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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 and the United States of America were computed. Brown Swiss, Guernsey, Holstein, Jersey, Red
Dairy Cattle and Simmental breed data were included in this evaluation.

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

T1 (HC): Maiden (H)eifer's ability to (C)onceive. A measure of confirmed
         conception, such as conception rate (CR), will be considered for this
         trait group. In the absence of confirmed conception an alternative
         measure, such as interval first-last insemination (FL), interval first
         insemination-conception (FC), number of inseminations (NI), or
         non-return rate (NR,preferably NR56) can be submitted;
T2 (CR): Lactating (C)ow's ability to (R)ecycle after calving. The interval
         calving-first insemination (CF) is an example for this ability. In the
         abscence of such a trait, a measure of the interval calving-conception,
         such as says oprn (DO) or calving interval (CI) can be submitted;
T3 (C1): Lactating (C)ow's ability to conceive (1), expressed as a rate trait.
         Traits like conception rate (CR) and non-return rate (NR, preferably
         NR56) will be considered for this trait group;
T4 (C2): Lactating (C)ow's ability to conceive (2), expressed as an interval
         trait. The interval first insemination-conception (FC) or interval
         first-last insemination (FL) will be considered for this trait group.
         As an alternative, number of inseminations (NI) can be submitted.
         In the abscence 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
         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)
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AUT/DEU   T1=HC   NR=Heifers' Non Return Rate after 56 days
          T2=CY   CF=Interval from calving to first insemination cows (days)
          T3=C1   NR=Cows' Non Return Rate after 56 days
          T4=C2   FL=Interval from first to last insemination cows (days)
          T5=IT   DO=Days open (days)

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

ESP       T2=CY   DO=Days open
          T4=C2   DO=Days open
          T5=IT   DO=Days open

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

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       T2=CY   CF=Days to first service
          T3=C1   NR=Non-return rate at 56 days (%)
          T4=C2   CI=Calving Interval (days)
          T5=IT   CI=Calving interval (days)

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

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

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

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

POL       T1=HC        Non return rate at 56 days for heifer
         T2=CR  Interval from calving to first insemination
          T3=C1        Non return rate at 56 days for cows
          T4=IT        Days open
          T5=IT        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)
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         T4=C2   DP=Daughter Pregnancy Rate
         T5=IT   DP=Daughter Pregnancy Rate

ZAF     T4=IT   CI=Calving Interval
        T5=IT   CI=Calving Interval
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CHANGES IN NATIONAL PROCEDURES

Changes in the national genetic evaluation of female fertility traits are as follows:

BEL HOL   Changed the "national standards" for official publication

FRA HOL   First participation with int

FRA ALL   Base change

DEU HOL/RDC   Changes in data editing

DEA BSW   Base change

ITA HOL   Base change + cut-off of one year of data

ITA BSW   Base change

AUS ALL   Changes in publication rules resulting in many bulls changing status to N
              Pedigree changes + data editing

NZL ALL   Continuous parentage testing

CAN ALL   Base change

USA RDC   Corrected a bug in the Pedigree system

CZE HOL   cut off of half a year of data

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

Subsetting:

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:

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

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

DATA AND METHOD OF ANALYSIS

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

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

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

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

SCIENTIFIC LITERATURE

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

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

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

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

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

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

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

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

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

NEXT ROUTINE INTERNATIONAL EVALUATION

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

NEXT TEST INTERNATIONAL EVALUATION

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

PUBLICATION OF INTERBULL TEST RUN

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

Number of records for lactating cow's ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		122	7694	1562	657	
BEL			1704			
CAN	132	40	8511	470	503	
CHE	2638		3080			
CZE			3681			
DEA	5293					
DEU			25200		343	
DFS			15322	2300	9541	
ESP			4746			
EST						
FRA	360		15812			
FRM						
GBR	84	216	6283	519	369	
HUN						
IRL			2653	167	58	
ISR			1317			
ITA	1698		8830			
JPN						
KOR						
LTU						
LVA						
NLD	169		14652	129	67	
NOR					3877	
NZL	52	58	7336	4497	1291	
POL			6752			
PRT						
SVK						
SVN						
URY			1357			
USA	1051	740	36362	4357	679	
ZAF			1213	671	143	
HRV						
MEX						
CAM						
No.Records	11477	1176	172505	14672	17528	
Pub. Proofs	10612	973	142738	12424	16365	0

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

BSW   hco

	CAN	DEA	FRA	USA	CHE	NLD
CAN	9.06					
DEA	0.87	9.74				
FRA	0.81	0.83	0.91			
USA	0.80	0.84	0.90	2.70		
CHE	0.93	0.94	0.88	0.88	13.09	
NLD	0.79	0.72	0.87	0.88	0.88	3.62

BSW   crc

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	7.14								
CHE	0.85	11.25							
DEA	0.85	0.94	14.18						
NLD	0.87	0.88	0.85	3.48					
NZL	0.62	0.66	0.76	0.64	10.97				
USA	0.85	0.85	0.85	0.85	0.62	3.38			
GBR	0.75	0.76	0.75	0.80	0.65	0.83	3.87		
FRA	0.86	0.96	0.93	0.91	0.65	0.86	0.79	1.78	

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ITA       0.85    0.85    0.84    0.86    0.69    0.85    0.80    0.87   18.69
---------------------------------------------------------------------------------
BSW    cc1
---------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     USA     GBR     FRA
CAN       7.47
CHE       0.78   11.86
DEA       0.79    0.96   10.98
NLD       0.73    0.69    0.67    3.61
USA       0.74    0.67    0.67    0.91    2.83
GBR       0.73    0.82    0.79    0.68    0.67    0.04
FRA       0.71    0.69    0.67    0.89    0.92    0.68    0.96
---------------------------------------------------------------------------------
BSW    cc2
---------------------------------------------------------------------------------
          CAN     CHE     DEA     NLD     NZL     USA     GBR     FRA     ITA
CAN       6.34
CHE       0.73   11.06
DEA       0.83    0.92   11.70
NLD       0.88    0.85    0.85    3.32
NZL       0.64    0.54    0.65    0.64    7.11
USA       0.85    0.83    0.85    0.88    0.65    2.39
GBR       0.82    0.78    0.85    0.83    0.69    0.85    3.87
FRA       0.84    0.87    0.87    0.83    0.64    0.85    0.83    0.96
ITA       0.85    0.70    0.85    0.85    0.65    0.88    0.86    0.85   23.83
---------------------------------------------------------------------------------
BSW    int
---------------------------------------------------------------------------------
          CAN     DEA     NLD     NZL     USA     GBR     ITA
CAN       6.89
DEA       0.88   13.53
NLD       0.89    0.87    3.20
NZL       0.59    0.67    0.65    6.99
USA       0.90    0.87    0.87    0.57    2.39
GBR       0.87    0.88    0.90    0.66    0.87    3.87
ITA       0.88    0.93    0.88    0.65    0.89    0.88   17.92
---------------------------------------------------------------------------------
GUE    crc
---------------------------------------------------------------------------------
          CAN     GBR     NZL     USA     AUS
CAN       7.40
GBR       0.75    4.92
NZL       0.61    0.65   11.79
USA       0.84    0.86    0.62    3.46
AUS       0.73    0.87    0.70    0.74    6.96
---------------------------------------------------------------------------------
GUE    cc1
---------------------------------------------------------------------------------
          CAN     GBR     USA
CAN       7.04
GBR       0.72    0.03
USA       0.80    0.74    3.41
---------------------------------------------------------------------------------
GUE    cc2
---------------------------------------------------------------------------------
          CAN     GBR     NZL     USA     AUS
CAN       6.80
GBR       0.84    4.92
NZL       0.64    0.70    7.69
USA       0.85    0.85    0.65    2.68
AUS       0.71    0.72    0.75    0.79    6.88


---------------------------------------------------------------------------------
GUE    int
---------------------------------------------------------------------------------
          CAN     GBR     NZL     USA     AUS
CAN       7.44
GBR       0.87    4.92
NZL       0.59    0.65    7.69
USA       0.91    0.87    0.61    2.68
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AUS        0.87    0.87    0.73    0.87    6.88


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HOL    hco
--------------------------------------------------------------------------------
           CAN     CZE     DEU     DFS     FRA     USA     POL     CHE     NLD
CAN        7.82
CZE        0.78   17.61
DEU        0.93    0.80   15.12
DFS        0.82    0.85    0.88   13.68
FRA        0.82    0.87    0.82    0.87    0.84
USA        0.84    0.88    0.87    0.89    0.91    2.39
POL        0.79    0.67    0.78    0.78    0.67    0.68   19.18
CHE        0.96    0.87    0.93    0.84    0.87    0.88    0.70   13.84
NLD        0.81    0.87    0.78    0.83    0.87    0.88    0.68    0.86    4.12


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HOL    crc
--------------------------------------------------------------------------------
           BEL     CAN     CHE     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA
POL        FRA     AUS
BEL        4.71
CAN        0.72    6.80
CHE        0.79    0.84   12.37
DEU        0.72    0.85    0.89   11.20
DFS        0.80    0.89    0.95    0.90   12.03
ESP        0.87    0.80    0.84    0.80    0.83   11.22
GBR        0.88    0.74    0.77    0.74    0.81    0.89    4.68
IRL        0.86    0.72    0.72    0.71    0.72    0.87    0.87    3.48
ITA        0.79    0.85    0.89    0.88    0.91    0.86    0.83    0.72    7.79
NLD        0.81    0.87    0.92    0.91    0.96    0.82    0.81    0.72    0.88    4.57
NZL        0.65    0.60    0.62    0.59    0.62    0.63    0.64    0.61    0.70    0.60    8.52
USA        0.82    0.84    0.84    0.84    0.84    0.83    0.87    0.77    0.84    0.84    0.60    3.25
POL        0.75    0.89    0.89    0.87    0.89    0.80    0.74    0.71    0.91    0.87    0.62    0.84
14.16
FRA        0.75    0.86    0.94    0.92    0.94    0.85    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    0.87    0.86    0.88    0.72    0.72    0.61    0.72
0.71    0.72    4.94


--------------------------------------------------------------------------------
HOL    cc1
--------------------------------------------------------------------------------
           CAN     CHE     CZE     DEU     DFS     FRA     GBR     ISR     ITA     NLD     USA     POL
CAN        6.85
CHE        0.92   10.99
CZE        0.83    0.75   15.88
DEU        0.90    0.94    0.75   14.40
DFS        0.73    0.72    0.88    0.72   13.20
FRA        0.73    0.74    0.89    0.68    0.85    1.01
GBR        0.73    0.77    0.70    0.77    0.70    0.68    0.03
ISR        0.78    0.71    0.91    0.71    0.84    0.86    0.75    3.16
ITA        0.85    0.88    0.71    0.94    0.70    0.65    0.76    0.73    0.05
NLD        0.74    0.71    0.89    0.68    0.93    0.91    0.68    0.88    0.66    4.49
USA        0.78    0.70    0.95    0.70    0.86    0.89    0.66    0.91    0.71    0.91    2.78
POL        0.80    0.81    0.65    0.85    0.70    0.64    0.70    0.66    0.87    0.65    0.66   17.21


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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
BEL     4.71
CAN     0.83    6.09
CHE     0.79    0.86   11.16
CZE     0.65    0.84    0.87   15.89
DEU     0.82    0.92    0.90    0.88   12.96
DFS     0.83    0.85    0.86    0.81    0.93   13.22
ESP     0.85    0.86    0.81    0.77    0.87    0.84   11.21
FRA     0.83    0.86    0.91    0.79    0.88    0.84    0.86    0.99
GBR     0.89    0.84    0.72    0.64    0.82    0.83    0.87    0.81    4.68
IRL     0.84    0.83    0.80    0.66    0.82    0.82    0.84    0.82    0.85    3.48
ISR     0.52    0.62    0.65    0.80    0.73    0.68    0.62    0.65    0.55    0.61    3.15
ITA     0.84    0.86    0.81    0.81    0.88    0.85    0.92    0.83    0.86    0.84    0.70   17.68
NLD     0.83    0.91    0.89    0.84    0.93    0.91    0.85    0.85    0.83    0.83    0.70    0.86
4.49
NZL     0.73    0.64    0.52    0.48    0.62    0.62    0.67    0.61    0.70    0.73    0.46    0.65
0.62    5.41
USA     0.84    0.85    0.84    0.86    0.89    0.88    0.87    0.85    0.84    0.84    0.73    0.93
0.88    0.65    2.31
POL     0.83    0.82    0.68    0.62    0.79    0.79    0.85    0.76    0.84    0.81    0.49    0.87
0.80    0.62    0.83   13.09
ZAF     0.75    0.77    0.79    0.71    0.82    0.78    0.83    0.79    0.80    0.87    0.60    0.87
0.80    0.70    0.87    0.75   16.02
AUS     0.77    0.72    0.79    0.67    0.72    0.70    0.77    0.79    0.74    0.88    0.58    0.77
0.71    0.70    0.78    0.66    0.84    5.09
URY     0.84    0.81    0.68    0.59    0.80    0.81    0.83    0.81    0.85    0.84    0.50    0.82
0.81    0.75    0.83    0.86    0.79    0.72    1.45


--------------------------------------------------------------------------------
HOL     int
--------------------------------------------------------------------------------
        BEL     CAN     DEU     DFS     ESP     GBR     IRL     ITA     NLD     NZL     USA     POL
ZAF     AUS     URY     FRA
BEL     4.70
CAN     0.87    6.49
DEU     0.86    0.88   12.20
DFS     0.89    0.90    0.93   13.13
ESP     0.88    0.88    0.87    0.87   11.21
GBR     0.88    0.87    0.87    0.90    0.89    4.68
IRL     0.87    0.87    0.86    0.86    0.87    0.87    3.48
ITA     0.87    0.89    0.90    0.89    0.95    0.88    0.87   17.68
NLD     0.91    0.90    0.92    0.94    0.87    0.90    0.87    0.88    4.41
NZL     0.71    0.58    0.59    0.59    0.64    0.69    0.70    0.67    0.62    5.41
USA     0.87    0.92    0.88    0.88    0.88    0.87    0.87    0.91    0.87    0.60    2.31
POL     0.86    0.86    0.86    0.86    0.86    0.86    0.86    0.89    0.86    0.66    0.87   13.09
ZAF     0.87    0.87    0.87    0.87    0.87    0.87    0.87    0.91    0.87    0.67    0.87    0.85
16.02
AUS     0.87    0.87    0.86    0.87    0.87    0.86    0.88    0.86    0.86    0.69    0.87    0.86
0.87    5.09
URY     0.87    0.86    0.86    0.86    0.85    0.87    0.87    0.87    0.87    0.72    0.87    0.87
0.86    0.86    1.45
FRA     0.74    0.81    0.76    0.76    0.84    0.69    0.74    0.75    0.73    0.44    0.78    0.65
0.75    0.80    0.58    0.99


--------------------------------------------------------------------------------
JER     hco
--------------------------------------------------------------------------------
        CAN     DFS     USA     NLD
CAN     7.93
DFS     0.82   17.37
USA     0.85    0.87    2.68
NLD     0.79    0.81    0.88    4.32


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JER     crc
--------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     AUS     IRL
CAN       6.72
DFS       0.87    14.03
GBR       0.73    0.86    4.12
NLD       0.87    0.91    0.78    3.86
NZL       0.61    0.66    0.67    0.61    6.84
USA       0.84    0.84    0.84    0.85    0.63    3.86
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    1.88


--------------------------------------------------------------------------------
JER     cc1
--------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     USA
CAN       6.68
DFS       0.73    15.49
GBR       0.73    0.71    0.03
NLD       0.73    0.89    0.67    3.48
USA       0.75    0.87    0.67    0.91    2.92


--------------------------------------------------------------------------------
JER     cc2
--------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN       6.60
DFS       0.85    16.11
GBR       0.85    0.84    4.12
NLD       0.90    0.89    0.83    3.64
NZL       0.65    0.64    0.72    0.64    4.37
USA       0.85    0.87    0.85    0.87    0.67    2.63
ZAF       0.71    0.73    0.77    0.79    0.72    0.86    11.05
AUS       0.67    0.72    0.70    0.70    0.70    0.69    0.77    3.68
IRL       0.84    0.84    0.85    0.84    0.68    0.85    0.74    0.77    1.88


--------------------------------------------------------------------------------
JER     int
--------------------------------------------------------------------------------
          CAN     DFS     GBR     NLD     NZL     USA     ZAF     AUS     IRL
CAN       6.39
DFS       0.88    15.87
GBR       0.87    0.88    4.12
NLD       0.89    0.91    0.89    3.63
NZL       0.62    0.65    0.72    0.61    4.37
USA       0.89    0.87    0.87    0.87    0.65    2.63
ZAF       0.87    0.87    0.87    0.87    0.70    0.87    11.05
AUS       0.87    0.87    0.87    0.87    0.66    0.87    0.87    3.68
IRL       0.86    0.86    0.86    0.87    0.47    0.86    0.86    0.87    1.88


--------------------------------------------------------------------------------
RDC     hco
--------------------------------------------------------------------------------
          CAN     DEU     DFS     NOR     USA     NLD
CAN       7.16
DEU       0.91    14.34
DFS       0.84    0.83    12.34
NOR       0.86    0.83    0.80    15.60
USA       0.86    0.85    0.90    0.75    2.49
NLD       0.81    0.78    0.81    0.72    0.88    4.62


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

```
RDC     crc
--------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NZL     USA     NLD     AUS     IRL
CAN      6.29
DEU      0.85   10.11
DFS      0.87    0.90   12.91
GBR      0.75    0.75    0.77    4.37
NOR      0.90    0.87    0.90    0.75   14.95
NZL      0.61    0.62    0.61    0.65    0.64   10.54
USA      0.84    0.84    0.84    0.82    0.85    0.70    3.49
NLD      0.87    0.91    0.92    0.80    0.86    0.61    0.85    3.12
AUS      0.73    0.73    0.73    0.87    0.75    0.68    0.74    0.73    4.70
IRL      0.73    0.73    0.74    0.87    0.74    0.63    0.77    0.73    0.88    2.63


--------------------------------------------------------------------------------
RDC     cc1
--------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NLD     USA
CAN      6.84
DEU      0.89   13.14
DFS      0.77    0.74   12.99
GBR      0.73    0.78    0.78    0.03
NOR      0.84    0.78    0.76    0.74   14.80
NLD      0.74    0.70    0.86    0.69    0.70    4.18
USA      0.82    0.71    0.83    0.67    0.70    0.91    2.60


--------------------------------------------------------------------------------
RDC     cc2
--------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.72
DEU      0.91   10.58
DFS      0.85    0.93   13.04
GBR      0.85    0.83    0.85    4.35
NOR      0.89    0.87    0.85    0.86   15.78
NZL      0.65    0.64    0.65    0.68    0.66    6.80
USA      0.87    0.89    0.86    0.85    0.86    0.70    2.38
ZAF      0.70    0.81    0.75    0.72    0.70    0.72    0.85   17.96
NLD      0.91    0.93    0.89    0.84    0.86    0.64    0.88    0.79    3.87
AUS      0.69    0.71    0.67    0.70    0.66    0.70    0.72    0.77    0.71    4.59
IRL      0.84    0.84    0.85    0.85    0.86    0.72    0.85    0.85    0.84    0.83    2.63


--------------------------------------------------------------------------------
RDC     int
--------------------------------------------------------------------------------
         CAN     DEU     DFS     GBR     NOR     NZL     USA     ZAF     NLD     AUS     IRL
CAN      6.70
DEU      0.88   10.64
DFS      0.88    0.94   13.34
GBR      0.87    0.87    0.89    4.35
NOR      0.89    0.89    0.87    0.88   15.78
NZL      0.65    0.58    0.59    0.67    0.54    6.80
USA      0.90    0.89    0.87    0.87    0.88    0.69    2.38
ZAF      0.88    0.87    0.88    0.88    0.90    0.68    0.89   17.96
NLD      0.90    0.92    0.92    0.90    0.89    0.61    0.87    0.87    3.31
AUS      0.87    0.87    0.87    0.87    0.88    0.68    0.87    0.88    0.87    4.59
IRL      0.87    0.87    0.87    0.87    0.88    0.66    0.87    0.88    0.87    0.88    2.63


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

```
^LAPPENDIX II. Number of common bulls
----------------------------------------------------------------------------------------------------
---------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DEA  FRA  USA  CHE  NLD
 --------------------------------------------------------------------------
   CAN    0   77   45   85   79   27
   DEA   62    0  183  157  536  118
   FRA   39  134    0   67  147   68
   USA   73  115   51    0  181   41
   CHE   63  442  111  150    0   76
   NLD   24  110   56   37   71    0
 --------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 --------------------------------------------------------------------------
   CAN    0  100   92   33   18  117   43   64   90
   CHE   78    0  515   84   25  242   53  148  378
   DEA   73  413    0  129   32  197   53  184  511
   NLD   29   76  118    0   23   46   33   72  105
   NZL   16   20   25   17    0   19   16   20   26
   USA  105  212  150   41   16    0   52   87  150
   GBR   37   39   37   26   13   49    0   43   58
   FRA   53  111  136   58   16   60   33    0  160
   ITA   72  316  392   83   19  104   40  124    0
 --------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  USA  GBR  FRA
 --------------------------------------------------------------------------
   CAN    0  100   93   33  118   44   67
   CHE   78    0  510   84  243   56  154
   DEA   74  407    0  128  198   57  193
   NLD   29   76  118    0   46   34   77
   USA  106  212  150   41    0   55   91
   GBR   38   41   39   26   51    0   47
   FRA   56  117  147   64   65   38    0
 --------------------------------------------------------------------------
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 --------------------------------------------------------------------------
   CAN    0   83   76   30   15  101   38   58   76
   CHE   64    0  505   84   25  300   53  154  378
   DEA   60  405    0  128   32  296   52  191  501
   NLD   26   76  118    0   23   69   33   77  105
   NZL   13   20   25   17    0   28   16   21   26
   USA   88  281  258   57   24    0   63  112  200
   GBR   33   39   37   26   13   59    0   45   58
   FRA   50  117  147   64   17   79   36    0  171
   ITA   63  316  386   83   19  137   40  135    0
 --------------------------------------------------------------------------
```

```
BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DEA  NLD  NZL  USA  GBR  ITA
 -----------------------------------------------------------------------------
   CAN    0   80   33   16  106   41   81
   DEA   63    0  130   32  295   52  613
   NLD   30  120    0   23   70   33  111
   NZL   14   25   17    0   28   16   26
   USA   93  258   60   24    0   63  218
   GBR   35   37   26   13   59    0   59
   ITA   67  516   91   19  152   40    0
 -----------------------------------------------------------------------------
GUE
--------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  NZL  USA  AUS
 -----------------------------------------------------------------------------
   CAN    0   13    3   33   18
   GBR   10    0   13   44   28
   NZL    2   11    0    9   26
   USA   32   41    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   13   33
   GBR   10    0   48
   USA   32   45    0
 -----------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  NZL  USA  AUS
 -----------------------------------------------------------------------------
   CAN    0   10    2   31   19
   GBR    7    0   13   75   30
   NZL    2   11    0   29   26
   USA   29   76   28    0   55
   AUS   15   24   25   52    0
 -----------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  NZL  USA  AUS
 -----------------------------------------------------------------------------
   CAN    0   10    2   31   19
   GBR    7    0   13   75   30
   NZL    2   11    0   29   26
   USA   29   76   28    0   55
   AUS   15   24   25   52    0
 -----------------------------------------------------------------------------
```

```
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  CZE  DEU  DFS  FRA  USA  POL  CHE  NLD
 -----------------------------------------------------------------------------
  CAN    0  865 1698  957 1065 2155  835  683 1014
  CZE  599    0 1530  989 1058 1156  837  424 1203
  DEU 1024 1047    0 2274 2192 2192 1394  970 2627
  DFS  814  586 1324    0 1436 1213  910  595 1713
  FRA  748  607 1093  735    0 1418 1055  589 1686
  USA 2323  863 1280  962  774    0 1189  706 1405
  POL  649  588  995  638  600 1114    0  370 1021
  CHE  571  280  799  521  529  626  271    0  759
  NLD  927  998 1978 1344 1013 1120  797  730    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  608  519 1030  687  742  730  450  692 1046  441  642  392  804  529
  CAN  595    0  704 1875 1037 1197 1255  456 1438 1139  590 2265  783 1155  767
  CHE  515  596    0  995  598  593  616  363  627  775  360  740  343  596  415
  DEU 1028 1227  840    0 2348 1866 1880  812 2293 2928  881 2485 1298 2349 1202
  DFS  615  873  522 1386    0 1195 1332  669 1353 1715  736 1332  840 1447  893
  ESP  791  938  546 1578  960    0 1215  625 1380 1354  631 1367  781 1343  799
  GBR  700 1265  566 1278  928 1085    0  860 1398 1544  840 1532  688 1406  993
  IRL  443  447  367  702  546  640  891    0  606  815  667  539  292  686  571
  ITA  641 1079  553 1335  919 1147  987  519    0 1526  694 1971  902 1610  848
  NLD 1174 1068  747 2428 1381 1359 1274  762 1151    0  938 1618  939 1788 1059
  NZL  360  543  305  652  504  517  713  577  499  845    0  683  330  749  955
  USA  592 2462  663 1537 1014 1064 1363  516 1277 1327  605    0 1110 1596  875
  POL  306  579  248  864  553  547  424  211  551  684  226  930    0  974  361
  FRA  782  818  526 1147  725 1228  855  551  808 1043  432  859  521    0  948
  AUS  409  628  338  712  494  588  753  454  520  812  906  700  165  545    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
 -----------------------------------------------------------------------------
  CAN    0  703  922 1811 1040 1148 1307   81 1447 1146 2305  813
  CHE  595    0  428  968  598  603  617   46  627  775  740  368
  CZE  646  284    0 1539  983 1069  887   82 1089 1226 1247  828
  DEU 1095  795 1049    0 2312 2314 1887  119 2230 2817 2387 1352
  DFS  875  522  591 1308    0 1454 1348  113 1353 1714 1335  889
  FRA  834  534  607 1116  737    0 1436  104 1609 1793 1590 1009
  GBR 1339  567  519 1208  942  878    0  103 1439 1580 1603  726
  ISR   61   31   64   98   91   59   72    0  105  117  100   63
  ITA 1088  553  688 1251  919  825 1013   78    0 1527 1969  946
  NLD 1075  747 1022 2214 1380 1063 1314   99 1150    0 1619 1004
  USA 2514  663  905 1385 1014  868 1455   90 1277 1327    0 1153
  POL  614  273  570  937  613  556  457   45  591  764  985    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
 ------------------------------------------------------------------------------
  BEL    0  597  519  501 1007  688  742  796  730  451   59  689 1046  441  798  386  303  636  268
  CAN  582    0  693  903 1766 1017 1184 1098 1228  444   78 1375 1106  572 2437  754  407 1030  542
  CHE  515  580    0  429  968  599  593  590  616  363   46  624  776  360  864  333  249  529  241
  CZE  375  614  284    0 1541  984  896 1061  865  412   82 1079 1228  494 1394  775  299  695  370
  DEU  985 1055  793 1048    0 2305 1839 2283 1843  797  121 2195 2816  863 3136 1230  531 1444  570
  DFS  615  844  523  591 1308    0 1202 1441 1334  669  114 1345 1720  738 1729  818  474 1085  475
  ESP  791  911  546  676 1519  966    0 1345 1217  626  101 1383 1359  633 1691  767  480  967  498
  FRA  767  766  520  594 1069  709 1216    0 1394  687  106 1583 1765  748 2280  950  448 1141  468
  GBR  700 1232  566  513 1198  929 1085  839    0  860  103 1387 1546  841 1914  674  467 1209  513
  IRL  443  428  367  283  675  546  640  546  891    0   76  605  816  667  707  285  315  657  296
  ISR   38   57   31   64   98   91   81   57   69   61    0  104  118   86  125   60   51   80   54
  ITA  635 1013  549  675 1223  904 1146  784  972  517   76    0 1504  690 2265  871  458 1058  532
  NLD 1174 1020  747 1022 2200 1383 1362 1016 1275  762   99 1118    0  941 2188  910  470 1289  496
  NZL  360  521  305  319  625  505  519  426  713  577   72  494  847    0  980  320  338 1091  394
  USA  678 2569  767  977 1729 1149 1333 1136 1610  621  109 1372 1757  914    0 1121  595 1645  842
  POL  296  543  237  505  782  535  532  493  410  202   39  528  651  218  908    0  190  516  297
  ZAF  248  368  202  187  386  341  433  304  401  275   34  348  383  269  557  116    0  441  272
  AUS  536  969  464  406  935  711  755  737  999  560   54  711 1068 1076 1538  311  374    0  492
  URY  195  500  171  235  369  309  427  269  399  224   28  361  372  298 1034  213  224  364    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
 ------------------------------------------------------------------------------
  BEL    0  600 1026  688  742  730  451  688 1047  441  798  386  303  636  268  796
  CAN  587    0 1834 1022 1190 1236  450 1384 1121  578 2449  757  409 1037  547 1106
  DEU 1023 1190    0 2339 1873 1880  813 2248 2934  884 3236 1259  536 1489  589 2318
  DFS  615  854 1378    0 1201 1333  669 1344 1721  738 1727  818  473 1085  475 1440
  ESP  791  926 1577  966    0 1217  626 1383 1361  633 1689  767  479  966  498 1344
  GBR  700 1245 1277  929 1085    0  860 1387 1552  841 1914  674  466 1209  513 1394
  IRL  443  436  703  546  640  891    0  605  820  667  707  285  315  657  296  687
  ITA  635 1026 1301  904 1146  972  517    0 1507  690 2265  870  458 1058  532 1583
  NLD 1179 1041 2421 1390 1371 1281  766 1123    0  941 2195  912  470 1291  498 1768
  NZL  360  526  652  505  519  713  577  494  848    0  980  320  337 1091  394  748
  USA  678 2596 1907 1149 1333 1610  621 1372 1764  914    0 1120  594 1645  842 2280
  POL  296  548  822  535  532  410  202  528  652  218  908    0  190  516  297  950
  ZAF  248  374  395  341  433  401  275  348  384  269  557  116    0  440  272  448
  AUS  536  974  996  711  755  999  560  711 1074 1076 1538  311  374    0  492 1141
  URY  195  506  397  309  427  399  224  361  375  298 1034  213  224  364    0  468
  FRA  767  775 1111  709 1216  839  546  784 1022  426 1136  493  304  737  269    0
 ------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  USA  NLD
 ------------------------------------------------------------------------------
  CAN    0   51  240   21
  DFS   39    0   89   54
  USA  224   68    0   44
  NLD   15   51   44    0
 ------------------------------------------------------------------------------
```

```
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  AUS  IRL
 ----------------------------------------------------------------------------
  CAN    0   56  115   26  132  276  119   10
  DFS   41    0  122   76  114  104   93   35
  GBR  115  111    0   65  178  167  142   54
  NLD   20   69   61    0   61   57   47   26
  NZL  134   86  185   53    0  230  325  103
  USA  270   83  180   59  255    0  233   35
  AUS  119   57  150   42  357  237    0   34
  IRL    8   29   56   26  115   37   31    0
 ----------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  USA
 ----------------------------------------------------------------------------
  CAN    0   56  116   26  285
  DFS   41    0  123   76  103
  GBR  115  112    0   65  168
  NLD   20   69   62    0   56
  USA  283   83  181   59    0
 ----------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL
 ----------------------------------------------------------------------------
  CAN    0   55  113   26  129  288  112  179   10
  DFS   40    0  122   76  114  149  112  109   35
  GBR  110  111    0   65  179  196  144  173   54
  NLD   19   69   61    0   62   70   63   58   26
  NZL  128   86  185   54    0  330  182  393  103
  USA  278  115  215   74  403    0  270  438   42
  ZAF  108   88  148   58  193  277    0  209   33
  AUS  167   72  182   50  426  468  196    0   50
  IRL    8   29   56   26  115   44   34   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   56  114   26  131  291  114  181   10
  DFS   41    0  122   80  114  149  112  109   35
  GBR  112  111    0   69  179  196  144  173   54
  NLD   21   74   65    0   65   75   66   60   27
  NZL  132   86  185   58    0  330  182  393  103
  USA  284  115  215   80  403    0  270  438   42
  ZAF  111   88  148   62  193  277    0  209   33
  AUS  171   72  182   52  426  468  196    0   50
  IRL    8   29   56   26  115   44   34   47    0
 ----------------------------------------------------------------------------
```

```
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DEU  DFS  NOR  USA  NLD
 -------------------------------------------------------------------------------
  CAN    0   10  123    5   83    4
  DEU    9    0   44   13   14   11
  DFS  123   34    0  124  124   40
  NOR    5   13   95    0   54   27
  USA   78   14  116   55    0   27
  NLD    4   11   38   26   25    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   11  120   62    5   58  116    5   54    3
  DEU   10    0   48   12   14   13   15   11   20    5
  DFS  121   38    0   89  110  155  139   42  137   15
  GBR   63   11   85    0   40   62   77   26   48   17
  NOR    5   14   80   42    0   40   62   29   34   48
  NZL   59   13  150   59   38    0   78   15  101    9
  USA  112   15  130   74   62   79    0   28   55   22
  NLD    5   11   41   25   28   15   26    0   12    8
  AUS   53   19  117   45   29  103   53   10    0    8
  IRL    3    5   10   16   47    9   22    7    7    0
 -------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DEU  DFS  GBR  NOR  NLD  USA
 -------------------------------------------------------------------------------
  CAN    0   11  120   64    5    5  116
  DEU   10    0   47   12   14   11   15
  DFS  121   37    0   91  113   42  137
  GBR   65   11   86    0   42   26   79
  NOR    5   14   83   44    0   29   61
  NLD    5   11   41   25   28    0   28
  USA  112   15  129   75   61   26    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   10  117   58    5   56  139   67    5   61    3
  DEU    9    0   48   12   13   13   16    1   11   34    5
  DFS  118   38    0   89  107  155  155   52   42  175   15
  GBR   59   11   85    0   40   63   88   38   26   66   17
  NOR    5   13   76   42    0   40   64    0   28   54   48
  NZL   57   13  150   60   38    0  104   35   15  124    9
  USA  142   16  151   87   65  105    0   67   31  107   23
  ZAF   72    1   51   36    0   33   62    0    2   37    2
  NLD    5   11   41   25   27   15   29    2    0   23    8
  AUS   60   33  149   63   45  126  107   37   21    0   12
  IRL    3    5   10   16   47    9   23    2    7   11    0
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RDC
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 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DEU  DFS  GBR  NOR  NZL  USA  ZAF  NLD  AUS  IRL
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   CAN    0   11  117   59    5   56  139   67    6   61    3
   DEU   10    0   50   13   13   14   17    2   11   35    5
   DFS  118   40    0   89  107  155  156   52   42  175   15
   GBR   60   12   85    0   40   63   89   38   26   66   17
   NOR    5   13   76   42    0   40   65    0   30   54   48
   NZL   57   14  150   60   38    0  104   35   15  124    9
   USA  142   17  151   88   65  105    0   67   34  107   23
   ZAF   72    2   51   36    0   33   62    0    2   37    2
   NLD    6   11   41   25   29   15   31    2    0   23    8
   AUS   60   34  149   63   45  126  107   37   21    0   12
   IRL    3    5   10   16   47    9   23    2    7   11    0
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SIM
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SIM
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SIM
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SIM
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SIM
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