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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
         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      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    Days Open
           T4=C2    Days Open
           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=Calving Interval (days)

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    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
         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:

DFS (ALL)     Decrease in information mainly caused by the check, which is done, after a cow has calved. There must be consistency between
              the insemination date and the calving date.
DEA (BSW)     Base change
POL (HOL)     Some decrease in information due to data edits
DEU (HOL,RDC) Base change
ITA (HOL)     Base change, editing and pedigree checks
BEL (HOL)     Up to 21 bulls missing in current data most of them are Montbeliard bulls erroneusly added before due to a bug in one of the programs preparing
              the file to be submitted. which has now been fixed.
GBR (HOL)     changes in data from the data provider.
FRA (ALL)     Base change
CAN (ALL)     Base change
AUS (ALL)     New database and procedures for data extraction. Mix99 software will be used for all traits.
              EBV expression is now on the observable scale for a trait into consideration (kg, days, log(scc), type scores, etc).
              Drop in reliabilities.
JPN (HOL)     No longer submitting CRC data
CHE (HOL,BSW) Changes in data edits
              introduced a separate level for sexed semen in the fixed effect sampling code, which is now also included in the model
              for interval between first and last service (cc2)
NLD (ALL)     Changes in the breeding value estimation for fertility (NLD): 1) CR is based on all inseminations (repeated measurements),
              with the cow effect as permanent environment effect. 2) Conception rate (CR), interval between first and last insemination (IFL)
              and calving interval (CI) are corrected for effect of sexed semen. CI and IFL are based on multiple inseminations, for these
              traits a pre-correction was applied. For CR the sexed semen effect could be included in the model. 3) Day-of-the-week was added to the model for CR.
              4) For parities > 1 the hys effect is based on the calving date or insemination date of the first parity. Inclusion of the day of the week effect if
              it was DIY or an inseminator plus minor adjustment in the base animals.
NOR (RDC)     New data extraction pipeline.
          Introduced a data cutoff at 2002 for HCO, CC1 and CC2; causing old bulls to disappear
          The new traits are: hco - No. of inseminations as heifer, crc - Days from calving to first insemination. Lactations 1 to 4, repeatability mode,
              cc1 - No. of inseminations. Lactations 1 to 4, repeatability model, cc2 - No. of inseminations. Lactations 1 to 4, repeatability model,
              int - Days from calving to first insemination. Lactations 1 to 4, repeatability model
              Mix99 used for calculation of EDC and reliability
NZL (ALL)     NZL has continuous DNA parentage testing so daughters, herds, EDC will always change. Small decrease in Reliability as consequence
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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
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:
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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
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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
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     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 TEST RUN
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Test evaluation results are meant for review purposes only and should not be
published.
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^LTable 1. National evaluation data considered in the Interbull
evaluation for fertility (April Routine Evaluation 2019).
Number of records for lactating cow's ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		137	7893	1702	706	
BEL			1778			
CAN	148	43	8912	509	526	
CHE	2715		3210			
CZE			3733			
DEA	5393					
DEU			26460		367	
DFS			15737	2363	9787	
ESP			5066			
EST						
FRA	376		16120			
FRM						
GBR	85	220	6472	539	382	
HUN						
IRL			2764	173	63	
ISR			1376			
ITA	1746		9470			
JPN			5643			
KOR						
LTU						
LVA						
NLD	185		15094	149	78	
NOR					2895	
NZL	55	58	7677	4666	1338	
POL			7262			
PRT						
SVK						
SVN						

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URY                                 1573
USA           1078         752      38074         4577          695
ZAF                                 1222           690          144
HRV
MEX
CAM
=================================================================================
No.Records    11781        1210     185536        15368        16981
Pub. Proofs   10854         996     151578        12977        16901          0
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW   hco

	CAN	DEA	FRA	USA	CHE	NLD
CAN	8.69					
DEA	0.84	9.77				
FRA	0.78	0.84	0.90			
USA	0.79	0.80	0.89	2.67		
CHE	0.91	0.95	0.88	0.88	13.02	
NLD	0.78	0.70	0.87	0.88	0.87	3.24

BSW   crc

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	7.35								
CHE	0.85	11.23							
DEA	0.85	0.94	14.23						
NLD	0.87	0.88	0.86	3.58					
NZL	0.62	0.65	0.77	0.64	11.08				
USA	0.85	0.86	0.85	0.85	0.62	3.34			
GBR	0.75	0.76	0.75	0.80	0.65	0.83	3.86		
FRA	0.86	0.96	0.94	0.91	0.65	0.86	0.79	1.81	
ITA	0.85	0.85	0.84	0.86	0.69	0.84	0.80	0.87	18.20

BSW   cc1

	CAN	CHE	DEA	NLD	USA	GBR	FRA
CAN	8.01						
CHE	0.79	11.77					
DEA	0.79	0.95	11.01				
NLD	0.75	0.71	0.67	3.88			
USA	0.74	0.67	0.67	0.90	2.79		
GBR	0.73	0.81	0.78	0.70	0.67	0.04	
FRA	0.71	0.69	0.67	0.91	0.92	0.69	0.95

BSW   cc2

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	6.73								
CHE	0.73	11.04							
DEA	0.83	0.91	11.69						
NLD	0.88	0.84	0.85	3.23					
NZL	0.64	0.54	0.65	0.64	7.01				
USA	0.85	0.84	0.85	0.87	0.65	2.36			
GBR	0.83	0.78	0.86	0.84	0.70	0.85	3.86		
FRA	0.85	0.86	0.87	0.86	0.64	0.85	0.84	0.95	
ITA	0.85	0.69	0.85	0.85	0.62	0.88	0.84	0.85	23.42

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BSW    int
---------------------------------------------------------------------------------
           CAN     DEA     NLD     NZL     USA     GBR     ITA
CAN      7.31
DEA      0.88   13.57
NLD      0.89    0.88    3.39
NZL      0.60    0.65    0.66    6.87
USA      0.90    0.87    0.87    0.58    2.36
GBR      0.87    0.88    0.89    0.67    0.87    3.86
ITA      0.88    0.93    0.88    0.65    0.89    0.88   17.98


---------------------------------------------------------------------------------
GUE    crc
---------------------------------------------------------------------------------
           CAN     GBR     NZL     USA     AUS
CAN      7.63
GBR      0.75    5.09
NZL      0.61    0.65   11.76
USA      0.84    0.87    0.62    3.34
AUS      0.73    0.87    0.70    0.74    6.96


---------------------------------------------------------------------------------
GUE    cc1
---------------------------------------------------------------------------------
           CAN     GBR     USA
CAN      7.35
GBR      0.73    0.03
USA      0.80    0.73    3.41


---------------------------------------------------------------------------------
GUE    cc2
---------------------------------------------------------------------------------
           CAN     GBR     NZL     USA     AUS
CAN      6.95
GBR      0.84    5.09
NZL      0.64    0.70    7.53
USA      0.86    0.85    0.66    2.65
AUS      0.75    0.73    0.80    0.81   12.39


---------------------------------------------------------------------------------
GUE    int
---------------------------------------------------------------------------------
           CAN     GBR     NZL     USA     AUS
CAN      7.84
GBR      0.87    5.09
NZL      0.61    0.66    7.53
USA      0.91    0.87    0.63    2.65
AUS      0.87    0.86    0.78    0.87   12.39


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HOL    hco
---------------------------------------------------------------------------------
           CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD     ITA     JPN
CAN      7.78
CZE      0.76   19.15
DEU      0.93    0.78   15.09
DFS      0.82    0.87    0.86   13.70
FRA      0.82    0.88    0.82    0.88    0.84
USA      0.84    0.88    0.86    0.89    0.90    2.38
POL      0.71    0.88    0.71    0.85    0.82    0.83   19.67
CHE      0.95    0.86    0.93    0.86    0.87    0.88    0.80   14.08
NLD      0.80    0.87    0.79    0.85    0.87    0.88    0.80    0.87    3.80
ITA      0.84    0.87    0.92    0.88    0.88    0.88    0.87    0.90    0.88    0.04
JPN      0.83    0.74    0.79    0.75    0.76    0.83    0.68    0.84    0.75    0.73    6.28


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HOL    crc
---------------------------------------------------------------------------------
         BEL    CAN    CHE    DEU    DFS    ESP    GBR    IRL    ITA    NLD    NZL    USA    POL    FRA    AUS
BEL     4.74
CAN     0.72   6.96
CHE     0.80   0.84   12.40
DEU     0.72   0.85   0.88   11.19
DFS     0.79   0.89   0.95   0.90   11.80
ESP     0.87   0.80   0.83   0.79   0.83   11.15
GBR     0.89   0.74   0.77   0.74   0.80   0.89   4.67
IRL     0.86   0.72   0.72   0.72   0.72   0.87   0.87   3.44
ITA     0.78   0.85   0.88   0.87   0.89   0.86   0.82   0.72   8.32
NLD     0.81   0.87   0.93   0.90   0.96   0.82   0.80   0.72   0.87   4.54
NZL     0.65   0.60   0.62   0.60   0.62   0.64   0.64   0.61   0.70   0.60   8.48
USA     0.84   0.84   0.84   0.84   0.84   0.84   0.88   0.77   0.84   0.84   0.60   3.23
POL     0.74   0.89   0.89   0.87   0.88   0.82   0.74   0.71   0.92   0.86   0.62   0.84   14.15
FRA     0.76   0.86   0.94   0.92   0.94   0.84   0.80   0.72   0.91   0.95   0.62   0.84   0.88   1.19
AUS     0.86   0.72   0.72   0.71   0.72   0.86   0.86   0.87   0.72   0.72   0.61   0.73   0.71   0.72   4.94

---------------------------------------------------------------------------------
HOL    cc1
---------------------------------------------------------------------------------
         CAN    CHE    CZE    DEU    DFS    FRA    GBR    ISR    ITA    NLD    USA    POL    JPN
CAN     6.77
CHE     0.92   11.12
CZE     0.81   0.75   17.87
DEU     0.90   0.93   0.77   14.39
DFS     0.74   0.72   0.89   0.73   13.28
FRA     0.74   0.74   0.89   0.70   0.87   1.02
GBR     0.73   0.77   0.71   0.78   0.68   0.69   0.03
ISR     0.76   0.67   0.89   0.73   0.85   0.86   0.74   3.16
ITA     0.86   0.88   0.74   0.95   0.69   0.68   0.76   0.74   0.05
NLD     0.76   0.73   0.90   0.72   0.92   0.92   0.69   0.88   0.69   4.71
USA     0.79   0.71   0.95   0.72   0.87   0.89   0.66   0.91   0.74   0.90   2.80
POL     0.76   0.75   0.87   0.81   0.81   0.80   0.67   0.78   0.80   0.76   0.80   19.55
JPN     0.77   0.69   0.90   0.70   0.83   0.79   0.70   0.81   0.70   0.82   0.89   0.68   7.68

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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     4.74
CAN     0.83   6.06
CHE     0.79   0.86   11.14
CZE     0.65   0.84   0.87   17.88
DEU     0.83   0.92   0.90   0.89   13.01
DFS     0.84   0.85   0.86   0.80   0.93   12.88
ESP     0.85   0.86   0.80   0.76   0.87   0.84   11.15
FRA     0.83   0.87   0.91   0.80   0.90   0.85   0.86   0.98
GBR     0.89   0.84   0.73   0.65   0.83   0.84   0.87   0.82   4.67
IRL     0.84   0.83   0.80   0.65   0.83   0.83   0.84   0.83   0.85   3.44
ISR     0.52   0.62   0.63   0.81   0.74   0.69   0.62   0.65   0.56   0.60   3.16
ITA     0.75   0.85   0.86   0.90   0.91   0.84   0.86   0.84   0.77   0.78   0.81   15.92
NLD     0.83   0.90   0.89   0.84   0.94   0.91   0.86   0.88   0.83   0.83   0.71   0.85   4.44
NZL     0.73   0.64   0.52   0.48   0.63   0.63   0.67   0.62   0.71   0.74   0.46   0.59   0.63   5.37
USA     0.84   0.85   0.85   0.86   0.90   0.88   0.87   0.85   0.84   0.84   0.74   0.91   0.88   0.65   2.31
POL     0.83   0.82   0.70   0.62   0.81   0.81   0.84   0.79   0.84   0.81   0.52   0.76   0.81   0.63   0.83   13.05
ZAF     0.76   0.77   0.80   0.70   0.82   0.77   0.83   0.79   0.80   0.87   0.58   0.84   0.79   0.71   0.87   0.76   15.95
AUS     0.77   0.77   0.81   0.69   0.77   0.71   0.80   0.78   0.75   0.92   0.60   0.78   0.74   0.74   0.82   0.69   0.90   9.56
URY     0.84   0.81   0.68   0.59   0.80   0.81   0.82   0.81   0.85   0.84   0.47   0.65   0.81   0.75   0.83   0.85   0.77   0.72   1.43
JPN     0.83   0.85   0.83   0.74   0.84   0.85   0.89   0.84   0.86   0.84   0.59   0.85   0.84   0.65   0.92   0.90   0.87   0.80   0.82   18.58

---------------------------------------------------------------------------------
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     6.50
DEU        0.87     0.89    12.23
DFS        0.90     0.90     0.94    12.84
ESP        0.88     0.88     0.87     0.88    11.15
GBR        0.88     0.87     0.87     0.90     0.89     4.67
IRL        0.87     0.87     0.87     0.87     0.87     0.87     3.44
ITA        0.87     0.89     0.90     0.90     0.93     0.87     0.87    20.93
NLD        0.92     0.90     0.91     0.94     0.88     0.90     0.87     0.87     4.53
NZL        0.73     0.60     0.59     0.59     0.65     0.70     0.71     0.66     0.63     5.37
USA        0.87     0.92     0.89     0.89     0.89     0.87     0.87     0.93     0.87     0.61     2.31
POL        0.86     0.87     0.86     0.86     0.86     0.87     0.86     0.89     0.87     0.67     0.87    13.04
ZAF        0.86     0.87     0.87     0.87     0.87     0.87     0.88     0.89     0.87     0.70     0.88     0.86    15.96
AUS        0.87     0.87     0.87     0.87     0.87     0.87     0.93     0.87     0.87     0.75     0.87     0.87     0.91     9.56
URY        0.87     0.86     0.86     0.86     0.86     0.87     0.86     0.87     0.87     0.74     0.87     0.87     0.86     0.87     1.43
FRA        0.76     0.83     0.77     0.78     0.82     0.70     0.76     0.79     0.76     0.47     0.81     0.65     0.77     0.79     0.61     0.98
JPN        0.87     0.93     0.90     0.90     0.91     0.87     0.87     0.94     0.87     0.64     0.92     0.92     0.89     0.87     0.87     0.75    18.58


------------------------------------------------------------------------
JER     hco
------------------------------------------------------------------------
           CAN      DFS      USA      NLD
CAN        8.07
DFS        0.79    17.29
USA        0.84     0.88     2.71
NLD        0.79     0.85     0.88     3.70


------------------------------------------------------------------------
JER     crc
------------------------------------------------------------------------
           CAN      DFS      GBR      NLD      NZL      USA      AUS      IRL
CAN        6.68
DFS        0.87    13.61
GBR        0.73     0.85     4.10
NLD        0.87     0.91     0.78     3.76
NZL        0.61     0.67     0.67     0.61     6.79
USA        0.84     0.84     0.84     0.85     0.63     3.78
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     1.85


------------------------------------------------------------------------
JER     cc1
------------------------------------------------------------------------
           CAN      DFS      GBR      NLD      USA
CAN        6.69
DFS        0.72    15.52
GBR        0.75     0.69     0.03
NLD        0.75     0.90     0.69     3.80
USA        0.74     0.88     0.67     0.90     2.90


------------------------------------------------------------------------
JER     cc2
------------------------------------------------------------------------
           CAN      DFS      GBR      NLD      NZL      USA      ZAF      AUS      IRL
CAN        6.62
DFS        0.85    15.67
GBR        0.85     0.84     4.10
NLD        0.89     0.89     0.84     3.36
NZL        0.66     0.65     0.74     0.64     4.34
USA        0.85     0.87     0.85     0.87     0.68     2.60
ZAF        0.71     0.71     0.77     0.75     0.75     0.86    11.14
AUS        0.70     0.71     0.70     0.70     0.74     0.77     0.84     7.11
IRL        0.84     0.85     0.85     0.85     0.68     0.85     0.73     0.77     1.85


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

```
--------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN       6.41
DFS       0.88   15.42
GBR       0.87    0.88    4.10
NLD       0.88    0.91    0.88    3.54
NZL       0.64    0.63    0.73    0.61    4.34
USA       0.89    0.87    0.87    0.87    0.66    2.60
ZAF       0.87    0.87    0.87    0.86    0.72    0.87   11.14
AUS       0.87    0.87    0.87    0.87    0.74    0.87    0.88    7.11
IRL       0.85    0.86    0.85    0.86    0.46    0.86    0.84    0.87    1.85


-------------------------------------------------------------------------
RDC    hco
-------------------------------------------------------------------------
          CAN     DEU     DFS     NOR     USA     NLD
CAN       7.47
DEU       0.91   14.29
DFS       0.82    0.80   12.36
NOR       0.87    0.83    0.79   15.62
USA       0.85    0.84    0.90    0.72    2.57
NLD       0.79    0.79    0.86    0.72    0.88    4.04


-------------------------------------------------------------------------
RDC    crc
-------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     AUS     IRL
CAN       6.36
DEU       0.85   10.18
DFS       0.87    0.90   12.66
GBR       0.76    0.74    0.77    4.44
NOR       0.89    0.87    0.88    0.75   14.06
NZL       0.61    0.62    0.61    0.65    0.66   10.55
USA       0.84    0.84    0.84    0.84    0.85    0.70    3.47
NLD       0.87    0.89    0.93    0.79    0.86    0.61    0.85    3.18
AUS       0.73    0.73    0.73    0.87    0.75    0.69    0.76    0.73    4.70
IRL       0.73    0.73    0.74    0.87    0.74    0.63    0.77    0.73    0.88    2.61


-------------------------------------------------------------------------
RDC    cc1
-------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN       7.01
DEU       0.89   13.16
DFS       0.77    0.76   13.08
GBR       0.73    0.78    0.74    0.03
NOR       0.85    0.82    0.87    0.72   12.55
NLD       0.77    0.75    0.90    0.71    0.75    3.92
USA       0.83    0.73    0.86    0.67    0.80    0.90    2.57


-------------------------------------------------------------------------
RDC    cc2
-------------------------------------------------------------------------
          CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN       6.81
DEU       0.92   10.52
DFS       0.85    0.94   12.81
GBR       0.85    0.84    0.85    4.43
NOR       0.88    0.87    0.85    0.86   12.00
NZL       0.65    0.64    0.65    0.69    0.66    6.80
USA       0.87    0.90    0.86    0.85    0.86    0.71    2.35
ZAF       0.71    0.81    0.74    0.72    0.70    0.72    0.85   17.80
NLD       0.90    0.95    0.90    0.85    0.86    0.65    0.87    0.78    3.38
AUS       0.71    0.73    0.67    0.76    0.66    0.78    0.80    0.81    0.72    8.64
IRL       0.84    0.84    0.85    0.85    0.86    0.73    0.85    0.85    0.84    0.86    2.61
```

```
--------------------------------------------------------------------------------
RDC     int
--------------------------------------------------------------------------------
        CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN     6.73
DEU     0.89    10.66
DFS     0.88    0.94    13.09
GBR     0.87    0.87    0.88    4.43
NOR     0.90    0.89    0.87    0.88    13.80
NZL     0.66    0.58    0.59    0.67    0.63    6.80
USA     0.91    0.89    0.88    0.87    0.88    0.70    2.35
ZAF     0.87    0.86    0.87    0.87    0.91    0.69    0.88    17.80
NLD     0.90    0.91    0.92    0.89    0.88    0.62    0.87    0.87    3.30
AUS     0.87    0.87    0.87    0.87    0.88    0.76    0.87    0.89    0.87    8.64
IRL     0.86    0.87    0.87    0.87    0.88    0.67    0.87    0.88    0.87    0.92    2.61
--------------------------------------------------------------------------------------------------
^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   79   47   91   83   28
 DEA   64    0  189  163  562  124
 FRA   41  139    0   69  153   70
 USA   80  122   52    0  185   42
 CHE   65  468  114  152    0   81
 NLD   25  117   58   38   77    0
 ----------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 ----------------------------------------------------------------------------------
 CAN    0  102   97   36   19  120   43   64   92
 CHE   82    0  541   90   26  250   53  153  393
 DEA   78  439    0  138   33  203   53  191  529
 NLD   32   82  128    0   24   50   34   74  111
 NZL   17   21   26   18    0   21   17   21   27
 USA  111  218  154   46   18    0   52   89  153
 GBR   38   39   37   27   13   49    0   43   58
 FRA   54  113  140   60   17   61   33    0  169
 ITA   75  330  406   89   20  107   40  129    0
 ----------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  CHE  DEA  NLD  USA  GBR  FRA
 ----------------------------------------------------------------------------------
 CAN    0  103   97   36  123   44   67
 CHE   82    0  536   89  251   56  159
 DEA   78  434    0  136  204   57  201
 NLD   32   82  128    0   50   36   79
 USA  113  218  154   46    0   56   92
 GBR   39   40   38   27   50    0   46
 FRA   57  119  152   66   66   37    0
 ----------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
```

```
         CAN   CHE   DEA   NLD   NZL   USA   GBR   FRA   ITA
-------------------------------------------------------------------------------
  CAN      0    91    86    34    18   113    41    63    84
  CHE     71     0   529    90    26   309    53   159   393
  DEA     68   430     0   137    33   301    52   200   520
  NLD     30    82   128     0    24    74    34    79   111
  NZL     16    21    26    18     0    30    17    22    27
  USA     99   288   262    63    26     0    63   113   203
  GBR     34    39    37    27    13    59     0    45    58
  FRA     54   119   152    66    18    80    36     0   179
  ITA     69   330   401    89    20   140    40   140     0
-------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN   DEA   NLD   NZL   USA   GBR   ITA
-------------------------------------------------------------------------------
  CAN      0    90    36    19   117    43    90
  DEA     71     0   139    33   300    52   633
  NLD     33   131     0    24    75    34   116
  NZL     17    26    18     0    30    17    27
  USA    103   262    66    26     0    63   222
  GBR     36    37    27    13    59     0    59
  ITA     74   533    96    20   156    40     0
-------------------------------------------------------------------------------
GUE
--------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN   GBR   NZL   USA   AUS
-------------------------------------------------------------------------------
  CAN      0    14     3    36    18
  GBR     11     0    13    47    28
  NZL      2    11     0     9    26
  USA     35    44     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    51
  USA     35    48     0
-------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN   GBR   NZL   USA   AUS
-------------------------------------------------------------------------------
  CAN      0    10     2    34    19
  GBR      7     0    13    78    32
  NZL      2    11     0    29    26
  USA     32    79    28     0    59
  AUS     15    26    26    55     0
-------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
```

```
          CAN  GBR  NZL  USA  AUS
      ----------------------------------------------------------------------------
      CAN    0   10    2   34   19
      GBR    7    0   13   78   32
      NZL    2   11    0   29   26
      USA   32   79   28    0   59
      AUS   15   26   26   55    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  915 1942 1049 1131 2338  944  738 1108 1492  991
      CZE  642    0 1654 1034 1107 1224  915  445 1255 1147  710
      DEU 1419 1201    0 2434 2342 2520 1630 1086 2931 2455 1293
      DFS  937  638 1566    0 1496 1316 1015  648 1837 1481  845
      FRA  809  645 1256  791    0 1498 1160  633 1767 1677 1047
      USA 2596  934 1771 1091  841    0 1334  759 1508 1994 1268
      POL  770  663 1290  754  687 1292    0  417 1144 1118  664
      CHE  620  294  945  562  563  672  314    0  808  687  414
      NLD 1045 1064 2416 1508 1091 1247  942  779    0 1583  924
      ITA 1191  766 1546 1077  898 1443  776  611 1230    0 1096
      JPN  509  276  471  398  350  605  322  249  419  440    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
      ----------------------------------------------------------------------------
      BEL    0  642  535 1085  728  772  762  468  736 1087  460  689  429  841  532
      CAN  638    0  753 2025 1125 1277 1315  484 1568 1226  623 2459  855 1220  767
      CHE  538  645    0 1076  638  621  644  379  675  817  379  807  374  632  415
      DEU 1105 1470  932    0 2487 1982 1979  857 2471 3192  941 2744 1427 2466 1218
      DFS  665  990  559 1579    0 1267 1385  693 1463 1832  767 1446  911 1505  896
      ESP  822 1016  570 1706 1024    0 1272  645 1490 1427  658 1487  857 1421  802
      GBR  729 1349  586 1403 1000 1135    0  897 1471 1600  867 1616  749 1451  995
      IRL  460  479  384  751  575  662  929    0  633  841  690  577  314  710  573
      ITA  697 1257  607 1586 1063 1280 1081  552    0 1646  737 2150  993 1690  851
      NLD 1229 1176  788 2805 1541 1440 1346  791 1315    0  977 1737 1019 1865 1061
      NZL  377  573  317  718  535  543  737  599  546  884    0  729  363  772  956
      USA  646 2733  714 1860 1148 1172 1482  558 1511 1465  656    0 1216 1690  882
      POL  344  670  274 1033  646  614  486  227  643  784  260 1104    0 1045  366
      FRA  815  883  558 1275  779 1304  895  572  885 1125  453  928  587    0  949
      AUS  409  628  338  726  500  589  754  454  525  813  906  704  167  546    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  754  954 2026 1130 1218 1362   89 1570 1241 2512  892 1123
      CHE  646    0  437 1073  638  636  655   48  675  817  807  398  441
      CZE  692  295    0 1626 1013 1089  899   91 1134 1261 1301  887  717
      DEU 1464  928 1188    0 2493 2461 2022  132 2460 3184 2721 1546 1414
      DFS  994  559  639 1578    0 1509 1411  118 1464 1832 1451  973  893
      FRA  901  567  646 1278  791    0 1488  107 1686 1864 1678 1100 1164
      GBR 1407  592  563 1444 1025  924    0  109 1509 1633 1687  796  991
      ISR   67   32   73  114   93   61   78    0  119  124  113   74   84
      ITA 1262  607  768 1575 1061  905 1123   91    0 1646 2144 1043 1139
      NLD 1189  788 1084 2794 1540 1138 1384  103 1313    0 1738 1103  985
      USA 2785  714  977 1839 1149  943 1567  103 1507 1465    0 1269 1437
      POL  711  302  638 1202  723  634  533   52  693  893 1164    0  659
```

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    JPN  604  277  306  543  452  411  485   39  498  495  729  335    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  632  535  519 1077  729  772  835  762  469   63  735 1087  460  843  419  310  663  301  459
CAN   626    0  741  940 1974 1107 1265 1171 1292  473   85 1534 1198  604 2626  831  415 1083  615 1036
CHE   538  629    0  438 1069  639  621  621  644  379   49  672  818  379  928  361  256  557  267  410
CZE   396  662  295    0 1623 1015  942 1081  888  421   91 1134 1264  502 1431  829  302  706  425  686
DEU  1094 1394  921 1177    0 2479 1988 2426 1972  855  135 2441 3152  932 3476 1386  551 1568  691 1340
DFS   665  958  560  639 1564    0 1274 1495 1390  693  120 1461 1837  770 1839  892  485 1140  557  845
ESP   822  991  570  722 1697 1030    0 1424 1274  646  110 1498 1432  660 1810  842  489 1024  566  964
FRA   805  838  550  633 1233  763 1296    0 1446  710  110 1662 1835  773 2366 1024  458 1191  533 1100
GBR   729 1314  586  555 1394 1002 1135  884    0  897  110 1469 1602  868 1994  736  477 1254  577  929
IRL   460  461  384  298  748  575  662  566  929    0   83  632  842  690  742  305  321  689  335  408
ISR    40   63   32   73  114   93   84   60   77   66    0  118  126   90  138   68   52   86   67   83
ITA   690 1207  603  760 1543 1050 1276  859 1076  548   88    0 1635  735 2497  968  465 1130  619 1079
NLD  1229 1135  788 1084 2732 1543 1443 1093 1347  791  103 1295    0  980 2301  984  478 1345  570  927
NZL   377  551  317  342  707  536  545  449  737  599   76  542  886    0 1019  351  345 1131  447  513
USA   728 2836  816 1037 2206 1284 1442 1213 1724  660  121 1646 1897  958    0 1231  602 1716  968 1741
POL   331  637  262  565  980  626  599  557  471  217   44  616  747  249 1078    0  199  568  355  602
ZAF   254  375  207  192  407  347  440  312  409  278   34  355  391  274  564  124    0  450  298  386
AUS   564 1060  490  438 1093  772  805  787 1050  591   59  797 1139 1127 1649  362  384    0  565  789
URY   221  576  196  274  475  369  493  310  457  259   34  431  435  363 1188  263  247  434    0  486
JPN   272  496  239  262  450  388  418  342  406  239   30  416  414  233  615  268  239  378  230    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  635 1075  729  772  762  469  734 1088  460  843  418  310  663  301  835  459
CAN   631    0 1979 1113 1271 1300  479 1542 1213  610 2639  835  417 1090  621 1179 1039
DEU  1093 1402    0 2477 1987 1972  855 2441 3166  932 3473 1382  550 1568  691 2425 1340
DFS   665  968 1562    0 1273 1389  693 1460 1839  770 1838  892  484 1140  556 1495  845
ESP   822 1006 1697 1030    0 1274  646 1497 1437  660 1807  842  488 1023  566 1423  963
GBR   729 1328 1394 1002 1135    0  897 1469 1609  868 1994  736  476 1254  577 1446  929
IRL   460  469  748  575  662  929    0  632  846  690  742  305  321  689  335  710  408
ITA   690 1222 1543 1050 1275 1076  548    0 1640  735 2497  967  465 1130  619 1662 1079
NLD  1234 1156 2751 1549 1453 1354  794 1303    0  980 2310  990  478 1348  573 1837  932
NZL   377  556  707  536  545  737  599  542  888    0 1019  351  344 1131  447  773  513
USA   728 2864 2206 1284 1442 1724  660 1646 1906  958    0 1230  601 1716  968 2366 1741
POL   331  642  978  626  599  471  217  616  751  249 1078    0  199  568  355 1024  602
ZAF   254  381  407  347  440  409  278  355  392  274  564  124    0  449  298  458  385
AUS   564 1065 1093  772  805 1050  591  797 1146 1127 1649  362  384    0  565 1191  789
URY   221  583  475  369  493  457  259  431  437  363 1188  263  247  434    0  533  486
FRA   805  847 1233  763 1296  884  566  859 1098  449 1213  557  312  787  310    0 1100
JPN   272  498  450  388  418  406  239  416  417  233  615  268  239  378  230  342    0
   ------------------------------------------------------------------------

JER
--------
common bulls below diagonal
common three quarter sib group above diagonal
        CAN  DFS  USA  NLD
   ------------------------------------------------------------------------
CAN     0   59  265   23
DFS    47    0   96   57
USA   247   75    0   49
NLD    17   53   48    0
   ------------------------------------------------------------------------

JER
--------
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```
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  AUS  IRL
-------------------------------------------------------------------------------
CAN     0   64  120   27  136  301  119   10
DFS    50    0  129   84  121  114   94   37
GBR   120  118    0   69  184  175  142   62
NLD    21   78   63    0   64   66   48   29
NZL   138   93  191   56    0  241  328  105
USA   300   93  189   68  265    0  234   35
AUS   119   58  150   42  359  238    0   34
IRL     8   32   63   29  117   37   31    0
-------------------------------------------------------------------------------
JER
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  USA
-------------------------------------------------------------------------------
CAN     0   64  123   27  305
DFS    50    0  130   84  113
GBR   122  118    0   68  178
NLD    21   78   63    0   66
USA   304   93  192   68    0
-------------------------------------------------------------------------------
JER
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
-------------------------------------------------------------------------------
CAN     0   63  118   27  133  313  115  186   10
DFS    49    0  129   84  122  158  123  121   37
GBR   116  118    0   69  184  202  150  183   62
NLD    20   78   63    0   65   79   66   61   29
NZL   132   93  191   57    0  340  190  414  105
USA   306  124  223   83  412    0  281  451   42
ZAF   113   99  154   61  201  289    0  217   36
AUS   176   84  192   54  451  488  207    0   50
IRL     8   32   63   29  117   44   37   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   64  119   27  135  317  117  188   10
DFS    50    0  129   88  122  158  123  121   37
GBR   118  118    0   73  184  202  150  183   62
NLD    22   83   67    0   68   83   69   63   30
NZL   135   93  191   61    0  340  190  414  105
USA   312  124  223   88  412    0  281  451   42
ZAF   115   99  154   65  201  289    0  217   36
AUS   180   84  192   56  451  488  207    0   50
IRL     8   32   63   29  117   44   37   47    0
-------------------------------------------------------------------------------
RDC
--------
common bulls below diagonal
common three quarter sib group above diagonal
      CAN  DEU  DFS  NOR  USA  NLD
-------------------------------------------------------------------------------
CAN     0   13  135    5   86    4
DEU    12    0   59   16   19   12
DFS   137   48    0  110  134   44
```

```
  NOR     5    15    87     0    59    29
  USA    82    19   127    60     0    28
  NLD     4    12    41    29    26     0
  ------------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
        CAN   DEU   DFS   GBR   NOR   NZL   USA   NLD   AUS   IRL
  ------------------------------------------------------------------------
  CAN     0    14   134    64     5    61   123     5    54     4
  DEU    13     0    63    18    19    21    25    12    22     6
  DFS   136    52     0    91   124   162   153    48   137    18
  GBR    65    17    86     0    43    65    81    28    49    20
  NOR     5    18    95    45     0    40    64    36    35    52
  NZL    60    20   155    61    38     0    87    16   102    12
  USA   120    24   146    77    64    88     0    31    54    26
  NLD     5    12    46    27    36    16    30     0    12    11
  AUS    53    21   117    46    30   104    52    10     0     8
  IRL     4     6    13    19    51    12    26    11     7     0
  ------------------------------------------------------------------------
RDC
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
        CAN   DEU   DFS   GBR   NOR   NLD   USA
  ------------------------------------------------------------------------
  CAN     0    14   134    67     5     5   123
  DEU    13     0    62    19    17    12    25
  DFS   136    52     0    93   111    49   153
  GBR    67    18    87     0    43    28    83
  NOR     5    17    86    45     0    34    65
  NLD     5    12    46    27    34     0    31
  USA   120    25   147    78    66    30     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   131    60     5    60   145    68     5    65     4
  DEU    12     0    62    18    17    21    27     2    12    42     6
  DFS   133    52     0    91   111   162   170    53    49   185    18
  GBR    61    17    86     0    42    66    93    38    28    70    20
  NOR     5    17    86    44     0    39    66     0    34    57    52
  NZL    59    20   155    62    37     0   110    35    16   131    12
  USA   148    27   167    91    67   111     0    67    33   113    27
  ZAF    72     2    51    36     0    33    62     0     2    38     2
  NLD     5    12    46    27    34    16    32     2     0    23    11
  AUS    66    41   161    68    47   132   114    40    21     0    15
  IRL     4     6    13    19    51    12    27     2    11    14     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   131    61     5    60   145    68     6    65     4
  DEU    12     0    62    18    18    21    27     2    12    42     6
  DFS   133    52     0    91   124   162   170    53    49   185    18
  GBR    62    17    86     0    43    66    93    38    29    70    20
  NOR     5    18    95    45     0    40    66     0    38    61    52
  NZL    59    20   155    62    38     0   110    35    16   131    12
  USA   148    26   166    91    66   111     0    67    36   113    27
```

```
   ZAF   72     2    51    36     0    33    62     0     2    38     2
   NLD    6    12    46    28    38    16    34     2     0    23    11
   AUS   66    41   161    68    51   132   114    40    21     0    15
   IRL    4     6    13    19    51    12    27     2    11    14     0
  --------------------------------------------------------------------

SIM
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