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

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

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

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


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

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

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

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

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

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


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


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


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


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


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


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


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


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


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


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


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


NZL      T2=CY   PM=Lactating cow's ability to start cycling
         T4=C2   PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), (in days)
         T5=IT   PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), (in days)


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


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


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


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


SVN     T5=IT   CI=Calving interval (days)


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


AUS (ALL)          Decrease in information due to the data clean-up, pedigree changes, bulls' statue changes and rounding effect
FRA (ALL)          All proofs sent to MACE are now â\200\234genomic-freeâ\200\235 single-step proofs, issued from a BLUP evaluation running on single-step preadjusted performances, as suggested as one of the methods of choice to provide unbiased â\200\234genomic-freeâ\200\235 proofs to
                   Interbull by the Interbull working group on this topic. In addition to these changes, unknown parent groups have been modified for all traits.
NZL (ALL)          cc2 and int: Change in model, definition of the traits, scale and heritability.
                   New trait definition - PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), calculated from the days between PSM until date of conception (confirmed by the date of next calving) (expressed in days).
ESP (HOL)          Drop in information due to the update of national database.
DEU (HOL)          Drop in information due to the data changing, some bulls don't meet the requirements to be included in the evaluation (daughters in less than 10 herd)
CZE (HOL)          Drop in information as they trimmed 6 months of data for cc1/2 inseminations.
BEL(HOL)           Small decrease in information due to the pedigree(alias) correction and rounding effect
JPN (HOL)          Small decrease in information due to the pedigree modification
USA (HOL,JER,RDC)  Drop in information (hco,cc1,crc) due to the pedigree correction and herd-year minimum edits.
GBR(HOL,JER)       Decrease in information due to the update in data input
NLD (ALL)          Decrease in information (hco and cc1 maily for RDC) due to pedigree changes /correction.
CHE (HOL)          Decrease in information due to the edits in database, and change in hys assignment.
ITA (HOL)          Drop in information (hco) due to pedigree editing.

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN
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Post-processing Windows:
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According to the decision taken by ITC in Orlando (2015) to review the
post-processing windows every 5 years, during the 2020 the relative working group
has been re-activated and new windows have been identified.

As before, the upper bounds have been set to 0.99 as these were judged to have
very little effect on evaluations while the lower values have been reduced
to the 10th percentile. This reduction would provide post-processed correlations to be closer to the
real estimated ones. Over the past five years, in fact, the previous adopted lower value (25th percentile) had been found too high
causing estimated and post-processed correlations to differ significantly from each other.
The new lower values have been applied to all breeds and traits.

The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations
to take more in consideration the value of the new estimated ones even when no changes are applied by the countries.
The new weights are as follows:
No changes   :: 2
Small changes:: 1
Big changes  :: 0


More information can be read on https://interbull.org/ib/rg_procedure
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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
     https://wiki.interbull.org/public/rG%20procedure?action=print

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

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

NEXT ROUTINE INTERNATIONAL EVALUATION

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

NEXT TEST INTERNATIONAL EVALUATION

Dates for the next test run can be found on

PUBLICATION OF INTERBULL ROUTINE RUN

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

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

PUBLICATION OF INTERBULL TEST RUN

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

^LTable 1. National evaluation data considered in the Interbull
evaluation for fertility (December Routine Evaluation 2023).
Number of records for lactating cow's ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		149	8777	1867	798	
BEL			2119			
CAN	184	50	10349	655	598	
CHE	3023		3288			
CZE			3579			
DEA	4962					
DEU			25689		317	
DFS			17447	2518	10638	
ESP			6735			
EST						
FRA	443		17305			
FRM						
GBR	112	255	7694	632	471	
HUN						
IRL			3340	242	75	
ISR			1684			
ITA	1984		9491			
JPN			6673			
KOR						
LTU						
LVA						
NLD	222		16685	256	98	
NOR					3135	
NZL	54	50	8736	5002	1334	
POL			9216			
PRT						
SVK						
SVN						
URY			1995			
USA	1207	801	42411	5368	798	
ZAF			1276	753	158	
HRV						
CAM						
No.Records	12191	1305	204489	17293	18420	
Pub. Proofs	10726	1077	159239	14327	18178	0

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

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BSW   hco

	CAN	DEA	FRA	USA	CHE	NLD
CAN	9.62					
DEA	0.86	9.93				
FRA	0.75	0.90	0.76			
USA	0.79	0.80	0.85	2.60		
CHE	0.91	0.94	0.87	0.81	13.18	
NLD	0.80	0.68	0.76	0.76	0.71	4.52

BSW   crc

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	6.84								
CHE	0.81	11.39							
DEA	0.77	0.95	14.99						
NLD	0.82	0.86	0.84	3.54					
NZL	0.61	0.69	0.81	0.61	0.13				
USA	0.77	0.84	0.81	0.78	0.62	8.15			
GBR	0.70	0.69	0.63	0.73	0.66	0.73	3.92		
FRA	0.81	0.97	0.96	0.85	0.69	0.85	0.73	1.70	
ITA	0.82	0.78	0.79	0.79	0.69	0.78	0.74	0.80	16.11

BSW   cc1

	CAN	CHE	DEA	NLD	USA	GBR	FRA
CAN	7.43						
CHE	0.82	11.80					
DEA	0.79	0.95	11.44				
NLD	0.74	0.70	0.67	3.85			
USA	0.75	0.68	0.67	0.80	2.85		
GBR	0.77	0.81	0.79	0.70	0.68	0.03	
FRA	0.73	0.69	0.67	0.82	0.86	0.72	0.89

BSW   cc2

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	6.65								
CHE	0.78	11.15							
DEA	0.76	0.93	12.30						
NLD	0.82	0.79	0.77	3.22					
NZL	0.65	0.81	0.68	0.64	0.07				
USA	0.81	0.83	0.82	0.78	0.65	2.50			
GBR	0.70	0.80	0.80	0.72	0.68	0.81	3.92		
FRA	0.86	0.89	0.90	0.82	0.66	0.84	0.79	0.89	
ITA	0.79	0.71	0.78	0.79	0.74	0.80	0.76	0.75	21.51

BSW   int

	CAN	DEA	NLD	NZL	USA	GBR	ITA	SVN
CAN	7.32							
DEA	0.79	14.32						
NLD	0.83	0.88	3.10					
NZL	0.66	0.69	0.65	0.07				
USA	0.90	0.82	0.77	0.60	2.50			
GBR	0.82	0.71	0.81	0.68	0.82	3.92		
ITA	0.85	0.92	0.84	0.65	0.78	0.81	17.44	
SVN	0.72	0.68	0.72	0.68	0.70	0.75	0.71	19.91

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GUE    crc
------------------------------------------------------------------------------------
           CAN     GBR     NZL     USA     AUS
CAN       7.75
GBR       0.73    4.79
NZL       0.61    0.65    0.11
USA       0.78    0.76    0.61    6.84
AUS       0.67    0.78    0.90    0.66    6.97


------------------------------------------------------------------------------------
GUE    cc1
------------------------------------------------------------------------------------
           CAN     GBR     USA
CAN       7.55
GBR       0.77    0.03
USA       0.81    0.73    3.45


------------------------------------------------------------------------------------
GUE    cc2
------------------------------------------------------------------------------------
           CAN     GBR     NZL     USA     AUS
CAN       7.33
GBR       0.70    4.79
NZL       0.63    0.68    0.07
USA       0.84    0.80    0.67    2.83
AUS       0.68    0.68    0.70    0.72   10.30


------------------------------------------------------------------------------------
GUE    int
------------------------------------------------------------------------------------
           CAN     GBR     NZL     USA     AUS
CAN       8.06
GBR       0.82    4.79
NZL       0.64    0.67    0.07
USA       0.90    0.80    0.63    2.83
AUS       0.72    0.69    0.70    0.73   10.30


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HOL    hco
------------------------------------------------------------------------------------
           CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD     ITA     JPN
CAN       7.83
CZE       0.77   17.70
DEU       0.90    0.79   15.14
DFS       0.78    0.84    0.84   13.56
FRA       0.76    0.77    0.79    0.88    0.71
USA       0.84    0.84    0.84    0.86    0.84    2.38
POL       0.63    0.51    0.63    0.51    0.47    0.55   19.58
CHE       0.96    0.79    0.93    0.78    0.78    0.86    0.54   13.63
NLD       0.81    0.77    0.83    0.86    0.81    0.83    0.50    0.79    5.13
ITA       0.80    0.76    0.92    0.73    0.71    0.79    0.61    0.87    0.72    0.04
JPN       0.85    0.71    0.85    0.71    0.70    0.83    0.63    0.84    0.75    0.73    6.19


------------------------------------------------------------------------------------
HOL    crc
------------------------------------------------------------------------------------
           BEL     CAN     CHE     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     FRA
BEL       4.64
CAN       0.75    7.26
CHE       0.80    0.83   12.31
DEU       0.71    0.83    0.87   10.91
DFS       0.79    0.86    0.94    0.91   11.60
ESP       0.74    0.78    0.81    0.78    0.79   10.93
GBR       0.89    0.74    0.77    0.71    0.79    0.73    4.58
IRL       0.85    0.59    0.66    0.59    0.61    0.68    0.82    3.56
ITA       0.79    0.86    0.87    0.86    0.86    0.82    0.80    0.66    7.57
NLD       0.79    0.83    0.89    0.85    0.93    0.79    0.76    0.59    0.81    4.44
NZL       0.62    0.60    0.63    0.59    0.64    0.60    0.65    0.58    0.71    0.57    0.09
USA       0.74    0.78    0.82    0.82    0.86    0.78    0.78    0.59    0.79    0.78    0.61    6.86
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POL      0.74    0.90    0.89    0.84    0.84    0.80    0.73    0.65    0.95    0.79    0.67    0.76   13.54
FRA      0.78    0.85    0.94    0.93    0.94    0.80    0.79    0.64    0.90    0.88    0.65    0.83    0.88    1.13


--------------------------------------------------------------------------------
HOL    cc1
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         CAN     CHE     CZE     DEU     DFS     FRA     GBR     ISR     ITA     NLD     USA     POL     JPN
CAN      6.68
CHE      0.93   10.87
CZE      0.83    0.74   17.45
DEU      0.91    0.92    0.80   14.67
DFS      0.75    0.69    0.86    0.78   13.17
FRA      0.77    0.75    0.89    0.77    0.87    0.96
GBR      0.77    0.77    0.69    0.78    0.66    0.73    0.03
ISR      0.79    0.71    0.93    0.78    0.88    0.90    0.76    3.29
ITA      0.87    0.85    0.81    0.93    0.71    0.76    0.79    0.80    0.05
NLD      0.75    0.73    0.86    0.78    0.89    0.90    0.70    0.86    0.72    4.56
USA      0.80    0.71    0.95    0.75    0.83    0.86    0.68    0.93    0.79    0.82    2.82
POL      0.73    0.74    0.72    0.74    0.59    0.56    0.66    0.68    0.77    0.59    0.65   19.58
JPN      0.79    0.76    0.89    0.76    0.83    0.83    0.76    0.86    0.76    0.79    0.92    0.66    7.57


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HOL    cc2
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         BEL     CAN     CHE     CZE     DEU     DFS     ESP     FRA     GBR     IRL     ISR     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     JPN
BEL      4.64
CAN      0.74    6.15
CHE      0.82    0.90   10.98
CZE      0.66    0.86    0.88   17.45
DEU      0.79    0.93    0.92    0.91   13.46
DFS      0.81    0.84    0.88    0.83    0.94   12.84
ESP      0.71    0.74    0.83    0.84    0.77    0.73   10.92
FRA      0.81    0.90    0.93    0.85    0.95    0.88    0.77    0.91
GBR      0.89    0.70    0.74    0.65    0.76    0.79    0.71    0.75    4.58
IRL      0.84    0.75    0.83    0.70    0.79    0.76    0.73    0.82    0.82    3.57
ISR      0.62    0.73    0.73    0.87    0.82    0.77    0.79    0.74    0.65    0.67    3.29
ITA      0.76    0.86    0.88    0.90    0.91    0.83    0.86    0.87    0.78    0.80    0.88   14.98
NLD      0.78    0.85    0.87    0.81    0.93    0.89    0.74    0.89    0.72    0.77    0.78    0.83    4.30
NZL      0.69    0.63    0.76    0.75    0.65    0.63    0.75    0.65    0.67    0.73    0.72    0.79    0.63    0.06
USA      0.80    0.86    0.85    0.88    0.91    0.86    0.76    0.84    0.82    0.81    0.80    0.90    0.80    0.65    2.36
POL      0.80    0.71    0.73    0.62    0.70    0.71    0.69    0.72    0.81    0.77    0.62    0.80    0.69    0.67    0.78   12.31
ZAF      0.77    0.78    0.81    0.71    0.81    0.75    0.69    0.80    0.78    0.86    0.61    0.83    0.73    0.67    0.86    0.80   15.11
AUS      0.69    0.68    0.73    0.62    0.70    0.64    0.64    0.74    0.68    0.83    0.61    0.69    0.64    0.64    0.72    0.62    0.78    8.46
URY      0.72    0.69    0.67    0.64    0.68    0.69    0.64    0.66    0.70    0.70    0.57    0.65    0.69    0.75    0.69    0.70    0.77    0.66    1.39
JPN      0.83    0.82    0.85    0.77    0.85    0.85    0.72    0.84    0.86    0.85    0.69    0.87    0.77    0.66    0.92    0.89    0.88    0.71    0.70   18.25


--------------------------------------------------------------------------------
HOL    int
--------------------------------------------------------------------------------

         BEL     CAN     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL     ZAF     AUS     URY     FRA     JPN     SVN
BEL      4.64
CAN      0.88    6.62
DEU      0.86    0.91   12.30
DFS      0.90    0.91    0.95   12.75
ESP      0.84    0.78    0.79    0.81   10.92
GBR      0.89    0.83    0.86    0.89    0.80    4.58
IRL      0.84    0.82    0.82    0.80    0.83    0.82    3.57
ITA      0.85    0.89    0.90    0.88    0.85    0.87    0.83   19.47
NLD      0.90    0.86    0.88    0.93    0.79    0.84    0.79    0.85    4.25
NZL      0.70    0.63    0.62    0.60    0.63    0.67    0.72    0.64    0.59    0.06
USA      0.81    0.92    0.91    0.87    0.83    0.82    0.81    0.90    0.80    0.59    2.36
POL      0.81    0.86    0.79    0.81    0.73    0.81    0.78    0.91    0.78    0.66    0.78   12.32
ZAF      0.79    0.84    0.85    0.80    0.81    0.80    0.87    0.86    0.78    0.67    0.87    0.84   15.11
AUS      0.72    0.72    0.70    0.68    0.71    0.70    0.84    0.69    0.67    0.64    0.73    0.68    0.80    8.46
URY      0.73    0.68    0.68    0.68    0.68    0.69    0.72    0.70    0.67    0.80    0.67    0.71    0.79    0.69    1.39
FRA      0.81    0.89    0.84    0.83    0.77    0.75    0.81    0.82    0.78    0.59    0.82    0.70    0.80    0.74    0.66    0.91
JPN      0.85    0.93    0.90    0.90    0.82    0.87    0.84    0.93    0.85    0.62    0.92    0.90    0.89    0.72    0.72    0.82   18.25
SVN      0.88    0.75    0.77    0.83    0.75    0.79    0.76    0.81    0.81    0.64    0.72    0.68    0.65    0.68    0.67    0.76    0.76   20.05
```

```
------------------------------------------------------------------------------------------
JER    hco
------------------------------------------------------------------------------------------
          CAN     DFS     USA     NLD
CAN      8.01
DFS      0.73   17.30
USA      0.76    0.83    2.71
NLD      0.82    0.82    0.71    4.71


------------------------------------------------------------------------------------------
JER    crc
------------------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     IRL
CAN      6.92
DFS      0.81   13.41
GBR      0.66    0.83    3.87
NLD      0.81    0.83    0.68    3.34
NZL      0.58    0.67    0.65    0.55    0.08
USA      0.77    0.82    0.78    0.76    0.65    8.31
IRL      0.61    0.62    0.79    0.60    0.57    0.60    2.38


------------------------------------------------------------------------------------------
JER    cc1
------------------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     USA
CAN      7.00
DFS      0.71   15.41
GBR      0.78    0.67    0.03
NLD      0.72    0.77    0.68    3.53
USA      0.75    0.81    0.67    0.70    2.90


------------------------------------------------------------------------------------------
JER    cc2
------------------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN      6.79
DFS      0.80   15.64
GBR      0.71    0.74    3.88
NLD      0.80    0.80    0.70    3.13
NZL      0.64    0.64    0.64    0.64    0.05
USA      0.80    0.79    0.78    0.75    0.68    2.64
ZAF      0.66    0.66    0.73    0.67    0.75    0.84   11.32
AUS      0.64    0.64    0.64    0.63    0.63    0.65    0.70    6.44
IRL      0.75    0.74    0.76    0.75    0.66    0.76    0.78    0.72    2.38


------------------------------------------------------------------------------------------
JER    int
------------------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN      6.59
DFS      0.84   15.34
GBR      0.75    0.82    3.88
NLD      0.80    0.83    0.76    3.06
NZL      0.62    0.61    0.64    0.60    0.05
USA      0.83    0.81    0.78    0.74    0.67    2.64
ZAF      0.71    0.71    0.74    0.71    0.75    0.84   11.32
AUS      0.69    0.68    0.68    0.67    0.63    0.69    0.72    6.44
IRL      0.79    0.74    0.75    0.74    0.63    0.76    0.80    0.75    2.38


------------------------------------------------------------------------------------------
RDC    hco
------------------------------------------------------------------------------------------
          CAN     DEU     DFS     NOR     USA     NLD
CAN      7.66
DEU      0.89   14.40
DFS      0.72    0.80   12.26
NOR      0.86    0.87    0.87   16.48
USA      0.83    0.82    0.83    0.73    2.82
NLD      0.81    0.83    0.78    0.66    0.79    5.87
```

```
------------------------------------------------------------------------------------
RDC    crc
------------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     IRL
CAN      6.53
DEU      0.83   10.12
DFS      0.84    0.90   12.67
GBR      0.77    0.71    0.69    4.16
NOR      0.84    0.81    0.85    0.62   14.09
NZL      0.68    0.60    0.56    0.69    0.58    0.11
USA      0.77    0.81    0.80    0.76    0.77    0.69    8.44
NLD      0.82    0.83    0.87    0.72    0.81    0.57    0.77    3.30
IRL      0.61    0.60    0.62    0.81    0.61    0.61    0.62    0.60    2.82


------------------------------------------------------------------------------------
RDC    cc1
------------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN      7.31
DEU      0.90   13.87
DFS      0.71    0.80   13.00
GBR      0.77    0.79    0.67    0.03
NOR      0.80    0.85    0.93    0.77   14.02
NLD      0.75    0.77    0.84    0.69    0.70    3.93
USA      0.82    0.75    0.77    0.68    0.73    0.79    2.80


------------------------------------------------------------------------------------
RDC    cc2
------------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.87
DEU      0.92   11.47
DFS      0.81    0.94   12.83
GBR      0.71    0.76    0.75    4.16
NOR      0.79    0.82    0.89    0.72   14.02
NZL      0.64    0.67    0.64    0.66    0.66    0.07
USA      0.87    0.89    0.80    0.79    0.72    0.66    2.57
ZAF      0.70    0.81    0.73    0.70    0.78    0.65    0.81   17.10
NLD      0.84    0.92    0.85    0.73    0.74    0.67    0.79    0.73    3.38
AUS      0.66    0.68    0.63    0.67    0.65    0.64    0.68    0.66    0.65    7.62
IRL      0.76    0.80    0.76    0.80    0.72    0.72    0.79    0.83    0.77    0.79    2.82


------------------------------------------------------------------------------------
RDC    int
------------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.62
DEU      0.90   11.28
DFS      0.88    0.94   13.16
GBR      0.82    0.85    0.81    4.16
NOR      0.77    0.77    0.69    0.70   14.09
NZL      0.69    0.63    0.60    0.67    0.63    0.07
USA      0.91    0.89    0.78    0.81    0.69    0.63    2.57
ZAF      0.80    0.85    0.76    0.74    0.82    0.65    0.82   17.10
NLD      0.86    0.88    0.91    0.82    0.77    0.61    0.78    0.78    3.11
AUS      0.71    0.71    0.68    0.70    0.70    0.64    0.71    0.73    0.67    7.62
IRL      0.81    0.82    0.78    0.80    0.70    0.71    0.78    0.85    0.78    0.81    2.82
```

----
^LAPPENDIX II. Number of common bulls

```
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DEA  FRA  USA  CHE  NLD
 --------------------------------------------------------------------------------
  CAN    0  102   55  106  104   32
```

```
   DEA   90     0   194   198   608   142
   FRA   47   154     0    73   164    74
   USA   95   158    56     0   210    53
   CHE   87   514   129   175     0   101
   NLD   28   133    62    49    95     0
------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   CHE   DEA   NLD   NZL   USA   GBR   FRA   ITA
------------------------------------------------------------------------------

   CAN     0   123   120    39    20   137    48    74   114
   CHE   104     0   620   107    30   276    66   165   466
   DEA   107   515     0   158    41   245    63   203   617
   NLD    34    98   144     0    24    64    36    78   131
   NZL    19    24    36    18     0    21    16    21    33
   USA   134   242   196    58    18     0    68    94   176
   GBR    46    49    46    31    12    66     0    48    72
   FRA    63   128   159    64    16    65    39     0   190
   ITA   100   401   503   105    27   123    53   150     0
------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   CHE   DEA   NLD   USA   GBR   FRA
------------------------------------------------------------------------------

   CAN     0   126   122    40   139    47    78
   CHE   107     0   618   106   276    67   173
   DEA   109   512     0   156   245    65   215
   NLD    35    98   143     0    63    36    82
   USA   136   242   196    58     0    69    99
   GBR    46    51    48    31    68     0    53
   FRA    67   135   170    69    71    45     0
------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   CHE   DEA   NLD   NZL   USA   GBR   FRA   ITA
------------------------------------------------------------------------------

   CAN     0   111   107    35    15   133    45    71   102
   CHE    92     0   611   107    26   331    66   173   466
   DEA    95   508     0   158    35   320    63   213   613
   NLD    31    98   144     0    22    86    36    82   131
   NZL    14    21    32    17     0    24    13    19    28
   USA   125   308   277    75    21     0    77   119   223
   GBR    42    49    46    31     9    75     0    51    72
   FRA    62   135   168    69    15    85    43     0   202
   ITA    90   401   501   105    24   155    53   161     0
------------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN   DEA   NLD   NZL   USA   GBR   ITA   SVN
------------------------------------------------------------------------------

   CAN     0   112    37    15   138    47   109    27
   DEA    99     0   158    35   319    63   714    80
   NLD    33   144     0    22    87    36   137    38
   NZL    14    32    17     0    24    13    28     9
   USA   130   277    75    21     0    77   247    34
   GBR    44    46    31     9    75     0    73    17
   ITA    96   633   112    24   176    53     0    78
   SVN    25    76    38     9    30    14    75     0
------------------------------------------------------------------------------
GUE
--------
```

```
GUE
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
------------------------------------------------------------------------
   CAN    0   18    3   42   18
   GBR   15    0   14   56   28
   NZL    2   12    0   10   26
   USA   41   53    7    0   19
   AUS   13   22   23   16    0
------------------------------------------------------------------------
GUE
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  USA
------------------------------------------------------------------------
   CAN    0   19   42
   GBR   15    0   60
   USA   41   57    0
------------------------------------------------------------------------
GUE
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
------------------------------------------------------------------------
   CAN    0   14    1   41   25
   GBR   11    0   12   86   35
   NZL    1   10    0   24   22
   USA   39   87   23    0   69
   AUS   21   29   21   66    0
------------------------------------------------------------------------
GUE
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        CAN  GBR  NZL  USA  AUS
------------------------------------------------------------------------
   CAN    0   14    1   41   25
   GBR   11    0   12   86   35
   NZL    1   10    0   24   22
   USA   39   87   23    0   69
   AUS   21   29   21   66    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 1135 2358 1466 1332 3104 1448  862 1482 1950 1197
   CZE  849    0 1891 1290 1235 1539 1256  501 1532 1375  842
   DEU 1956 1458    0 2741 2398 3105 2431 1168 3227 2785 1369
   DFS 1397  883 2130    0 1718 1839 1528  757 2302 1732 1013
   FRA 1020  770 1396 1028    0 1711 1552  728 1992 1698 1150
   USA 3599 1270 2542 1715 1056    0 2105  914 1990 2665 1526
   POL 1347 1025 2195 1298 1098 2248    0  573 1722 1737  873
   CHE  787  352 1097  712  674  852  471    0  926  791  476
   NLD 1472 1330 2904 2037 1340 1803 1584  921    0 1846 1100
   ITA 1748 1037 2079 1495 1066 2313 1483  742 1612    0 1196
   JPN  701  384  643  552  437  840  490  310  580  595    0
------------------------------------------------------------------------
HOL
--------

 common bulls below diagonal
 common three quarter sib group above diagonal
        BEL  CAN  CHE  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  USA  POL  FRA
```

```
----------------------------------------------------------------------------
BEL    0  814  637 1277  911  958  914  549  841 1300  535  876  619 1001
CAN  817    0  895 2513 1542 1699 1740  602 1974 1637  751 3317 1338 1433
CHE  644  825    0 1210  768  769  795  457  789  982  448  978  543  743
DEU 1309 2031 1146    0 2930 2452 2381  985 2787 3738 1083 3382 2203 2641
DFS  858 1469  729 2227    0 1653 1718  815 1713 2358  907 1995 1380 1731
ESP 1028 1521  721 2178 1487    0 1613  755 1809 1897  777 2012 1344 1874
GBR  897 1823  762 1852 1377 1479    0 1081 1726 2021 1022 2210 1176 1663
IRL  539  600  469  869  694  775 1129    0  659  986  800  734  449  794
ITA  849 1762  739 2074 1471 1667 1439  608    0 1923  724 2735 1528 1695
NLD 1479 1650  981 3503 2144 1992 1806  937 1701    0 1166 2265 1617 2124
NZL  434  684  373  833  657  640  878  697  581 1053    0  910  492  842
USA  833 3907  914 2667 1812 1820 2184  728 2303 2079  854    0 1904 1916
POL  530 1223  425 1884 1136 1129  946  347 1223 1446  376 1942    0 1462
FRA  989 1106  679 1532 1025 1801 1102  650 1056 1417  518 1161  991    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  896 1072 2512 1551 1446 1770  142 1985 1643 3365 1382 1346
 CHE  826    0  441 1207  768  750  796   65  789  982  979  569  512
 CZE  834  315    0 1631 1100 1030  951  121 1230 1378 1474 1206  752
 DEU 2025 1142 1315    0 2923 2658 2406  180 2763 3724 3355 2352 1568
 DFS 1479  729  844 2210    0 1742 1746  162 1713 2358 2001 1476 1068
 FRA 1126  689  652 1549 1038    0 1692  129 1700 2143 1927 1527 1287
 GBR 1869  769  678 1877 1405 1130    0  165 1761 2042 2258 1231 1164
 ISR  101   38   94  139  124   72  122    0  152  171  196  124  121
 ITA 1775  739  965 2048 1467 1067 1480  113    0 1919 2731 1591 1236
 NLD 1659  981 1271 3481 2143 1442 1841  135 1695    0 2266 1734 1176
 USA 3965  915 1236 2631 1813 1177 2251  192 2300 2080    0 1962 1739
 POL 1280  461 1016 2120 1258 1061 1015   91 1299 1608 2026    0  886
 JPN  817  352  402  727  615  507  627   56  663  670  991  511    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  804  637  548 1269  912  958  998  916  551   80  836 1302  524 1028  609  334  780  357  547
 CAN  805    0  884 1051 2442 1517 1684 1407 1711  590  138 1928 1603  708 3449 1298  445 1384  775 1240
 CHE  644  808    0  441 1196  769  769  739  795  457   66  787  982  436 1074  530  263  680  327  477
 CZE  437  805  315    0 1629 1100 1077 1022  941  426  121 1228 1378  484 1515 1129  272  707  472  716
 DEU 1297 1941 1131 1311    0 2910 2451 2618 2367  980  180 2731 3692 1044 3902 2143  559 1811  858 1480
 DFS  858 1432  730  844 2196    0 1661 1727 1723  815  164 1709 2362  887 2388 1353  512 1379  683 1008
 ESP 1028 1485  721  884 2168 1494    0 1874 1616  756  144 1801 1902  761 2332 1323  517 1271  701 1167
 FRA  981 1070  673  645 1493 1010 1786    0 1661  798  131 1674 2118  831 2613 1435  482 1363  619 1224
 GBR  897 1781  762  674 1829 1377 1480 1095    0 1082  165 1720 2024  996 2589 1150  505 1552  738 1099
 IRL  539  580  469  325  861  694  775  647 1129    0  112  658  989  794  900  435  338  807  403  477
 ISR   48   96   38   94  138  124  109   70  119   85    0  152  173  121  221  117   60  121   89  115
 ITA  844 1701  737  957 2017 1463 1660 1035 1435  608  114    0 1907  696 2852 1486  438 1225  710 1165
 NLD 1481 1603  981 1271 3429 2145 1995 1403 1807  938  135 1685    0 1135 2831 1570  502 1579  735 1109
 NZL  422  636  362  364  793  636  622  501  855  693   97  556 1022    0 1161  467  352 1263  554  581
 USA  915 3956 1008 1258 2890 1948 2089 1449 2431  829  209 2346 2527 1107    0 1906  636 2107 1230 2029
 POL  510 1163  409  905 1794 1104 1104  956  920  335   80 1178 1384  352 1909    0  231  838  513  812
 ZAF  281  409  222  195  429  379  476  337  444  297   39  361  416  282  612  160    0  476  314  411
 AUS  679 1415  607  501 1377 1028 1049  941 1373  701   78  985 1377 1256 2162  636  416    0  704  939
 URY  261  729  245  321  607  468  607  362  593  315   47  527  571  455 1499  397  266  550    0  589
 JPN  348  679  303  355  626  536  569  441  545  300   43  572  575  286  852  426  260  508  296    0
----------------------------------------------------------------------------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       BEL  CAN  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  USA  POL  ZAF  AUS  URY  FRA  JPN  SVN
----------------------------------------------------------------------------
```

```
  BEL      0   806 1267   912   958   916   551   835 1302   524 1028   608   334   780   357   998   547   156
  CAN    809     0  2447  1524 1690 1720   596 1935 1612   713 3462 1301   449 1392   781 1415 1245   199
  DEU   1296 1950     0  2906 2450 2367   980 2730 3690 1044 3898 2137   559 1811   858 2618 1480   319
  DFS    858 1442 2193     0  1661 1722   815 1708 2359   887 2384 1352   512 1379   683 1727 1008   239
  ESP   1028 1501 2168 1494     0  1616   756 1801 1900   761 2329 1323   517 1270   701 1873 1165   230
  GBR    897 1794 1829 1377 1480     0  1082 1720 2024   996 2589 1150   505 1552   737 1661 1099   195
  IRL    539   588   861   694   775 1129     0   658   988   794   900   435   338   807   403   798   477   106
  ITA    844 1713 2017 1463 1660 1435   608     0  1907   696 2852 1481   438 1225   710 1674 1165   242
  NLD   1481 1616 3428 2144 1995 1807   938 1685     0  1135 2830 1567   502 1579   735 2117 1108   256
  NZL    422   640   793   636   622   855   693   556 1022     0  1161   467   352 1263   553   831   581   112
  USA    915 3985 2890 1948 2089 2431   829 2346 2527 1107     0  1904   636 2107 1230 2613 2029   228
  POL    510 1169 1790 1103 1104   920   335 1177 1384   352 1909     0   231   838   513 1435   811   238
  ZAF    281   416   429   379   476   444   297   361   416   282   612   160     0   476   314   482   411    67
  AUS    679 1420 1377 1028 1049 1373   701   985 1377 1256 2162   636   416     0   704 1363   939   151
  URY    261   735   607   468   607   593   315   527   571   455 1499   397   266   550     0   619   589    85
  FRA    981 1078 1493 1010 1786 1095   647 1035 1403   501 1449   956   337   941   362     0  1224   193
  JPN    348   682   626   536   569   545   300   572   575   286   852   426   260   508   296   441     0   150
  SVN    122   151   311   187   204   142    83   204   222    77   183   197    47   105    44   140    79     0
--------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  USA  NLD
--------------------------------------------------------------------------------
 CAN    0  105  347   34
 DFS  101    0  157   92
 USA  338  147    0   76
 NLD   27   90   76    0
--------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  IRL
--------------------------------------------------------------------------------
 CAN    0  110  161   44  170  406   14
 DFS  104    0  180  162  169  175   58
 GBR  161  176    0   95  235  229   84
 NLD   38  162   89    0   96  105   40
 NZL  172  146  240   89    0  307  151
 USA  409  165  249  106  333    0   46
 IRL   13   54   87   39  168   48    0
--------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  USA
--------------------------------------------------------------------------------
 CAN    0  110  161   44  410
 DFS  104    0  183  161  174
 GBR  161  179    0   98  229
 NLD   38  161   93    0  104
 USA  414  165  250  106    0
--------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
--------------------------------------------------------------------------------
 CAN    0  106  159   42  161  413  135  234   14
 DFS  100    0  181  162  162  226  160  170   58
 GBR  157  176    0   95  230  257  180  238   84
 NLD   35  162   89    0   89  118   80   82   40
 NZL  162  138  235   81    0  394  217  456  149
 USA  416  204  284  123  466    0  327  528   54
 ZAF  134  142  183   76  226  340    0  255   44
```

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  AUS   230  142  245   75  501  575  243    0   65
  IRL    13   54   87   39  165   56   45   63    0
 ------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
 ------------------------------------------------------------------------------
  CAN     0  108  160   42  163  418  137  236   14
  DFS   102    0  181  162  162  226  160  170   58
  GBR   159  176    0   95  230  257  180  238   84
  NLD    36  162   89    0   89  118   80   82   40
  NZL   165  138  235   81    0  394  217  456  149
  USA   423  204  284  123  466    0  327  528   54
  ZAF   136  142  183   76  226  340    0  255   44
  AUS   233  142  245   75  501  575  243    0   65
  IRL    13   54   87   39  165   56   45   63    0
 ------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DEU  DFS  NOR  USA  NLD
 ------------------------------------------------------------------------------
  CAN     0   10  179    7  110    6
  DEU    10    0   65   16   19   12
  DFS   187   56    0  135  171   58
  NOR     6   15  114    0   73   43
  USA   104   18  163   73    0   39
  NLD     6   12   55   43   37    0
 ------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DEU  DFS  GBR  NOR  NZL  USA  NLD  IRL
 ------------------------------------------------------------------------------
  CAN     0   13  182   81    7   73  147    6    4
  DEU    12    0   70   15   16   21   21   17    5
  DFS   190   58    0  122  150  189  193   61   20
  GBR    82   14  118    0   68   85  108   41   26
  NOR     6   15  123   72    0   50   82   48   62
  NZL    74   21  184   83   49    0  109   24   15
  USA   141   20  188  104   82  111    0   44   32
  NLD     6   17   58   40   48   24   42    0   14
  IRL     4    5   15   25   61   15   32   14    0
 ------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DEU  DFS  GBR  NOR  NLD  USA
 ------------------------------------------------------------------------------
  CAN     0   13  182   84    7    6  148
  DEU    12    0   69   16   16   17   21
  DFS   190   57    0  125  135   61  193
  GBR    85   15  121    0   68   42  113
  NOR     6   15  112   72    0   46   82
  NLD     6   17   58   41   46    0   44
  USA   142   20  188  109   82   42    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  181   76    7   68  174   77    6   76    4
```

```
 DEU    12     0    67    15    16    20    23     3    17    46     5
 DFS   188    56     0   122   135   176   220    62    61   229    20
 GBR    76    14   118     0    67    77   123    48    41    90    26
 NOR     6    15   112    71     0    43    86     0    46    73    62
 NZL    68    20   172    74    42     0   118    40    22   150    15
 USA   176    21   219   121    86   120     0    77    47   143    33
 ZAF    81     3    59    44     0    38    72     0     3    46     3
 NLD     6    17    58    40    46    22    45     3     0    38    14
 AUS    78    44   206    88    62   150   145    48    36     0    21
 IRL     4     5    15    25    61    15    33     3    14    20     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   181    77     7    68   174    77     6    76     4
 DEU    12     0    67    15    16    20    23     3    17    46     5
 DFS   188    56     0   122   150   176   220    62    61   229    20
 GBR    77    14   118     0    68    77   123    48    41    90    26
 NOR     6    15   123    72     0    44    86     0    48    77    62
 NZL    68    20   172    74    43     0   118    40    22   150    15
 USA   176    21   219   121    86   120     0    77    47   143    33
 ZAF    81     3    59    44     0    38    72     0     3    46     3
 NLD     6    17    58    40    48    22    45     3     0    38    14
 AUS    78    44   206    88    66   150   145    48    36     0    21
 IRL     4     5    15    25    61    15    33     3    14    20     0
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SIM
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