------------------

  BEL    0  772 1224  879  920  883  530  819 1263  508  987  572  333  764  350  974  531  151
  CAN  775    0 2343 1439 1597 1646  568 1863 1536  684 3291 1184  447 1342  749 1375 1213  185
  DEU 1249 1835    0 2785 2327 2280  944 2674 3552 1010 3776 1944  558 1753  815 2552 1443  292
  DFS  822 1354 2053    0 1563 1658  781 1644 2264  852 2264 1236  511 1341  654 1688  980  226
  ESP  990 1394 2041 1390    0 1554  727 1744 1800  734 2208 1195  517 1233  672 1788 1134  212
  GBR  861 1722 1748 1314 1420    0 1032 1685 1947  963 2479 1048  504 1500  690 1630 1072  183
  IRL  521  564  827  662  748 1077    0  657  950  758  858  398  336  775  385  777  459   99
  ITA  824 1632 1919 1366 1577 1387  596    0 1872  709 2785 1333  455 1215  689 1678 1159  226
  NLD 1440 1525 3263 2036 1879 1723  902 1626    0 1088 2735 1441  504 1541  692 2073 1080  238
  NZL  405  619  762  606  606  830  658  557  982    0 1126  433  353 1227  529  812  568  107
  USA  879 3779 2732 1804 1937 2311  785 2223 2407 1064    0 1711  635 2038 1163 2581 1981  215
  POL  478 1039 1587  978  959  815  303 1015 1240  322 1663    0  230  786  469 1341  772  222
  ZAF  279  414  428  378  474  443  295  371  420  281  611  158    0  476  315  481  410   66
  AUS  661 1368 1321  987 1006 1324  673  961 1341 1217 2076  575  416    0  676 1337  916  148
  URY  259  711  575  452  587  558  298  509  541  429 1429  360  267  535    0  607  569   77
  FRA  957 1033 1429  965 1694 1067  628 1003 1351  487 1412  860  336  914  356    0 1207  181
  JPN  332  654  596  516  546  527  284  548  552  277  814  400  259  486  288  426    0  142
  SVN  117  139  286  175  187  134   77  188  205   74  168  183   45  101   39  132   76    0
     ----------------------------------------------------------------------------------------

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

  CAN    0   95  330   33
  DFS   89    0  146   84
  USA  320  133    0   71
  NLD   26   81   70    0
     ----------------------------------------------------------------------------------------

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

  CAN    0  100  152   41  163  390   13
  DFS   93    0  174  149  155  163   53
  GBR  151  169    0   94  220  220   75
  NLD   36  147   88    0   83   92   34
  NZL  164  132  225   75    0  288  137
  USA  393  150  237   96  312    0   44
  IRL   12   49   77   34  155   46    0
     ----------------------------------------------------------------------------------------

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

  CAN    0  101  154   41  393
  DFS   94    0  174  148  162
  GBR  153  169    0   93  221
  NLD   36  146   88    0   92
  USA  396  150  239   96    0
     ----------------------------------------------------------------------------------------

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

  CAN    0   97  150   40  156  391  132  226   13
```

```
    DFS    90     0   175   149   156   212   155   165    53
    GBR   147   169     0    94   220   247   175   229    75
    NLD    34   147    88     0    83   105    78    78    34
    NZL   154   132   225    76     0   384   211   441   137
    USA   392   187   271   111   456     0   318   513    50
    ZAF   130   137   177    74   221   331     0   251    42
    AUS   219   135   235    71   485   557   239     0    62
    IRL    12    49    77    34   155    52    43    60     0
  ------------------------------------------------------------------------------
JER
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  common bulls below diagonal
  common three quarter sib group above diagonal
        CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
  ------------------------------------------------------------------------------
    CAN     0    99   151    40   158   395   134   228    13
    DFS    92     0   175   149   156   212   155   165    53
    GBR   149   169     0    94   220   247   175   229    75
    NLD    35   147    88     0    83   105    78    78    34
    NZL   158   132   225    76     0   384   211   441   137
    USA   399   187   271   111   456     0   318   513    50
    ZAF   133   137   177    74   221   331     0   251    42
    AUS   223   135   235    71   485   557   239     0    62
    IRL    12    49    77    34   155    52    43    60     0
  ------------------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
        CAN  DEU  DFS  NOR  USA  NLD
  ------------------------------------------------------------------------------
    CAN     0    10   176     7   105     6
    DEU    10     0    61    15    15     9
    DFS   183    52     0   128   163    55
    NOR     6    14   106     0    70    40
    USA    99    14   155    70     0    38
    NLD     6     9    52    40    36     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   177    76     7    70   145     6     4
    DEU    12     0    65    14    15    18    20    13     5
    DFS   183    53     0   112   146   173   189    56    19
    GBR    77    13   108     0    61    76    99    37    25
    NOR     6    14   118    64     0    47    78    46    59
    NZL    70    18   169    75    46     0   102    20    15
    USA   139    19   184    95    78   105     0    43    29
    NLD     6    13    53    36    46    20    41     0    13
    IRL     4     5    14    24    58    15    29    13     0
  ------------------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
        CAN  DEU  DFS  GBR  NOR  NLD  USA
  ------------------------------------------------------------------------------
    CAN     0    13   178    77     7     6   146
    DEU    12     0    65    15    15    13    20
    DFS   184    53     0   114   134    56   190
    GBR    78    14   110     0    62    38   100
    NOR     6    14   110    65     0    44    78
    NLD     6    13    53    37    44     0    43
    USA   140    19   184    96    78    41     0
  ------------------------------------------------------------------------------
RDC
```

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 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  173   72    7   63  171   75    6   74    4
  DEU   12    0   62   14   15   17   22    3   13   44    5
  DFS  179   51    0  112  134  164  215   60   56  222   19
  GBR   72   13  108    0   60   71  115   45   37   81   25
  NOR    6   14  110   63    0   41   84    0   44   70   59
  NZL   64   17  160   69   40    0  111   38   18  138   15
  USA  173   20  213  113   84  113    0   75   46  137   30
  ZAF   79    3   57   42    0   36   70    0    3   45    3
  NLD    6   13   53   36   44   18   44    3    0   33   13
  AUS   75   42  198   80   59  138  137   46   31    0   19
  IRL    4    5   14   24   58   15   30    3   13   18    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  173   73    7   63  171   75    6   74    4
  DEU   12    0   62   14   15   17   22    3   13   44    5
  DFS  179   51    0  112  146  164  215   60   56  222   19
  GBR   73   13  108    0   61   71  115   45   37   81   25
  NOR    6   14  118   64    0   42   84    0   46   74   59
  NZL   64   17  160   69   41    0  111   38   18  138   15
  USA  173   20  213  113   84  113    0   75   46  137   30
  ZAF   79    3   57   42    0   36   70    0    3   45    3
  NLD    6   13   53   36   46   18   44    3    0   33   13
  AUS   75   42  198   80   63  138  137   46   31    0   19
  IRL    4    5   14   24   58   15   30    3   13   18    0
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SIM
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SIM
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