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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      T2=CY   Calving interval converted to 42 days pregnancy rate
         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
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          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)
          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    DO=Days open
          T4=C2    DO=Days open
          T5=IT    DO=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) for cows
          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=Calving Interval (days)

NOR       T1=HC    NR=Non-return rate 56 days (heifers)
          T2=CY    CF=Interval calving to first insemination (days)
          T3=C1    NR=NR=Non-return rate 56 days (cows)
          T4=C2    CI=Calving Interval (days)
          T5=IT    CI=Calving Interval (days)

NZL       T2=CY    PM=Lactating cow's ability to start cycling
          T4=C2    PC=Lactating cow's ability to conceive (CR42)
          T5=IT    PC=Lactating cow's ability to conceive (CR42)
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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

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
         T2=CY   DO=Days open
         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:

CZE HOL     Base change
     Data edits

ITA HOL     First participation with HCO
     Change in the definition of T4 from calving interval to interval first to last insemination
     Change in the definition of T5, from calving interval to days open, calculated as the sum of
     raw solutions for T2 and T4
     Updated genetic parameters

DFS HOL     Change in lactation weights for all traits and breeds

FRA ALL     Evaluation now performed by a new genetic centre, GENEVAL

JPN HOL     First participation

IRL HOL/JER Base change
    RDC      Moved from Mixblup to Mix99


CHE ALL     Decrease of information due to continuous work on the raw data by herd-book organizations and
     joined data from two databases (for HOL-CHE and SIM-CHE)

NZL ALL     Continues DNA parentage testing resulting in pedigree editing

POL HOL     change in trait definition for hco and cc1: conception rate instead of non returned rates

SVN HOL     Pedigree update and phenotypic data improvement


INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN
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Subsetting:
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As decided by the ITC in Orlando, new subsetting was introduced
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in the september test run. Sub-setting is necessary for operational
purposes and restrictions of time scales. To minimize the effect of
subsetting, larger subsets with 10-12 countries and with 4 link
providing countries have been applied.

Window:

According to the decision taken by ITC in Orlando, the following
changes have been introduced in regards to the windows used for
post processing:

The upper bounds have been set to 0.99 as these were judged to have
very little effect on evaluations. The lower values have been
set to about the 25% percentile value. The largest changes are for
the lower values for conformation traits, with the lowest window being
40% for OFL otherwise it is about 50% for all other confirmation traits.
It is anticipated that these low values may not have large impact on
evaluations since there were very few countries combinations whose
estimated correlations fell between the old limit of 0.30 and these new limits.DATA AND METHOD OF ANALYSIS

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

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

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

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

SCIENTIFIC LITERATURE

The international genetic evaluation procedure is based on international work
described in the following scientific publications:

International genetic evaluation computation:
    Schaeffer. 1994. J. Dairy Sci. 77:2671-2678
    Klei, 1998. Interbull Bulletin 17:3-7

Verification and Genetic trend validation:
    Klei et al., 2002. Interbull Bulletin 29:178-182.
    Boichard et al., 1995. J. Dairy Sci. 78:431-437

Weighting factors:
    Fikse and Banos, 2001. J. Dairy Sci. 84:1759-1767

De-regression:
    Sigurdsson and G. Banos. 1995. Acta Agric. Scand. 45:207-219
    Jairath et al. 1998. J. Dairy Sci. Vol. 81:550-562

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

Post-processing of estimated genetic correlations:
    Mark et al., 2003, Interbull Bulletin 30:126-135
    Jorjani et al., 2003. J. Dairy Sci. 86:677-679

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 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 2018).
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		122	7741	1568	660	
BEL			1757			
CAN	141	41	8738	492	514	
CHE	2687		3165			
CZE			3746			
DEA	5366					
DEU			26231		363	
DFS			15727	2347	9741	
ESP			5066			
EST						
FRA	372		16032			
FRM						
GBR	84	220	6469	537	379	
HUN						
IRL			2685	171	60	
ISR			1358			
ITA	1735		9347			
JPN			5630			
KOR						
LTU						
LVA						
NLD	182		14942	141	71	
NOR					3960	
NZL	54	58	7660	4654	1335	
POL			7058			
PRT						
SVK						
SVN						
URY			1435			
USA	1068	748	37734	4491	692	
ZAF			1222	679	143	
HRV						
MEX						

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CAM
=====================================================================================
No.Records    11689        1189      183743       15080        17918
Pub. Proofs   10771         982      150753       12761        16836           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      9.06
DEA      0.85    9.78
FRA      0.78    0.84    0.90
USA      0.79    0.81    0.89    2.71
CHE      0.92    0.95    0.88    0.88   13.05
NLD      0.79    0.71    0.87    0.88    0.87    3.55


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BSW     crc
-------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN      7.38
CHE      0.85   11.26
DEA      0.85    0.94   14.25
NLD      0.87    0.88    0.86    3.58
NZL      0.62    0.66    0.77    0.64   11.07
USA      0.85    0.86    0.85    0.85    0.62    3.28
GBR      0.75    0.76    0.75    0.80    0.65    0.83    3.86
FRA      0.86    0.96    0.93    0.91    0.65    0.86    0.79    1.80
ITA      0.85    0.85    0.84    0.86    0.69    0.84    0.80    0.87   18.44


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BSW     cc1
-------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     USA     GBR     FRA
CAN      7.64
CHE      0.79   11.82
DEA      0.80    0.95   10.99
NLD      0.74    0.70    0.67    3.53
USA      0.74    0.67    0.67    0.90    2.83
GBR      0.73    0.82    0.79    0.70    0.67    0.04
FRA      0.71    0.69    0.67    0.90    0.92    0.69    0.95


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BSW     cc2
-------------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN      6.57
CHE      0.73   11.06
DEA      0.83    0.91   11.69
NLD      0.88    0.84    0.85    3.29
NZL      0.64    0.54    0.65    0.64    7.13
USA      0.85    0.84    0.85    0.88    0.65    2.34
GBR      0.83    0.78    0.86    0.83    0.70    0.85    3.86
FRA      0.85    0.86    0.87    0.85    0.64    0.85    0.84    0.95
ITA      0.86    0.70    0.85    0.85    0.65    0.88    0.85    0.85   23.53


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BSW     int
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          CAN     DEA     NLD     NZL     USA     GBR     ITA
CAN      7.24
DEA      0.88   13.58
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NLD      0.89    0.88    3.27
NZL      0.59    0.65    0.65    7.02
USA      0.90    0.87    0.87    0.57    2.34
GBR      0.87    0.88    0.89    0.66    0.87    3.86
ITA      0.88    0.93    0.88    0.65    0.89    0.88   17.91


------------------------------------------------------------------------------------
GUE    crc
------------------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      7.25
GBR      0.75    5.11
NZL      0.61    0.65   11.68
USA      0.84    0.87    0.62    3.32
AUS      0.73    0.87    0.70    0.74    6.96


------------------------------------------------------------------------------------
GUE    cc1
------------------------------------------------------------------------------------
         CAN     GBR     USA
CAN      7.17
GBR      0.72    0.03
USA      0.80    0.74    3.43


------------------------------------------------------------------------------------
GUE    cc2
------------------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      6.92
GBR      0.84    5.11
NZL      0.64    0.70    7.55
USA      0.85    0.85    0.65    2.64
AUS      0.68    0.68    0.75    0.73    6.82


------------------------------------------------------------------------------------
GUE    int
------------------------------------------------------------------------------------
         CAN     GBR     NZL     USA     AUS
CAN      7.50
GBR      0.87    5.11
NZL      0.59    0.65    7.55
USA      0.91    0.87    0.61    2.64
AUS      0.85    0.85    0.73    0.86    6.82


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HOL    hco
------------------------------------------------------------------------------------
         CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD     ITA     JPN
CAN      7.80
CZE      0.76   19.30
DEU      0.93    0.78   15.08
DFS      0.82    0.87    0.87   13.69
FRA      0.82    0.88    0.82    0.87    0.84
USA      0.84    0.88    0.86    0.89    0.91    2.39
POL      0.74    0.88    0.73    0.83    0.77    0.78   19.70
CHE      0.95    0.86    0.93    0.85    0.87    0.88    0.77   13.97
NLD      0.82    0.87    0.79    0.84    0.87    0.88    0.73    0.87    4.13
ITA      0.84    0.87    0.92    0.88    0.88    0.88    0.86    0.90    0.88    0.04
JPN      0.83    0.74    0.79    0.75    0.76    0.83    0.68    0.83    0.76    0.73    6.28


------------------------------------------------------------------------------------
HOL    crc
------------------------------------------------------------------------------------
         BEL     CAN     CHE     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     FRA     AUS     JPN
BEL      4.73
CAN      0.72    6.79
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CHE       0.79     0.84    12.40
DEU       0.72     0.85     0.89    11.18
DFS       0.79     0.89     0.94     0.90    11.79
ESP       0.87     0.78     0.82     0.78     0.81    11.15
GBR       0.89     0.74     0.77     0.74     0.81     0.89     4.67
IRL       0.86     0.72     0.72     0.71     0.72     0.87     0.87     3.45
ITA       0.78     0.85     0.88     0.87     0.90     0.84     0.82     0.72     8.36
NLD       0.81     0.87     0.93     0.91     0.95     0.80     0.80     0.72     0.87     4.56
NZL       0.65     0.60     0.62     0.60     0.62     0.64     0.64     0.61     0.70     0.60     8.46
USA       0.84     0.84     0.84     0.84     0.84     0.85     0.87     0.77     0.84     0.84     0.60     3.29
POL       0.74     0.89     0.89     0.87     0.89     0.79     0.74     0.71     0.92     0.86     0.62     0.84    14.06
FRA       0.76     0.86     0.94     0.92     0.94     0.82     0.80     0.72     0.91     0.95     0.62     0.84     0.88     1.19
AUS       0.86     0.71     0.72     0.71     0.72     0.86     0.86     0.88     0.72     0.72     0.61     0.73     0.71     0.72     4.94
JPN       0.87     0.74     0.77     0.72     0.73     0.92     0.87     0.86     0.80     0.72     0.61     0.89     0.84     0.74     0.86    18.57


---------------------------------------------------------------------------------------
HOL    cc1
---------------------------------------------------------------------------------------
          CAN      CHE      CZE      DEU      DFS      FRA      GBR      ISR      ITA      NLD      USA      POL      JPN
CAN       6.79
CHE       0.92    11.10
CZE       0.81     0.74    17.52
DEU       0.90     0.93     0.76    14.38
DFS       0.73     0.72     0.89     0.73    13.28
FRA       0.73     0.74     0.89     0.69     0.86     1.01
GBR       0.73     0.77     0.71     0.78     0.69     0.69     0.03
ISR       0.77     0.69     0.90     0.72     0.85     0.86     0.75     3.16
ITA       0.86     0.88     0.73     0.94     0.69     0.67     0.75     0.74     0.05
NLD       0.75     0.72     0.89     0.70     0.92     0.92     0.69     0.88     0.67     4.50
USA       0.78     0.70     0.95     0.71     0.87     0.89     0.66     0.91     0.73     0.91     2.82
POL       0.76     0.76     0.88     0.82     0.79     0.76     0.68     0.76     0.80     0.71     0.77    19.61
JPN       0.76     0.70     0.90     0.70     0.84     0.79     0.70     0.82     0.70     0.82     0.89     0.68     7.67


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HOL    cc2
---------------------------------------------------------------------------------------
          BEL      CAN      CHE      CZE      DEU      DFS      ESP      FRA      GBR      IRL      ISR      ITA      NLD      NZL      USA      POL      ZAF      AUS      URY      JPN
BEL       4.73
CAN       0.83     6.05
CHE       0.79     0.86    11.19
CZE       0.65     0.84     0.87    17.52
DEU       0.82     0.92     0.90     0.89    12.98
DFS       0.83     0.85     0.86     0.81     0.93    12.87
ESP       0.85     0.86     0.79     0.73     0.86     0.84    11.15
FRA       0.83     0.86     0.91     0.80     0.89     0.84     0.85     0.98
GBR       0.89     0.84     0.73     0.65     0.82     0.84     0.88     0.82     4.67
IRL       0.84     0.83     0.80     0.65     0.82     0.82     0.85     0.83     0.85     3.45
ISR       0.51     0.61     0.63     0.80     0.73     0.68     0.60     0.65     0.55     0.60     3.16
ITA       0.75     0.85     0.86     0.90     0.91     0.84     0.84     0.84     0.77     0.78     0.81    15.90
NLD       0.83     0.91     0.89     0.84     0.94     0.91     0.85     0.87     0.83     0.83     0.70     0.85     4.45
NZL       0.73     0.64     0.52     0.48     0.62     0.62     0.68     0.62     0.70     0.73     0.46     0.60     0.62     5.36
USA       0.84     0.85     0.84     0.86     0.89     0.89     0.87     0.85     0.84     0.83     0.74     0.91     0.88     0.65     2.33
POL       0.83     0.82     0.69     0.62     0.80     0.80     0.85     0.77     0.84     0.81     0.50     0.76     0.80     0.62     0.83    12.99
ZAF       0.75     0.77     0.80     0.70     0.82     0.77     0.84     0.79     0.80     0.87     0.58     0.84     0.79     0.70     0.87     0.76    15.95
AUS       0.81     0.80     0.83     0.74     0.79     0.75     0.81     0.83     0.79     0.86     0.60     0.82     0.71     0.70     0.85     0.73     0.87     5.09
URY       0.84     0.81     0.68     0.59     0.80     0.81     0.83     0.80     0.85     0.84     0.47     0.65     0.81     0.74     0.83     0.85     0.78     0.74     1.44
JPN       0.83     0.84     0.83     0.74     0.84     0.85     0.90     0.84     0.87     0.84     0.58     0.85     0.84     0.65     0.92     0.89     0.87     0.87     0.82    18.56


---------------------------------------------------------------------------------------
HOL    int
---------------------------------------------------------------------------------------
          BEL      CAN      DEU      DFS      ESP      GBR      IRL      ITA      NLD      NZL      USA      POL      ZAF      AUS      URY      FRA      JPN
BEL       4.73
CAN       0.87     6.44
DEU       0.86     0.88    12.20
DFS       0.89     0.90     0.93    12.82
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ESP       0.87      0.88      0.87      0.87     11.15
GBR       0.88      0.87      0.87      0.90      0.89      4.67
IRL       0.87      0.86      0.86      0.86      0.87      0.87      3.45
ITA       0.87      0.89      0.90      0.90      0.93      0.87      0.87     20.95
NLD       0.92      0.90      0.91      0.94      0.87      0.90      0.87      0.88      4.39
NZL       0.71      0.58      0.59      0.59      0.65      0.69      0.70      0.66      0.62      5.36
USA       0.87      0.92      0.89      0.88      0.88      0.87      0.87      0.93      0.87      0.60      2.33
POL       0.86      0.87      0.86      0.86      0.86      0.86      0.86      0.89      0.86      0.66      0.87     12.99
ZAF       0.86      0.87      0.87      0.87      0.87      0.87      0.87      0.89      0.87      0.68      0.87      0.86     15.96
AUS       0.87      0.90      0.87      0.87      0.87      0.87      0.87      0.87      0.86      0.69      0.89      0.86      0.90      5.09
URY       0.86      0.86      0.86      0.86      0.85      0.87      0.86      0.86      0.87      0.73      0.87      0.87      0.86      0.86      1.44
FRA       0.75      0.82      0.76      0.77      0.81      0.70      0.75      0.78      0.74      0.45      0.80      0.65      0.76      0.83      0.60      0.98
JPN       0.87      0.93      0.90      0.91      0.92      0.88      0.87      0.94      0.87      0.63      0.92      0.92      0.89      0.89      0.87      0.74     18.56


-----------------------------------------------------------------------------------
JER     hco
-----------------------------------------------------------------------------------
          CAN       DFS       USA       NLD
CAN       7.91
DFS       0.80     17.31
USA       0.84      0.87      2.72
NLD       0.80      0.84      0.88      4.44


-----------------------------------------------------------------------------------
JER     crc
-----------------------------------------------------------------------------------
          CAN       DFS       GBR       NLD       NZL       USA       AUS       IRL
CAN       6.69
DFS       0.87     13.66
GBR       0.73      0.86      4.06
NLD       0.87      0.91      0.78      3.92
NZL       0.61      0.67      0.68      0.61      6.76
USA       0.84      0.84      0.84      0.85      0.63      3.80
AUS       0.72      0.73      0.87      0.73      0.61      0.73      3.67
IRL       0.74      0.73      0.87      0.73      0.62      0.76      0.88      1.89


-----------------------------------------------------------------------------------
JER     cc1
-----------------------------------------------------------------------------------
          CAN       DFS       GBR       NLD       USA
CAN       6.58
DFS       0.72     15.59
GBR       0.74      0.70      0.03
NLD       0.74      0.89      0.68      3.38
USA       0.75      0.88      0.67      0.90      2.92


-----------------------------------------------------------------------------------
JER     cc2
-----------------------------------------------------------------------------------
          CAN       DFS       GBR       NLD       NZL       USA       ZAF       AUS       IRL
CAN       6.51
DFS       0.85     15.71
GBR       0.85      0.84      4.06
NLD       0.90      0.89      0.84      3.51
NZL       0.66      0.64      0.74      0.64      4.32
USA       0.85      0.87      0.85      0.87      0.68      2.60
ZAF       0.72      0.71      0.77      0.77      0.74      0.86     11.04
AUS       0.75      0.74      0.76      0.70      0.70      0.79      0.83      3.70
IRL       0.84      0.84      0.85      0.84      0.68      0.84      0.74      0.76      1.89


-----------------------------------------------------------------------------------
JER     int
-----------------------------------------------------------------------------------
          CAN       DFS       GBR       NLD       NZL       USA       ZAF       AUS       IRL
CAN       6.35
DFS       0.88     15.48
```

```
GBR      0.87      0.88      4.06
NLD      0.88      0.90      0.88      3.55
NZL      0.63      0.64      0.72      0.61      4.32
USA      0.89      0.87      0.87      0.87      0.66      2.60
ZAF      0.87      0.87      0.87      0.86      0.71      0.87     11.04
AUS      0.86      0.86      0.87      0.87      0.66      0.87      0.87      3.70
IRL      0.84      0.85      0.85      0.86      0.46      0.86      0.83      0.82      1.89


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

          CAN       DEU       DFS       NOR       USA       NLD
CAN      7.17
DEU      0.91     14.41
DFS      0.82      0.81     12.35
NOR      0.87      0.83      0.77     16.48
USA      0.85      0.84      0.90      0.74      2.56
NLD      0.82      0.80      0.84      0.72      0.88      4.45


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

          CAN       DEU       DFS       GBR       NOR       NZL       USA       NLD       AUS       IRL
CAN      6.26
DEU      0.85     10.10
DFS      0.87      0.90     12.65
GBR      0.76      0.75      0.77      4.40
NOR      0.90      0.87      0.89      0.75     14.94
NZL      0.61      0.62      0.61      0.65      0.64     10.56
USA      0.84      0.84      0.84      0.84      0.85      0.70      3.45
NLD      0.87      0.90      0.92      0.79      0.86      0.61      0.85      3.07
AUS      0.73      0.73      0.73      0.87      0.75      0.68      0.75      0.73      4.70
IRL      0.73      0.73      0.74      0.87      0.74      0.63      0.77      0.73      0.88      2.60


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

          CAN       DEU       DFS       GBR       NOR       NLD       USA
CAN      6.86
DEU      0.89     13.16
DFS      0.77      0.75     13.06
GBR      0.73      0.78      0.78      0.03
NOR      0.83      0.78      0.76      0.75     15.39
NLD      0.75      0.73      0.88      0.70      0.70      4.11
USA      0.83      0.72      0.84      0.67      0.70      0.90      2.61


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

          CAN       DEU       DFS       GBR       NOR       NZL       USA       ZAF       NLD       AUS       IRL
CAN      6.73
DEU      0.92     10.50
DFS      0.85      0.93     12.79
GBR      0.85      0.84      0.85      4.40
NOR      0.89      0.87      0.85      0.86     16.08
NZL      0.65      0.64      0.65      0.69      0.66      6.80
USA      0.87      0.90      0.86      0.85      0.86      0.70      2.35
ZAF      0.71      0.81      0.75      0.72      0.70      0.72      0.86     17.76
NLD      0.90      0.94      0.90      0.84      0.86      0.64      0.88      0.78      3.73
AUS      0.70      0.72      0.67      0.72      0.66      0.70      0.73      0.77      0.71      4.59
IRL      0.84      0.84      0.85      0.85      0.86      0.73      0.85      0.85      0.84      0.83      2.60


-----------------------------------------------------------------------------------
RDC    int
-----------------------------------------------------------------------------------

          CAN       DEU       DFS       GBR       NOR       NZL       USA       ZAF       NLD       AUS       IRL
```

```
CAN       6.70
DEU       0.88    10.56
DFS       0.88     0.94    13.07
GBR       0.87     0.87     0.88     4.40
NOR       0.89     0.89     0.87     0.88    16.08
NZL       0.65     0.58     0.58     0.67     0.55     6.80
USA       0.90     0.89     0.87     0.87     0.88     0.69     2.35
ZAF       0.87     0.86     0.87     0.87     0.91     0.68     0.88    17.76
NLD       0.90     0.91     0.92     0.89     0.88     0.61     0.87     0.87     3.25
AUS       0.87     0.87     0.87     0.87     0.88     0.68     0.87     0.87     0.87     4.59
IRL       0.86     0.86     0.86     0.87     0.88     0.66     0.87     0.87     0.87     0.86     2.60
```

----
^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   77   45   87   81   27
    DEA   62    0  185  162  549  121
    FRA   39  136    0   67  149   68
    USA   76  120   51    0  184   41
    CHE   64  458  112  151    0   78
    NLD   24  114   56   37   75    0
    ---------------------------------------------------------------------------
```

BSW
----
 common bulls below diagonal
 common three quarter sib group above diagonal

```
        CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
    ---------------------------------------------------------------------------
    CAN    0  101   96   35   19  118   43   64   91
    CHE   80    0  530   87   26  246   53  148  388
    DEA   77  426    0  137   33  202   53  186  525
    NLD   31   80  126    0   24   48   33   72  109
    NZL   17   21   26   18    0   21   17   21   27
    USA  108  215  154   44   18    0   52   87  152
    GBR   38   39   37   26   13   49    0   43   58
    FRA   54  111  136   58   17   60   33    0  163
    ITA   74  325  402   87   20  106   40  124    0
    ---------------------------------------------------------------------------
```

BSW
----
 common bulls below diagonal
 common three quarter sib group above diagonal

```
        CAN  CHE  DEA  NLD  USA  GBR  FRA
    ---------------------------------------------------------------------------
    CAN    0  101   97   35  119   44   67
    CHE   80    0  526   86  247   57  156
    DEA   78  423    0  135  203   58  200
    NLD   31   80  126    0   48   34   78
    USA  109  215  154   44    0   57   91
    GBR   39   41   39   26   51    0   47
    FRA   57  118  151   65   65   38    0
    ---------------------------------------------------------------------------
```

BSW
----
 common bulls below diagonal
 common three quarter sib group above diagonal

```
        CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
    ---------------------------------------------------------------------------
    CAN    0   89   84   32   18  109   40   62   82
    CHE   69    0  521   87   26  305   53  156  388
```

```
   DEA   66   421     0   136    33   301    52   199   516
   NLD   28    80   126     0    24    72    33    78   109
   NZL   16    21    26    18     0    30    17    22    27
   USA   94   284   262    61    26     0    63   113   203
   GBR   34    39    37    26    13    59     0    45    58
   FRA   54   118   151    65    18    80    36     0   175
   ITA   68   325   397    87    20   140    40   136     0
--------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  DEA  NLD  NZL  USA  GBR  ITA
--------------------------------------------------------------------------------
   CAN    0   88   34   19  113   42   87
   DEA   69    0  137   33  300   52  626
   NLD   31  128    0   24   73   33  116
   NZL   17   26   18    0   30   17   27
   USA   98  262   64   26    0   63  221
   GBR   36   37   26   13   59    0   59
   ITA   72  525   96   20  155   40    0
--------------------------------------------------------------------------------
GUE
--------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
--------------------------------------------------------------------------------
   CAN    0   14    3   35   18
   GBR   11    0   13   48   28
   NZL    2   11    0    9   26
   USA   34   45    7    0   19
   AUS   13   22   24   16    0
--------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  USA
--------------------------------------------------------------------------------
   CAN    0   14   36
   GBR   11    0   52
   USA   35   49    0
--------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
--------------------------------------------------------------------------------
   CAN    0   10    2   32   19
   GBR    7    0   13   78   30
   NZL    2   11    0   29   26
   USA   30   79   28    0   55
   AUS   15   24   25   52    0
--------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
--------------------------------------------------------------------------------
   CAN    0   10    2   32   19
   GBR    7    0   13   78   30
```

```
   NZL    2   11    0   29   26
   USA   30   79   28    0   55
   AUS   15   24   25   52    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  899 1900 1039 1100 2271  907  722 1077 1467  989
   CZE  632    0 1630 1032 1092 1201  882  438 1234 1129  703
   DEU 1379 1178    0 2426 2303 2472 1565 1069 2888 2422 1292
   DFS  923  631 1538    0 1481 1299  978  637 1814 1473  842
   FRA  788  635 1227  780    0 1462 1112  620 1738 1641 1036
   USA 2510  912 1719 1067  821    0 1281  746 1472 1951 1266
   POL  726  627 1207  705  651 1221    0  402 1098 1075  650
   CHE  604  290  928  553  555  665  301    0  794  680  414
   NLD 1010 1040 2361 1472 1065 1212  877  765    0 1555  920
   ITA 1148  746 1499 1050  868 1388  724  603 1189    0 1093
   JPN  504  273  467  392  345  601  308  246  411  431    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  AUS  JPN
   ------------------------------------------------------------------
   BEL    0  630  531 1072  717  767  752  462  725 1074  453  674  409  827  531  445
   CAN  623    0  734 2003 1125 1277 1316  475 1540 1189  616 2404  818 1195  767 1028
   CHE  533  627    0 1057  629  621  639  373  664  804  371  783  360  615  415  404
   DEU 1088 1431  914    0 2497 1980 1977  844 2440 3146  932 2691 1371 2422 1218 1325
   DFS  653  989  552 1570    0 1268 1386  685 1466 1825  763 1436  890 1494  896  832
   ESP  817 1016  570 1700 1024    0 1271  641 1492 1426  655 1479  835 1417  802  952
   GBR  718 1343  580 1395  997 1132    0  887 1470 1593  862 1611  719 1445  995  917
   IRL  454  467  377  738  565  656  916    0  626  829  679  555  307  702  573  406
   ITA  680 1219  597 1546 1056 1280 1074  543    0 1610  733 2090  955 1658  855 1060
   NLD 1213 1132  775 2744 1525 1438 1337  778 1272    0  965 1679  981 1833 1062  910
   NZL  372  568  312  712  532  541  734  588  542  874    0  715  351  765  956  504
   USA  627 2660  693 1805 1138 1167 1472  533 1450 1409  644    0 1165 1645  879 1317
   POL  327  632  264  967  615  601  456  224  611  735  249 1030    0 1004  365  587
   FRA  803  865  549 1239  768 1300  888  563  864 1095  448  905  553    0  950 1084
   AUS  409  628  337  725  500  589  754  454  526  813  906  702  166  545    0  613
   JPN  264  488  236  442  380  416  400  236  406  404  228  568  266  337  255    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  734  943 1990 1128 1200 1359   86 1539 1195 2439  856 1118
   CHE  628    0  436 1055  629  624  643   47  664  804  783  385  437
   CZE  675  291    0 1630 1025 1091  906   88 1130 1262 1287  863  722
   DEU 1414  910 1176    0 2496 2427 2014  131 2431 3131 2663 1482 1407
   DFS  993  552  638 1562    0 1500 1411  117 1467 1824 1441  949  894
   FRA  885  559  635 1251  779    0 1474  106 1664 1845 1646 1061 1157
   GBR 1401  583  551 1430 1021  914    0  108 1502 1619 1677  764  986
   ISR   64   31   71  112   92   60   76    0  116  124  109   70   84
   ITA 1222  596  748 1537 1055  885 1107   89    0 1611 2086 1006 1140
   NLD 1140  775 1070 2724 1524 1118 1369  103 1270    0 1680 1057  980
   USA 2700  693  952 1774 1138  920 1553   99 1447 1409    0 1222 1428
   POL  674  292  614 1126  694  603  499   49  662  838 1095    0  641
   JPN  602  276  302  536  450  407  481   39  496  489  724  324    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  620  531  513 1065  718  767  819  752  463   60  724 1074  453  831  402  309  647  276  450
CAN   608    0  722  930 1927 1103 1262 1150 1291  464   83 1490 1152  595 2552  794  415 1046  565 1033
CHE   533  609    0  437 1050  630  621  610  639  373   47  663  805  371  908  350  255  539  246  407
CZE   388  646  291    0 1626 1026  945 1082  898  420   88 1130 1265  504 1431  801  305  704  389  692
DEU  1078 1334  899 1166    0 2477 1987 2392 1966  844  133 2413 3099  924 3430 1333  550 1525  627 1339
DFS   653  955  553  638 1542    0 1275 1484 1391  685  118 1465 1830  766 1833  867  485 1121  512  846
ESP   817  985  570  720 1695 1030    0 1420 1273  642  107 1497 1431  657 1809  819  489 1015  517  964
FRA   793  811  540  620 1196  748 1288    0 1435  703  108 1641 1817  767 2340  987  458 1168  488 1095
GBR   718 1304  580  546 1380  999 1132  870    0  887  108 1468 1595  863 1995  707  477 1231  537  929
IRL   454  448  377  292  737  565  656  559  916    0   77  625  830  679  725  298  321  675  308  406
ISR    39   61   31   71  112   92   82   59   75   62    0  114  125   88  134   65   52   84   58   82
ITA   673 1153  592  743 1502 1040 1274  837 1063  539   85    0 1603  731 2450  930  468 1102  564 1081
NLD  1213 1084  775 1070 2653 1527 1441 1070 1338  778  103 1251    0  968 2253  949  478 1305  523  924
NZL   372  544  312  342  700  533  543  442  734  588   75  536  876    0 1010  340  344 1112  416  512
USA   713 2738  798 1022 2142 1275 1442 1186 1721  639  117 1585 1842  952    0 1181  602 1666  881 1741
POL   316  595  252  535  914  592  583  529  442  214   43  581  697  239 1008    0  199  540  317  583
ZAF   253  375  206  192  406  347  440  312  409  278   34  355  391  273  564  124    0  447  279  386
AUS   546  992  473  420 1038  747  794  756 1019  574   56  758 1082 1095 1565  334  378    0  517  777
URY   198  521  179  251  429  330  445  279  417  223   31  390  393  326 1083  235  226  386    0  453
JPN   266  493  238  262  447  388  418  338  407  238   30  414  411  233  614  257  239  369  209    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  623 1063  718  767  752  463  723 1075  453  831  401  309  647  276  819  450
CAN   614    0 1933 1109 1269 1299  471 1498 1167  601 2564  797  417 1053  570 1159 1036
DEU  1077 1345    0 2475 1986 1966  844 2413 3108  924 3427 1329  549 1525  627 2391 1339
DFS   653  966 1540    0 1274 1390  685 1464 1831  766 1832  867  484 1121  512 1484  846
ESP   817 1002 1695 1030    0 1273  642 1496 1435  657 1806  819  488 1014  517 1419  963
GBR   718 1321 1380  999 1132    0  887 1468 1601  863 1995  707  476 1231  537 1435  929
IRL   454  458  737  565  656  916    0  625  833  679  725  298  321  675  308  703  406
ITA   673 1170 1502 1040 1273 1063  539    0 1607  731 2450  929  468 1102  564 1641 1081
NLD  1218 1106 2669 1534 1450 1344  781 1257    0  968 2260  954  478 1307  525 1819  928
NZL   372  549  700  533  543  734  588  536  877    0 1010  340  343 1112  416  767  512
USA   713 2769 2142 1275 1442 1721  639 1585 1849  952    0 1180  601 1666  881 2340 1741
POL   316  601  912  592  583  442  214  581  701  239 1008    0  199  540  317  987  583
ZAF   253  381  406  347  440  409  278  355  392  273  564  124    0  446  279  458  385
AUS   546  997 1038  747  794 1019  574  758 1088 1095 1565  334  378    0  517 1168  777
URY   198  527  429  330  445  417  223  390  395  326 1083  235  226  386    0  488  453
FRA   793  822 1196  748 1288  870  559  837 1075  442 1186  529  312  756  279    0 1095
JPN   266  495  447  388  418  407  238  414  414  233  614  257  239  369  209  338    0
    --------------------------------------------------------------------------------------------------------
JER
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DFS  USA  NLD
    --------------------------------------------------------------------------------------------------------

CAN     0   55  254   20
DFS    43    0   93   55
USA   237   72    0   45
NLD    14   52   44    0
    --------------------------------------------------------------------------------------------------------
JER
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  AUS  IRL
```

```
       -----------------------------------------------------------------------------
       CAN    0   61  119   27  134  298  119   10
       DFS   47    0  129   83  118  109   94   37
       GBR  119  118    0   69  184  173  142   60
       NLD   21   77   63    0   63   64   48   29
       NZL  135   91  190   55    0  234  328  104
       USA  295   88  187   66  259    0  233   35
       AUS  119   58  150   42  359  237    0   34
       IRL    8   32   62   29  116   37   31    0
       -----------------------------------------------------------------------------
JER
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  DFS  GBR  NLD  USA
       -----------------------------------------------------------------------------
       CAN    0   61  120   27  300
       DFS   47    0  128   83  108
       GBR  119  117    0   67  174
       NLD   21   77   63    0   63
       USA  298   88  188   66    0
       -----------------------------------------------------------------------------
JER
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
       -----------------------------------------------------------------------------
       CAN    0   60  117   27  131  306  113  181   10
       DFS   46    0  129   83  118  155  120  113   37
       GBR  115  118    0   68  185  202  149  179   60
       NLD   20   77   63    0   64   76   65   59   29
       NZL  130   91  190   56    0  334  187  398  104
       USA  296  121  222   80  407    0  274  441   42
       ZAF  111   97  153   60  198  282    0  212   35
       AUS  170   77  188   51  430  471  200    0   50
       IRL    8   32   62   29  116   44   36   47    0
       -----------------------------------------------------------------------------
JER
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
       -----------------------------------------------------------------------------
       CAN    0   61  118   27  133  309  115  183   10
       DFS   47    0  129   87  118  155  120  113   37
       GBR  117  118    0   72  185  202  149  179   60
       NLD   22   82   67    0   67   81   68   61   30
       NZL  133   91  190   60    0  334  187  398  104
       USA  301  121  222   86  407    0  274  441   42
       ZAF  113   97  153   64  198  282    0  212   35
       AUS  173   77  188   53  430  471  200    0   50
       IRL    8   32   62   29  116   44   36   47    0
       -----------------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
          CAN  DEU  DFS  NOR  USA  NLD
       -----------------------------------------------------------------------------
       CAN    0   13  131    5   85    4
       DEU   12    0   59   17   19   12
       DFS  132   48    0  132  134   43
       NOR    5   16  103    0   57   30
       USA   81   19  126   58    0   29
       NLD    4   12   40   30   27    0
```

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        ------------------------------------------------------------------------
RDC
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 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN   DEU   DFS   GBR   NOR   NZL   USA   NLD   AUS   IRL
        ------------------------------------------------------------------------
   CAN     0    14   131    63     5    61   117     5    54     3
   DEU    13     0    62    18    17    21    23    12    22     6
   DFS   133    52     0    91   117   159   146    44   137    16
   GBR    64    17    86     0    43    64    80    28    48    18
   NOR     5    17    87    45     0    40    63    33    34    50
   NZL    60    20   152    60    38     0    84    16   102    10
   USA   114    23   140    76    64    85     0    30    54    24
   NLD     5    12    42    27    33    16    29     0    12     9
   AUS    53    21   117    45    29   104    52    10     0     8
   IRL     3     6    11    17    49    10    24     9     7     0
        ------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN   DEU   DFS   GBR   NOR   NLD   USA
        ------------------------------------------------------------------------
   CAN     0    14   131    66     5     5   118
   DEU    13     0    62    19    17    12    23
   DFS   133    52     0    93   120    44   145
   GBR    66    18    87     0    44    28    82
   NOR     5    17    90    46     0    33    64
   NLD     5    12    42    27    33     0    30
   USA   115    22   139    77    64    29     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   129    59     5    60   142    67     5    62     3
   DEU    12     0    60    18    15    20    25     2    12    41     6
   DFS   131    50     0    91   109   159   168    52    44   176    16
   GBR    60    17    86     0    43    65    93    38    28    67    18
   NOR     5    15    79    45     0    40    67     0    33    54    50
   NZL    59    20   152    61    38     0   109    35    16   126    10
   USA   145    25   164    91    68   110     0    67    32   107    25
   ZAF    72     2    51    36     0    33    62     0     2    37     2
   NLD     5    12    42    27    33    16    31     2     0    23     9
   AUS    61    40   150    64    45   128   107    37    21     0    12
   IRL     3     6    11    17    49    10    25     2     9    11     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   129    60     5    60   142    67     6    62     3
   DEU    12     0    60    18    15    20    25     2    12    41     6
   DFS   131    50     0    91   109   159   168    52    44   176    16
   GBR    61    17    86     0    43    65    93    38    29    67    18
   NOR     5    15    79    45     0    40    67     0    35    54    50
   NZL    59    20   152    61    38     0   109    35    16   126    10
   USA   145    25   164    91    68   110     0    67    35   107    25
   ZAF    72     2    51    36     0    33    62     0     2    37     2
   NLD     6    12    42    28    35    16    33     2     0    23     9
   AUS    61    40   150    64    45   128   107    37    21     0    12
```

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   IRL     3     6    11    17    49    10    25     2     9    11     0
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SIM
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SIM
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