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Introduction
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The latest international evaluation for dairy production traits took place
as scheduled at the Interbull Centre. Data from thirty-four (34) countries were
included in this evaluation.

International genetic evaluations for milk, fat and protein yields of bulls from
Australia, Austria-Germany, Belgium, Canada, Croatia, Czech Republic, Denmark-Finland-Sweden, Estonia,
France, Hungary, Ireland, Israel, Italy, Japan, Latvia,Lithuania, Netherlands,
New Zealand, Norway, Poland, Republic of South Africa, Slovak Republic,
Slovenia, Spain, Switzerland, the United States of America
,Portugal,Korea,Uruguay and Mexico were computed. Brown Swiss, Guernsey, Holstein,
Jersey, Red Dairy Cattle and Simmental breed data were included in this evaluation.


Changes in national procedures
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Changes in the national genetic evaluation of production traits are as
follows:

NOR (RDC)        The rolling definition of hys is causing the daughters to distribute somewhat differently over hys-classes at each evaluation.
                 Therefore some bulls occasionally may loose EDC although the number of daughters stay the same.
DEU (ALL)        Base change. Performance data: phenotypic data from 2000 onwards (used to be 1990 before). Pedigree: sire and maternal grandsire of animals having own performance must be known
          Breed: breed of animal having own performance must be consistent with the breeds of parents
CHE (ALL)        Base change, Slight changes in number of daughters, number of herds and EDC are due to manual data edits in the database. BSW: few bulls missing in this evaluation due to change in status of bulls.
                 BSW, SIM, HOL: A numerical problem in the process of herd variance correction
                 for production traits was detected when moving computations to an updated Linux version using a different compiler.
                 While the ranking of bulls was not affected, generally inflated standard deviations of EBVs for production traits of previous evaluations were reduced in the new proofs for BSW, HOL and SIM.
          The change of herd-year-season assignment of certain data records might also explain small changes in EDC and reliabilities for certain bulls
LVA (HOL, RDC)  Due to changes in EU regulation and pedigree program in Latvia, there has been changes in animal selection for evaluation.
    Further animals born since 2017, January 1st, that has an unknown breed and are crosses will not participate in evaluation.
    This is the reason that some bulls will lose count of daughters and herds and will go from Y to N in publication. Fixed error detected after test run on convergence of data and on starting parameters used.
    Base change.
NZL (ALL)  Results based on brand new models which are based on the most recent version of LICâ s genetic evaluation software based on a multiple trait models.
                 The new multiple traits have caused a general drop in reliability. It contains a number of enhancements which result in more accurate genetic evaluations and reduces the time taken to compute genetic
    evaluations. Implementation of Parent Average Adjustment (PAA), changes to the daugher count for all traits. When the single trait models are combined  into a multi trait BV the single trait daughter count
    that was the greatest (which is always the 2 year old daughter count)was taken into account. The old routine for Fertility and longevity were based on having a record for that trait or a production record,
    this is now change so that it is a count of that particular trait.
NLD (ALL)        Base change, now the cows born in 2015 are the base (it was 2010)
AUS (ALL)  Changed the method for calculation of reliabilities, Pedigree corrections based on genotype information has caused drops in information
USA (ALL)  Base change pedigree corrections and herd-year minimum edits causing drops in information
SVN (ALL)  Until now the EBV were limited to the interval(52, 148). We used to reduce all EBV greater than 147 to not exceed 148.
                 We reduced all EBv smaller than 53 to be no less than 52. From now on, we no longer apply such restriction to EBVs.
POL (HOL)  Base change
PRT (HOL)  Recent update on the Pedigree file as well as routine corrections on the test-day records of the daughters causes drops in information
JPN (HOL)        Small decrease in information due to additional records and modification of pedigree.
BEL (HOL)        Some change in type of proof due to changes in pedigree information and the fact that the program that determines the type of proof for bulls is based on pedigree information
ISR (HOL)        Small decrease in information due to pedigree corrections.
ITA (HOL, JER)   Base change, for HOL cut off of 1 year of data causing decreases in information.
ITA (SIM)        Base change defined as average birth date of cows born within an interval of -7 and -5 years before evaluation.
ITA (BSW)        Base change applied a rolling base including a cow born between 15 an 12 year before the evaluation date.
ZAF (HOL)        Correction of an issue preventing to read properly the pev for fat, The correction caused a decrease in reliability for some bulls
EST (HOL, RDC)   Base change
LTU (HOL)        Base change
CAN (ALL)        Base change
FRA (ALL)        Base change
IRL (ALL)        Drop in information due to pedigree corrections
URY (HOL)        Base change
GBR (ALL)        Drops in daughters due to minor data editings. For RDC some daughters of these bulls were duplicated with some of them having eartag numbers and herd book numbers. Data providers have now correctly
                 eliminated the eartag numbers of these cows, so that only the herd-book numbers are now included. Base change

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

Window:

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.

The window so far applied for MAS evaluation have been found too high compared to the
within-country genetic correlation between mastitis and SCS available from the literature.
It has been an ITC recommendation to adjust the windows for MAS in this test run to make them more in line with the
values available from the literature. The recommendation has been approved by the Steering committee.
Also, according to the decision taken by ITC in Orlando (2015) to review all windows every five (5) years, an overall
review of the windows for all traits will take place during the first half of 2020 with the aim of implementation set for the September 2020 test run.

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 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 dairy production traits (April Routine Evaluation 2020).
Number of records for milk yield by breed

Country   BSW   GUE   HOL   JER   RDC   SIM

AUS   208   142   8339   1813   754
BEL   2077
CAN   246   102   12802   778   830
CHE   3012   3501   89   3325

CZE			4384			
DEA	6062					24570
DEU			22220	173	270	
DFS			13275	2172	7784	
ESP			3930			
EST			1192		451	
FRA	403		17319			477
FRM						4754
GBR	163	346	7424	909	640	94
HUN			3395			226
IRL			2799	161	59	85
ISR			1491			
ITA	2164		9327	171		1774
JPN			6112			
KOR			1461			
LTU			1213		437	
LVA			1228		692	
NLD	197		15771	180	84	419
NOR					4192	
NZL	58	60	8016	5027	1418	
POL			10803			
PRT			2437			
SVK			1123			
SVN	381		575			645
URY			1072			
USA	1127	792	39452	4831	729	68
ZAF			1306	720	143	
HRV			771			854
MEX			613			
CAM					44	

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No.Records   14021        1442      205428       17024        18527       37291
Pub. Proofs  11334        1149      152717       13744        16564       33846
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^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal
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BSW   mil

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	641.16										
FRA	0.89	630.87									
USA	0.92	0.89	636.56								
CHE	0.91	0.88	0.87	483.33							
ITA	0.88	0.83	0.88	0.86	602.25						
DEA	0.88	0.82	0.86	0.94	0.90	463.25					
NLD	0.88	0.87	0.87	0.85	0.86	0.87	658.30				
SVN	0.83	0.81	0.82	0.81	0.81	0.81	0.82	9.30			
NZL	0.70	0.75	0.70	0.74	0.70	0.73	0.71	0.74	355.37		
GBR	0.86	0.88	0.86	0.87	0.82	0.82	0.86	0.83	0.71	271.92	
AUS	0.74	0.76	0.72	0.72	0.70	0.70	0.74	0.72	0.82	0.73	404.50

BSW   fat

	CAN	FRA	USA	CHE	ITA	DEA	NLD	SVN	NZL	GBR	AUS
CAN	27.42										
FRA	0.89	26.87									
USA	0.90	0.89	23.52								
CHE	0.86	0.87	0.84	19.07							
ITA	0.89	0.83	0.86	0.86	22.96						
DEA	0.85	0.84	0.84	0.94	0.88	17.32					
NLD	0.87	0.85	0.86	0.84	0.85	0.86	26.03				
SVN	0.82	0.81	0.82	0.81	0.81	0.81	0.82	9.67			

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NZL      0.71    0.72    0.70    0.73    0.70    0.80    0.70    0.74   15.83
GBR      0.86    0.89    0.86    0.88    0.82    0.82    0.86    0.83    0.71   10.10
AUS      0.73    0.73    0.73    0.70    0.70    0.70    0.71    0.72    0.81    0.72   15.93


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BSW    pro
------------------------------------------------------------------------------
         CAN     FRA     USA     CHE     ITA     DEA     NLD     SVN     NZL     GBR     AUS
CAN     23.34
FRA      0.84   20.37
USA      0.89    0.86   18.78
CHE      0.84    0.83    0.83   15.27
ITA      0.85    0.82    0.83    0.84   21.15
DEA      0.85    0.81    0.82    0.92    0.88   14.43
NLD      0.85    0.83    0.84    0.83    0.83    0.84   21.67
SVN      0.82    0.81    0.82    0.81    0.81    0.81    0.82    9.18
NZL      0.70    0.70    0.69    0.71    0.70    0.72    0.69    0.74   11.63
GBR      0.84    0.85    0.83    0.84    0.81    0.82    0.85    0.82    0.70    7.75
AUS      0.71    0.70    0.69    0.70    0.69    0.70    0.69    0.72    0.81    0.70   12.36


------------------------------------------------------------------------------
GUE    mil
------------------------------------------------------------------------------
         CAN     USA     AUS     GBR     NZL
CAN    775.11
USA      0.94  773.74
AUS      0.80    0.76  490.55
GBR      0.87    0.83    0.75  242.44
NZL      0.71    0.70    0.84    0.71  301.48


------------------------------------------------------------------------------
GUE    fat
------------------------------------------------------------------------------
         CAN     USA     AUS     GBR     NZL
CAN     31.07
USA      0.93   27.74
AUS      0.78    0.76   17.62
GBR      0.86    0.84    0.74   10.17
NZL      0.72    0.72    0.82    0.70   14.79


------------------------------------------------------------------------------
GUE    pro
------------------------------------------------------------------------------
         CAN     USA     AUS     GBR     NZL
CAN     23.75
USA      0.91   21.24
AUS      0.71    0.69   13.89
GBR      0.85    0.82    0.71    7.24
NZL      0.70    0.69    0.81    0.69   10.05


------------------------------------------------------------------------------
HOL    mil
------------------------------------------------------------------------------
         CAN     DEU     DFS     FRA     ITA     NLD     USA     CHE     GBR     NZL     AUS     BEL     IRL     ESP     CZE     SVN     EST     ISR     HUN     POL     ZAF     JPN     LVA     SVK     LTU     PRT     KOR     URY     HRV     MEX
CAN    789.57
DEU      0.93  644.40
DFS      0.94    0.94   11.21
FRA      0.91    0.90    0.92  656.86
ITA      0.89    0.87    0.88    0.88  583.10
NLD      0.92    0.93    0.93    0.90    0.87  670.68
USA      0.93    0.92    0.90    0.91    0.90    0.89  713.94
CHE      0.89    0.91    0.90    0.93    0.88    0.91    0.88  580.34
GBR      0.86    0.84    0.85    0.86    0.82    0.86    0.84    0.89  275.26
NZL      0.68    0.68    0.69    0.74    0.68    0.70    0.69    0.75    0.69  343.84
AUS      0.77    0.75    0.72    0.78    0.71    0.75    0.75    0.78    0.74    0.82  427.07
BEL      0.85    0.87    0.82    0.83    0.80    0.82    0.81    0.81    0.80    0.69    0.77  495.16
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IRL   0.83  0.83  0.83  0.89  0.80  0.86  0.82  0.87  0.82  0.82  0.81  0.80  181.68
ESP   0.93  0.92  0.91  0.92  0.89  0.91  0.92  0.89  0.84  0.68  0.77  0.86  0.84  543.08
CZE   0.86  0.88  0.84  0.81  0.81  0.81  0.85  0.80  0.80  0.68  0.71  0.82  0.73  0.84  699.44
SVN   0.83  0.82  0.81  0.82  0.81  0.81  0.81  0.81  0.81  0.70  0.70  0.81  0.70  0.81  0.81  11.06
EST   0.89  0.87  0.90  0.86  0.84  0.85  0.89  0.86  0.81  0.71  0.76  0.81  0.76  0.86  0.85  0.82  542.14
ISR   0.83  0.83  0.84  0.83  0.84  0.83  0.85  0.84  0.82  0.63  0.67  0.83  0.69  0.84  0.83  0.84  0.84  386.77
HUN   0.86  0.85  0.86  0.87  0.89  0.85  0.90  0.85  0.82  0.68  0.68  0.80  0.79  0.86  0.82  0.81  0.84  0.84  664.07
POL   0.89  0.90  0.89  0.88  0.87  0.88  0.88  0.85  0.82  0.68  0.74  0.82  0.80  0.89  0.85  0.82  0.87  0.83  0.88  420.79
ZAF   0.84  0.80  0.81  0.83  0.80  0.80  0.83  0.81  0.80  0.69  0.78  0.80  0.77  0.83  0.80  0.81  0.82  0.84  0.80  0.80  531.70
JPN   0.94  0.91  0.93  0.91  0.89  0.91  0.93  0.89  0.83  0.69  0.76  0.84  0.82  0.91  0.84  0.83  0.87  0.87  0.85  0.90  0.83  629.23
LVA   0.80  0.80  0.81  0.81  0.80  0.80  0.80  0.81  0.81  0.69  0.69  0.81  0.71  0.80  0.80  0.81  0.81  0.83  0.81  0.80  0.81  0.81  487.11
SVK   0.80  0.81  0.82  0.81  0.81  0.80  0.80  0.81  0.81  0.69  0.69  0.81  0.73  0.81  0.80  0.82  0.82  0.85  0.83  0.82  0.81  0.82  0.81  384.22
LTU   0.81  0.80  0.81  0.81  0.81  0.81  0.80  0.82  0.81  0.70  0.70  0.81  0.71  0.81  0.81  0.82  0.82  0.84  0.81  0.80  0.82  0.81  0.81  0.82  368.85
PRT   0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.68  0.68  0.80  0.73  0.80  0.80  0.81  0.81  0.83  0.80  0.80  0.80  0.80  0.80  0.80  0.81  593.25
KOR   0.86  0.80  0.83  0.81  0.80  0.81  0.86  0.81  0.81  0.70  0.74  0.82  0.74  0.85  0.80  0.82  0.83  0.84  0.84  0.80  0.81  0.86  0.81  0.81  0.82  0.80  488.48
URY   0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.81  0.80  0.76  0.74  0.80  0.72  0.80  0.80  0.82  0.81  0.84  0.80  0.80  0.80  0.80  0.81  0.81  0.81  0.80  0.80  167.01
HRV   0.81  0.80  0.81  0.81  0.80  0.80  0.80  0.81  0.81  0.69  0.69  0.81  0.69  0.80  0.80  0.81  0.81  0.83  0.81  0.80  0.81  0.81  0.81  0.81  0.81  0.80  0.82  0.81  11.45
MEX   0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.81  0.80  0.69  0.69  0.80  0.69  0.80  0.80  0.82  0.82  0.84  0.80  0.80  0.80  0.80  0.81  0.81  0.82  0.80  0.80  0.80  0.81  380.36
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HOL   fat

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      CAN   DEU   DFS   FRA   ITA   NLD   USA   CHE   GBR   NZL   AUS   BEL   IRL   ESP   CZE   SVN   EST   ISR   HUN   POL   ZAF   JPN   LVA   SVK   LTU   PRT   KOR   URY   HRV   MEX
CAN  31.37
DEU   0.92  24.02
DFS   0.92  0.92  11.06
FRA   0.91  0.90  0.91  26.66
ITA   0.88  0.88  0.86  0.89  24.20
NLD   0.89  0.93  0.91  0.88  0.85  25.41
USA   0.93  0.93  0.89  0.91  0.91  0.88  26.47
CHE   0.87  0.89  0.89  0.90  0.84  0.89  0.85  23.18
GBR   0.86  0.87  0.87  0.89  0.83  0.87  0.86  0.89   9.55
NZL   0.68  0.68  0.69  0.70  0.68  0.68  0.69  0.72  0.69  12.86
AUS   0.74  0.72  0.71  0.76  0.70  0.70  0.76  0.71  0.72  0.80  14.96
BEL   0.84  0.87  0.81  0.84  0.80  0.82  0.82  0.80  0.80  0.69  0.75  20.21
IRL   0.81  0.80  0.83  0.84  0.74  0.82  0.79  0.82  0.80  0.81  0.80  0.82   6.94
ESP   0.91  0.91  0.87  0.91  0.90  0.88  0.93  0.85  0.85  0.68  0.75  0.82  0.79  21.77
CZE   0.84  0.87  0.84  0.81  0.81  0.80  0.85  0.80  0.80  0.68  0.68  0.80  0.69  0.84  22.09
SVN   0.81  0.80  0.81  0.81  0.81  0.81  0.81  0.81  0.81  0.70  0.69  0.81  0.70  0.81  0.81  10.87
EST   0.87  0.88  0.90  0.87  0.87  0.84  0.87  0.85  0.81  0.78  0.77  0.86  0.81  0.85  0.84  0.82  21.32
ISR   0.83  0.83  0.82  0.83  0.82  0.82  0.85  0.83  0.82  0.63  0.63  0.83  0.62  0.83  0.83  0.84  0.84  14.57
HUN   0.84  0.86  0.81  0.86  0.89  0.82  0.89  0.81  0.81  0.68  0.68  0.80  0.69  0.88  0.81  0.81  0.81  0.83  25.81
POL   0.89  0.91  0.87  0.89  0.89  0.86  0.90  0.81  0.82  0.68  0.69  0.84  0.75  0.92  0.86  0.80  0.89  0.83  0.88  16.91
ZAF   0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.81  0.80  0.69  0.68  0.80  0.68  0.80  0.80  0.81  0.82  0.83  0.80  0.80  17.65
JPN   0.92  0.90  0.92  0.90  0.87  0.89  0.90  0.88  0.84  0.69  0.70  0.83  0.81  0.86  0.82  0.81  0.87  0.83  0.88  0.80  0.80  24.19
LVA   0.80  0.80  0.81  0.81  0.81  0.80  0.80  0.81  0.81  0.69  0.69  0.81  0.69  0.81  0.80  0.81  0.81  0.83  0.83  0.81  0.80  0.81  19.79
SVK   0.80  0.80  0.81  0.80  0.81  0.80  0.80  0.81  0.81  0.69  0.69  0.81  0.69  0.81  0.80  0.81  0.82  0.85  0.85  0.81  0.83  0.81  0.81  15.01
LTU   0.81  0.80  0.81  0.81  0.81  0.81  0.80  0.82  0.81  0.70  0.70  0.81  0.70  0.81  0.81  0.82  0.82  0.84  0.81  0.80  0.82  0.81  0.81  0.81  16.21
PRT   0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.68  0.68  0.80  0.68  0.80  0.80  0.81  0.81  0.83  0.80  0.80  0.80  0.80  0.80  0.80  0.81  23.48
KOR   0.84  0.81  0.81  0.81  0.80  0.80  0.86  0.81  0.81  0.69  0.76  0.81  0.71  0.85  0.80  0.82  0.82  0.84  0.80  0.83  0.81  0.84  0.81  0.81  0.82  0.80  19.72
URY   0.80  0.80  0.80  0.80  0.80  0.80  0.80  0.81  0.80  0.74  0.70  0.80  0.74  0.80  0.80  0.82  0.84  0.84  0.80  0.80  0.80  0.80  0.81  0.81  0.81  0.80  0.80   6.82
HRV   0.81  0.80  0.81  0.81  0.80  0.80  0.80  0.81  0.81  0.69  0.69  0.81  0.69  0.80  0.80  0.81  0.81  0.83  0.83  0.80  0.80  0.81  0.81  0.81  0.81  0.80  0.82  0.81  11.78
MEX   0.81  0.81  0.81  0.81  0.81  0.81  0.80  0.81  0.81  0.70  0.69  0.81  0.69  0.81  0.81  0.83  0.84  0.86  0.81  0.81  0.81  0.81  0.83  0.82  0.85  0.81  0.81  0.81  0.82  13.33
```

HOL   pro

```
      CAN   DEU   DFS   FRA   ITA   NLD   USA   CHE   GBR   NZL   AUS   BEL   IRL   ESP   CZE   SVN   EST   ISR   HUN   POL   ZAF   JPN   LVA   SVK   LTU   PRT   KOR   URY   HRV   MEX
CAN  22.09
DEU   0.90  17.78
DFS   0.92  0.93  10.66
FRA   0.86  0.86  0.90  18.09
ITA   0.86  0.84  0.86  0.84  17.93
NLD   0.87  0.92  0.89  0.85  0.83  19.09
USA   0.91  0.91  0.89  0.88  0.87  0.85  18.52
CHE   0.84  0.87  0.86  0.90  0.83  0.86  0.85  16.92
```

```
GBR    0.85   0.83   0.85   0.86   0.80   0.85   0.83   0.86   7.37
NZL    0.68   0.68   0.68   0.68   0.69   0.68   0.68   0.69   0.68   9.63
AUS    0.68   0.68   0.68   0.69   0.68   0.68   0.68   0.69   0.69   0.80   11.18
BEL    0.80   0.82   0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.68   0.68   14.53
IRL    0.74   0.74   0.76   0.80   0.72   0.78   0.75   0.79   0.77   0.80   0.80   0.72   5.57
ESP    0.90   0.89   0.88   0.88   0.86   0.86   0.89   0.85   0.84   0.68   0.69   0.80   0.77   15.61
CZE    0.80   0.81   0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.68   0.68   0.80   0.68   0.80   16.90
SVN    0.81   0.80   0.81   0.81   0.81   0.81   0.81   0.81   0.81   0.70   0.69   0.81   0.70   0.81   0.81   10.41
EST    0.82   0.86   0.87   0.81   0.81   0.81   0.84   0.82   0.81   0.70   0.71   0.81   0.70   0.81   0.81   0.82   16.02
ISR    0.83   0.83   0.83   0.83   0.83   0.82   0.82   0.84   0.82   0.62   0.63   0.83   0.62   0.83   0.83   0.84   0.84   10.00
HUN    0.81   0.82   0.83   0.85   0.86   0.81   0.86   0.83   0.80   0.68   0.68   0.80   0.68   0.81   0.80   0.81   0.81   0.83   21.05
POL    0.85   0.86   0.86   0.83   0.83   0.83   0.85   0.80   0.80   0.68   0.68   0.80   0.72   0.86   0.80   0.80   0.86   0.83   0.84   11.36
ZAF    0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.81   0.80   0.69   0.72   0.80   0.69   0.80   0.80   0.81   0.82   0.84   0.80   0.80   13.34
JPN    0.91   0.88   0.91   0.87   0.87   0.87   0.90   0.86   0.83   0.69   0.68   0.80   0.75   0.88   0.80   0.81   0.85   0.83   0.80   0.87   0.80   17.15
LVA    0.80   0.80   0.81   0.81   0.80   0.80   0.80   0.81   0.81   0.69   0.69   0.81   0.69   0.80   0.80   0.81   0.81   0.83   0.81   0.80   0.81   0.81   14.10
SVK    0.80   0.80   0.81   0.81   0.81   0.80   0.80   0.81   0.81   0.69   0.69   0.81   0.69   0.81   0.80   0.82   0.82   0.85   0.82   0.80   0.81   0.81   0.81   10.72
LTU    0.81   0.80   0.81   0.81   0.81   0.81   0.80   0.82   0.81   0.70   0.70   0.81   0.70   0.81   0.81   0.82   0.82   0.85   0.81   0.80   0.82   0.81   0.81   0.82   10.95
PRT    0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.68   0.68   0.80   0.68   0.80   0.80   0.81   0.81   0.83   0.80   0.80   0.80   0.80   0.80   0.81   17.57
KOR    0.83   0.80   0.81   0.81   0.80   0.81   0.82   0.81   0.81   0.69   0.69   0.81   0.69   0.83   0.80   0.82   0.82   0.84   0.80   0.80   0.81   0.82   0.81   0.81   0.82   0.80   13.54
URY    0.80   0.80   0.80   0.80   0.80   0.80   0.80   0.81   0.80   0.71   0.69   0.80   0.69   0.80   0.80   0.82   0.81   0.84   0.80   0.80   0.80   0.80   0.81   0.81   0.81   0.80   0.80   5.25
HRV    0.81   0.80   0.81   0.81   0.80   0.80   0.80   0.81   0.81   0.69   0.69   0.81   0.69   0.80   0.80   0.81   0.81   0.84   0.81   0.80   0.81   0.81   0.81   0.82   0.81   0.80   0.82   0.81   11.18
MEX    0.81   0.81   0.81   0.81   0.81   0.81   0.81   0.81   0.81   0.70   0.69   0.81   0.69   0.81   0.81   0.83   0.84   0.87   0.81   0.81   0.81   0.81   0.83   0.82   0.85   0.81   0.81   0.81   0.83   11.24
```

JER   mil

```
       CAN      DFS      USA      NZL      AUS      GBR      NLD      ZAF      ITA      DEU      IRL      CHE
CAN    598.94
DFS    0.93     9.15
USA    0.92     0.92     679.38
NZL    0.74     0.72     0.74     268.04
AUS    0.80     0.73     0.76     0.82     388.43
GBR    0.84     0.83     0.82     0.69     0.71     210.50
NLD    0.91     0.92     0.88     0.71     0.76     0.84     630.97
ZAF    0.88     0.86     0.85     0.77     0.81     0.81     0.81     380.81
ITA    0.90     0.87     0.89     0.75     0.79     0.82     0.85     0.89     549.42
DEU    0.91     0.94     0.93     0.70     0.74     0.83     0.93     0.83     0.88     567.10
IRL    0.81     0.79     0.77     0.89     0.82     0.76     0.82     0.76     0.78     0.80     181.95
CHE    0.88     0.88     0.85     0.73     0.79     0.84     0.90     0.82     0.85     0.90     0.83     320.96
```

JER   fat

```
       CAN      DFS      USA      NZL      AUS      GBR      NLD      ZAF      ITA      DEU      IRL      CHE
CAN    26.81
DFS    0.90     11.20
USA    0.90     0.89     26.65
NZL    0.69     0.69     0.72     11.91
AUS    0.77     0.70     0.77     0.80     13.98
GBR    0.83     0.83     0.82     0.69     0.70     9.41
NLD    0.87     0.86     0.85     0.69     0.71     0.85     25.54
ZAF    0.81     0.81     0.80     0.69     0.70     0.81     0.81     14.27
ITA    0.89     0.84     0.87     0.71     0.73     0.82     0.84     0.82     26.73
DEU    0.91     0.91     0.90     0.69     0.75     0.84     0.90     0.81     0.87     22.63
IRL    0.79     0.78     0.75     0.81     0.81     0.75     0.80     0.71     0.74     0.78     6.42
CHE    0.86     0.85     0.83     0.73     0.77     0.84     0.86     0.81     0.84     0.89     0.80     15.77
```

JER   pro

```
       CAN      DFS      USA      NZL      AUS      GBR      NLD      ZAF      ITA      DEU      IRL      CHE
CAN    19.35
DFS    0.91     10.47
USA    0.89     0.91     20.25
NZL    0.69     0.69     0.68     8.44
AUS    0.71     0.69     0.68     0.80     10.69
```

```
GBR   0.83   0.84   0.81   0.69   0.69   6.80
NLD   0.87   0.88   0.84   0.69   0.70   0.84  20.26
ZAF   0.82   0.81   0.80   0.69   0.70   0.81   0.81  11.39
ITA   0.86   0.84   0.85   0.69   0.71   0.81   0.83   0.86  20.15
DEU   0.89   0.93   0.91   0.69   0.69   0.83   0.90   0.81   0.85  17.88
IRL   0.74   0.74   0.73   0.85   0.81   0.73   0.77   0.71   0.73   0.75   5.79
CHE   0.84   0.84   0.83   0.70   0.70   0.83   0.85   0.81   0.83   0.86   0.78  10.59
```

RDC   mil

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	599.17														
NOR	0.90	12.06													
USA	0.92	0.92	701.26												
NZL	0.69	0.71	0.69	316.81											
AUS	0.74	0.74	0.75	0.83	422.21										
GBR	0.84	0.82	0.83	0.69	0.77	252.49									
DFS	0.91	0.91	0.88	0.69	0.74	0.83	10.26								
DEU	0.93	0.86	0.91	0.70	0.74	0.85	0.93	658.93							
ZAF	0.82	0.88	0.84	0.72	0.75	0.81	0.81	0.81	604.73						
EST	0.88	0.89	0.90	0.75	0.75	0.82	0.86	0.85	0.83	493.08					
LVA	0.82	0.83	0.81	0.73	0.72	0.82	0.81	0.81	0.83	0.82	322.47				
LTU	0.83	0.83	0.82	0.72	0.71	0.82	0.81	0.81	0.84	0.83	0.82	311.86			
IRL	0.83	0.76	0.81	0.82	0.81	0.80	0.81	0.83	0.78	0.77	0.74	0.76	173.55		
NLD	0.91	0.92	0.89	0.72	0.77	0.86	0.93	0.93	0.81	0.86	0.82	0.82	0.84	794.51	
CAM	0.89	0.90	0.95	0.78	0.78	0.88	0.89	0.89	0.89	0.90	0.89	0.89	0.84	0.89	477.01

RDC   fat

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	23.37														
NOR	0.88	11.53													
USA	0.90	0.83	26.27												
NZL	0.69	0.77	0.71	12.86											
AUS	0.72	0.74	0.77	0.83	15.80										
GBR	0.84	0.81	0.84	0.69	0.73	8.52									
DFS	0.90	0.89	0.87	0.70	0.75	0.84	10.29								
DEU	0.92	0.91	0.91	0.70	0.74	0.87	0.91	24.83							
ZAF	0.81	0.88	0.84	0.70	0.70	0.81	0.81	0.81	19.54						
EST	0.87	0.84	0.88	0.78	0.74	0.83	0.85	0.85	0.83	19.40					
LVA	0.82	0.83	0.81	0.73	0.71	0.82	0.81	0.82	0.83	0.84	13.81				
LTU	0.83	0.83	0.82	0.72	0.72	0.82	0.81	0.81	0.84	0.83	0.82	14.79			
IRL	0.81	0.74	0.80	0.81	0.81	0.78	0.81	0.80	0.70	0.82	0.72	0.75	7.19		
NLD	0.89	0.87	0.88	0.69	0.72	0.86	0.91	0.93	0.81	0.84	0.82	0.82	0.81	29.10	
CAM	0.89	0.89	0.95	0.76	0.78	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.84	0.89	22.79

RDC   pro

	CAN	NOR	USA	NZL	AUS	GBR	DFS	DEU	ZAF	EST	LVA	LTU	IRL	NLD	CAM
CAN	18.10														
NOR	0.88	11.45													
USA	0.89	0.90	19.88												
NZL	0.69	0.72	0.69	9.34											
AUS	0.69	0.74	0.70	0.80	12.46										
GBR	0.83	0.82	0.82	0.69	0.71	6.96									
DFS	0.89	0.89	0.87	0.69	0.70	0.83	10.37								
DEU	0.90	0.87	0.90	0.70	0.70	0.84	0.92	19.42							
ZAF	0.81	0.88	0.81	0.70	0.72	0.81	0.81	0.81	16.33						
EST	0.83	0.83	0.87	0.75	0.72	0.83	0.82	0.84	0.83	15.21					
LVA	0.82	0.83	0.81	0.73	0.71	0.82	0.81	0.81	0.83	0.82	9.49				
LTU	0.83	0.83	0.82	0.72	0.71	0.82	0.81	0.81	0.84	0.83	0.82	9.38			
IRL	0.75	0.76	0.76	0.82	0.81	0.76	0.76	0.75	0.70	0.74	0.72	0.74	5.32		
NLD	0.87	0.92	0.85	0.69	0.69	0.84	0.90	0.92	0.81	0.82	0.82	0.82	0.78	28.30	

```
CAM       0.89    0.89    0.93    0.76    0.79    0.89    0.89    0.89    0.89    0.89    0.89    0.89    0.83    0.89   11.82

-----------------------------------------------------------------------------------
SIM    mil
-----------------------------------------------------------------------------------
          CHE     DEA     FRM     ITA     SVN     FRA     HUN     NLD     IRL     GBR     HRV     USA
CHE    563.62
DEA      0.87  508.60
FRM      0.96    0.86  615.52
ITA      0.83    0.80    0.81  529.56
SVN      0.83    0.81    0.83    0.81    8.68
FRA      0.92    0.89    0.89    0.86    0.82  668.10
HUN      0.85    0.82    0.89    0.87    0.83    0.87  422.98
NLD      0.89    0.93    0.89    0.83    0.82    0.89    0.85  754.04
IRL      0.82    0.73    0.85    0.73    0.74    0.88    0.79    0.80  179.58
GBR      0.87    0.87    0.86    0.82    0.81    0.86    0.82    0.86    0.78  227.96
HRV      0.82    0.80    0.88    0.80    0.81    0.81    0.82    0.81    0.73    0.81   10.79
USA      0.88    0.83    0.83    0.89    0.81    0.91    0.89    0.89    0.80    0.84    0.81  589.08

-----------------------------------------------------------------------------------
SIM    fat
-----------------------------------------------------------------------------------
          CHE     DEA     FRM     ITA     SVN     FRA     HUN     NLD     IRL     GBR     HRV     USA
CHE     22.43
DEA      0.87   19.24
FRM      0.94    0.90   24.18
ITA      0.82    0.82    0.81   21.31
SVN      0.83    0.81    0.83    0.81    8.93
FRA      0.90    0.91    0.89    0.86    0.81   26.97
HUN      0.81    0.82    0.89    0.87    0.83    0.86   16.33
NLD      0.88    0.94    0.89    0.82    0.81    0.88    0.82   27.88
IRL      0.76    0.73    0.81    0.71    0.73    0.84    0.70    0.78    7.89
GBR      0.91    0.85    0.86    0.82    0.81    0.89    0.81    0.86    0.76    8.32
HRV      0.82    0.80    0.88    0.80    0.81    0.81    0.83    0.81    0.73    0.81   10.79
USA      0.86    0.87    0.85    0.90    0.81    0.91    0.89    0.88    0.77    0.86    0.81   20.37

-----------------------------------------------------------------------------------
SIM    pro
-----------------------------------------------------------------------------------
          CHE     DEA     FRM     ITA     SVN     FRA     HUN     NLD     IRL     GBR     HRV     USA
CHE     16.73
DEA      0.85   15.48
FRM      0.93    0.86   19.09
ITA      0.82    0.80    0.81   16.79
SVN      0.83    0.81    0.83    0.81    8.80
FRA      0.89    0.86    0.88    0.83    0.82   21.26
HUN      0.83    0.82    0.88    0.85    0.83    0.84   13.65
NLD      0.84    0.92    0.87    0.81    0.82    0.85    0.81   23.80
IRL      0.75    0.73    0.81    0.71    0.74    0.80    0.69    0.75    6.36
GBR      0.85    0.85    0.86    0.81    0.81    0.86    0.80    0.85    0.74    7.08
HRV      0.82    0.80    0.88    0.80    0.81    0.81    0.83    0.81    0.73    0.81   10.66
USA      0.84    0.83    0.81    0.86    0.81    0.88    0.86    0.85    0.74    0.83    0.81   16.27

-----------------------------------------------------------------------------------------
^LAPPENDIX II. Number of common bulls
-----------------------------------------------------------------------------------------
BSW
--------
  common bulls below diagonal
  common three quarter sib group above diagonal
       CAN  FRA  USA  CHE  ITA  DEA  NLD  SVN  NZL  GBR  AUS
   -----------------------------------------------------------------
   CAN    0   84  173  134  128  144   51   34   26   67   91
   FRA   72    0  120  160  190  215   83   56   22   58   64
   USA  161   80    0  318  240  323   81   42   31   95  125
   CHE  110  116  296    0  459  588   95   79   27   74  115
```

```
    ITA  110  147  171  399    0  716  126   98   31   81  121
    DEA  121  156  288  484  610    0  146  105   37   79  128
    NLD   48   68   73   88  107  141    0   44   26   43   57
    SVN   30   55   34   75   97   97   45    0   12   25   30
    NZL   24   18   27   21   23   31   19   11    0   21   28
    GBR   59   45   79   53   54   52   32   18   18    0   59
    AUS   90   48  117   76   88   91   41   23   21   50    0
    ---------------------------------------------------------------------------
BSW
--------
   common bulls below diagonal
   common three quarter sib group above diagonal
         CAN  FRA  USA  CHE  ITA  DEA  NLD  SVN  NZL  GBR  AUS
    ---------------------------------------------------------------------------

    CAN    0   84  173  134  128  144   51   34   26   67   91
    FRA   72    0  120  160  190  215   83   56   22   58   64
    USA  161   80    0  318  240  323   81   42   31   95  125
    CHE  110  116  296    0  459  588   95   79   27   74  115
    ITA  110  147  171  399    0  716  126   98   31   81  121
    DEA  121  156  288  484  610    0  146  105   37   79  128
    NLD   48   68   73   88  107  141    0   44   26   43   57
    SVN   30   55   34   75   97   97   45    0   12   25   30
    NZL   24   18   27   21   23   31   19   11    0   21   28
    GBR   59   45   79   53   54   52   32   18   18    0   59
    AUS   90   48  117   76   88   91   41   23   21   50    0
    ---------------------------------------------------------------------------
BSW
--------
   common bulls below diagonal
   common three quarter sib group above diagonal
         CAN  FRA  USA  CHE  ITA  DEA  NLD  SVN  NZL  GBR  AUS
    ---------------------------------------------------------------------------

    CAN    0   84  173  134  128  144   51   34   26   67   91
    FRA   72    0  120  160  190  215   83   56   22   58   64
    USA  161   80    0  318  240  323   81   42   31   95  125
    CHE  110  116  296    0  459  588   95   79   27   74  115
    ITA  110  147  171  399    0  716  126   98   31   81  121
    DEA  121  156  288  484  610    0  146  105   37   79  128
    NLD   48   68   73   88  107  141    0   44   26   43   57
    SVN   30   55   34   75   97   97   45    0   12   25   30
    NZL   24   18   27   21   23   31   19   11    0   21   28
    GBR   59   45   79   53   54   52   32   18   18    0   59
    AUS   90   48  117   76   88   91   41   23   21   50    0
    ---------------------------------------------------------------------------
GUE
--------
   common bulls below diagonal
   common three quarter sib group above diagonal
         CAN  USA  AUS  GBR  NZL
    ---------------------------------------------------------------------------

    CAN    0   71   48   33   14
    USA   62    0   64   92   31
    AUS   46   60    0   38   27
    GBR   27   93   33    0   15
    NZL   11   29   27   13    0
    ---------------------------------------------------------------------------
GUE
--------
   common bulls below diagonal
   common three quarter sib group above diagonal
         CAN  USA  AUS  GBR  NZL
    ---------------------------------------------------------------------------

    CAN    0   71   48   33   14
    USA   62    0   64   92   31
    AUS   46   60    0   38   27
    GBR   27   93   33    0   15
```

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 NZL   11   29   27   13    0
   ----------------------------------------------------------------------------
GUE
--------
common bulls below diagonal
common three quarter sib group above diagonal
       CAN  USA  AUS  GBR  NZL
   ----------------------------------------------------------------------------
 CAN    0   71   48   33   14
 USA   62    0   64   92   31
 AUS   46   60    0   38   27
 GBR   27   93   33    0   15
 NZL   11   29   27   13    0
   ----------------------------------------------------------------------------
HOL
--------
common bulls below diagonal
common three quarter sib group above diagonal
       CAN  DEU  DFS  FRA  ITA  NLD  USA  CHE  GBR  NZL  AUS  BEL  IRL  ESP  CZE  SVN  EST  ISR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  HRV  MEX
   ----------------------------------------------------------------------------
 CAN    0 2280 1429 1461 1634 1495 3383  887 1660  743 1405  813  547 1280 1102  206  255  124 1021 1376  511 1302  486  426  300 1028  693  497  293  373
 DEU 1675    0 2498 2299 2415 3099 3342 1121 1979  931 1586 1196  829 1475 1791  306  407  153 1210 2380  547 1337  745  671  605 1197  614  472  597  346
 DFS 1200 1768    0 1609 1502 2045 2045  715 1525  811 1268  860  716 1003 1228  249  285  142  892 1557  507  931  476  402  362  921  482  417  388  286
 FRA  949 1166  821    0 1613 1941 2463  674 1508  787 1255  923  713 1129 1226  205  255  122  932 1622  477 1172  415  415  294  916  520  403  280  296
 ITA 1249 1474 1059  797    0 1625 2486  700 1495  691 1136  780  603 1191 1209  225  267  125  975 1545  457 1107  486  376  323  963  574  420  354  323
 NLD 1411 2811 1751 1163 1255    0 2461  887 1722 1025 1443 1274  859 1086 1469  258  355  150  961 1812  517 1026  529  530  394 1043  481  426  420  300
 USA 3738 2308 1499 1265 1592 2112    0 1009 2208 1059 1877  971  764 1527 1630  240  342  176 1307 2041  642 1892  633  534  405 1292  855  674  366  447
 CHE  745  992  629  580  611  860  896    0  706  396  615  604  389  559  523  142  163   58  438  672  270  459  281  231  177  503  265  214  200  174
 GBR 1879 1468 1121  896 1070 1480 1940  639    0  914 1386  857  927 1059 1044  212  249  133  865 1321  514 1008  424  369  306  944  495  443  321  319
 NZL  748  708  569  454  484  931  998  332  783    0 1187  511  696  533  608  131  137  107  500  645  366  548  248  256  181  562  316  357  212  196
 AUS 1413 1166  897  825  796 1251 1850  532 1178 1191    0  753  705  880  838  179  210  107  719 1022  481  864  375  306  256  781  447  434  286  267
 BEL  805 1237  799  902  737 1464  856  614  851  415  656    0  502  668  659  178  193   82  546  816  337  540  304  300  213  660  298  250  262  201
 IRL  515  721  579  554  493  800  680  391  950  596  607  500    0  497  508  119  130   95  434  583  331  427  207  202  156  486  233  266  178  174
 ESP  813  937  736  792  825  959  969  444  821  403  614  648  465    0  845  189  202  107  759 1031  450  884  362  313  234  822  478  362  272  281
 CZE  797 1355  790  737  827 1294 1247  366  709  425  538  518  373  571    0  217  253  121  911 1323  399  811  438  468  322  797  476  382  351  273
 SVN  148  296  204  141  187  223  181  101  156   92  126  146   89  139  159    0   95   46  161  254  100  163  121   83   80  167   99   77  108   67
 EST  152  288  168  119  145  253  223   89  137   67  105  121   67   94  158   56    0   47  197  318  106  199  187  114  114  193  113  105  120   71
 ISR   89  122  108   63   78  119  162   36   92   88   69   54   70   63   89   36   29    0  106  136   64   98   66   47   56   99   59   68   65   41
 HUN  952  943  696  614  810  796 1263  350  748  392  540  469  381  600  811  123  120   78    0  951  399  700  335  314  225  711  453  374  252  287
 POL 1154 2108 1227 1021 1141 1655 1911  549 1094  488  756  748  480  710 1084  226  228  107  835    0  418  955  614  447  439 1007  563  420  444  314
 ZAF  471  429  384  331  346  435  627  219  448  304  420  286  297  399  266   70   54   43  328  311    0  423  172  183  118  435  269  274  152  213
 JPN  629  554  473  396  483  510  788  284  493  278  456  338  265  400  343   90   68   42  376  493  277    0  341  299  210  685  546  386  209  293
 LVA  288  609  299  191  308  359  515  143  247  141  191  187  125  197  299   76  118   46  249  502   98  146    0  182  229  401  226  185  247  139
 SVK  301  496  208  216  218  368  355  118  212  153  154  185  102  156  382   48   53   20  223  310  100  104   92    0  134  320  208  182  140  125
 LTU  160  560  208  102  168  239  271   78  156   82  112  110   77   96  215   44   58   27  136  343   48   69  163   68    0  235  143  121  164   69
 PRT 1075 1098  807  762  876 1046 1352  444  861  463  622  666  438  783  653  132  135   74  706 1007  391  399  314  222  151    0  461  395  309  335
 KOR  658  408  340  290  456  338  973  184  358  232  323  218  164  335  340   62   55   36  373  469  203  315  134  129   62  389    0  296  136  253
 URY  488  350  298  235  313  336  839  161  370  281  328  194  217  290  285   46   64   35  318  360  232  230  112  119   71  359  240    0  138  236
 HRV  171  611  293  166  251  376  275  127  227  124  177  215  122  202  254   84   87   45  187  392   99   95  194   68  113  247   58   88    0  113
 MEX  390  290  240  231  298  251  535  154  288  158  222  190  152  256  227   51   49   27  275  294  197  227   96   75   30  351  238  223   74    0
   ----------------------------------------------------------------------------
HOL
--------
common bulls below diagonal
common three quarter sib group above diagonal
       CAN  DEU  DFS  FRA  ITA  NLD  USA  CHE  GBR  NZL  AUS  BEL  IRL  ESP  CZE  SVN  EST  ISR  HUN  POL  ZAF  JPN  LVA  SVK  LTU  PRT  KOR  URY  HRV  MEX
   ----------------------------------------------------------------------------
 CAN    0 2280 1429 1461 1635 1495 3383  887 1660  743 1405  813  547 1280 1102  206  255  124 1021 1376  511 1297  486  426  300 1028  693  497  293  143
 DEU 1675    0 2498 2299 2417 3099 3342 1121 1979  931 1586 1196  829 1475 1791  306  407  153 1210 2380  547 1332  745  671  605 1197  614  472  597  134
 DFS 1200 1768    0 1609 1504 2045 2045  715 1525  811 1268  860  716 1003 1228  249  285  142  892 1557  507  929  476  402  362  921  482  417  388  122
 FRA  949 1166  821    0 1615 1941 2463  674 1508  787 1254  923  714 1129 1226  205  255  122  932 1622  477 1172  415  415  294  916  520  403  280  125
 ITA 1251 1479 1064  800    0 1628 2488  701 1498  693 1138  782  605 1194 1211  227  267  126  975 1545  458 1105  487  377  323  966  574  420  354  120
 NLD 1411 2811 1751 1163 1261    0 2461  887 1722 1025 1443 1274  861 1086 1469  258  355  150  961 1812  517 1019  529  530  394 1043  481  426  420  128
 USA 3738 2308 1499 1265 1597 2112    0 1009 2208 1059 1877  971  764 1527 1630  240  342  176 1307 2041  642 1887  633  534  405 1292  855  674  366  149
 CHE  745  992  629  580  613  860  896    0  706  396  616  604  389  559  523  142  163   58  438  672  270  454  281  231  177  503  265  214  200   97
 GBR 1879 1468 1121  896 1075 1480 1940  639    0  914 1386  857  928 1059 1044  212  249  133  865 1321  514 1003  424  369  306  944  495  443  321  132
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First matrix (continuation, columns correspond to the HOL section headers):

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX
NZL	748	708	569	454	487	931	998	332	783	0	1187	511	696	533	608	131	137	107	500	645	366	547	248	256	181	562	316	357	212	102
AUS	1414	1167	898	825	802	1252	1851	533	1178	1191	0	753	706	880	838	179	210	107	719	1023	481	861	375	307	256	781	447	434	286	120
BEL	805	1237	799	902	740	1464	856	614	851	415	656	0	502	668	659	178	193	82	546	816	337	538	304	300	213	660	298	250	262	107
IRL	515	721	579	554	496	802	680	391	951	596	608	500	0	497	508	119	130	95	434	583	331	426	207	202	156	486	233	266	178	92
ESP	813	937	736	792	831	959	969	444	821	403	614	648	465	0	845	189	202	107	759	1031	450	881	362	313	234	822	478	362	272	121
CZE	797	1354	789	737	829	1293	1247	366	709	425	538	517	373	570	0	217	253	121	911	1323	399	809	438	468	322	797	476	382	351	97
SVN	148	296	204	141	189	223	181	101	156	92	126	146	89	139	159	0	95	46	161	254	100	162	121	83	80	167	99	77	108	36
EST	152	288	168	119	145	253	223	89	137	67	105	121	67	94	158	56	0	47	197	318	106	196	187	114	114	193	113	105	120	28
ISR	89	122	108	63	78	119	162	36	92	88	69	54	70	63	89	36	29	0	106	136	64	97	66	47	56	99	59	68	65	15
HUN	952	943	696	614	812	796	1263	350	748	392	540	469	381	600	811	123	120	78	0	951	399	698	335	314	225	711	453	374	252	112
POL	1154	2108	1227	1021	1143	1655	1911	549	1094	488	757	748	480	710	1083	226	228	107	835	0	418	949	614	447	439	1007	563	420	444	106
ZAF	471	429	384	331	348	435	626	219	447	304	420	286	297	399	266	70	54	43	328	311	0	422	172	183	118	435	269	274	152	105
JPN	624	549	471	392	482	504	780	280	488	276	452	335	264	398	341	89	65	41	374	487	276	0	340	298	210	682	545	385	209	128
LVA	288	609	299	191	309	359	515	143	247	141	191	187	125	197	299	76	118	46	249	502	98	145	0	182	229	401	226	185	247	45
SVK	301	496	208	216	219	368	355	118	212	153	154	185	102	156	381	48	53	20	223	310	100	103	92	0	134	320	208	182	140	58
LTU	160	560	208	102	168	239	271	78	156	82	112	110	77	96	215	44	58	27	136	343	48	69	163	68	0	235	143	121	164	26
PRT	1075	1098	807	761	882	1046	1352	444	861	463	622	666	438	783	653	132	135	74	706	1007	391	396	314	222	151	0	461	395	309	127
KOR	658	408	340	290	456	338	972	184	358	232	323	218	164	335	340	62	55	36	373	469	203	313	134	129	62	389	0	296	136	99
URY	488	350	298	235	313	336	839	161	370	281	328	194	217	290	285	46	64	35	318	360	232	227	112	119	71	359	240	0	138	103
HRV	171	610	292	166	250	375	275	127	227	123	176	214	122	202	253	83	87	44	187	391	99	95	194	68	112	247	58	88	0	46
MEX	175	147	126	126	126	137	191	95	154	99	125	117	100	137	79	28	17	11	117	105	115	126	29	42	7	150	101	109	30	0

HOL
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common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	FRA	ITA	NLD	USA	CHE	GBR	NZL	AUS	BEL	IRL	ESP	CZE	SVN	EST	ISR	HUN	POL	ZAF	JPN	LVA	SVK	LTU	PRT	KOR	URY	HRV	MEX
CAN	0	2280	1429	1461	1634	1495	3377	887	1660	743	1404	813	547	1280	1102	206	255	124	1021	1376	511	1296	486	426	300	1028	693	497	293	141
DEU	1675	0	2498	2299	2416	3099	3340	1121	1979	931	1586	1196	829	1475	1791	306	407	153	1210	2380	547	1332	745	671	605	1197	614	472	597	132
DFS	1200	1768	0	1609	1503	2045	2043	715	1525	811	1268	860	716	1003	1228	249	285	142	892	1557	507	929	476	402	362	921	482	417	388	120
FRA	949	1166	821	0	1614	1941	2462	674	1508	787	1255	923	714	1129	1226	205	255	122	932	1622	477	1169	415	415	294	916	520	403	280	123
ITA	1249	1475	1060	798	0	1627	2487	700	1497	692	1137	781	604	1193	1210	226	267	126	975	1545	457	1105	487	377	323	965	574	420	354	118
NLD	1411	2811	1751	1163	1258	0	2460	887	1722	1025	1443	1274	861	1086	1469	258	355	150	961	1812	517	1018	529	530	394	1043	481	426	420	126
USA	3735	2308	1499	1265	1593	2112	0	1009	2207	1059	1874	970	764	1526	1630	240	342	176	1307	2041	642	1884	633	533	405	1292	856	674	366	147
CHE	745	992	629	580	611	860	895	0	706	396	615	604	389	559	523	142	163	58	438	672	270	453	281	231	177	503	265	214	200	95
GBR	1879	1468	1121	896	1072	1480	1940	639	0	914	1386	857	928	1059	1044	212	249	133	865	1321	514	1003	424	369	306	944	495	443	321	130
NZL	748	708	569	454	485	931	998	332	783	0	1187	511	696	533	608	131	137	107	500	645	366	547	248	256	181	562	316	357	212	101
AUS	1412	1166	897	825	797	1251	1849	532	1178	1191	0	753	705	880	838	179	210	107	719	1022	481	860	375	306	256	781	447	434	286	118
BEL	805	1237	799	902	738	1464	855	614	851	415	656	0	502	668	659	178	193	82	546	816	337	538	304	300	213	660	298	250	262	105
IRL	515	721	579	554	493	802	680	391	951	596	607	500	0	497	508	119	130	95	434	583	331	426	207	202	156	486	233	266	178	90
ESP	813	937	736	792	827	959	969	444	821	403	614	648	465	0	845	189	202	107	759	1031	450	881	362	313	234	822	478	362	272	119
CZE	797	1354	789	737	828	1293	1247	366	709	425	538	517	373	570	0	217	253	121	911	1323	399	809	438	468	322	797	476	382	351	95
SVN	148	296	204	141	188	223	181	101	156	92	126	146	89	139	159	0	95	46	161	254	100	162	121	83	80	167	99	77	108	36
EST	152	288	168	119	145	253	223	89	137	67	105	121	67	94	158	56	0	47	197	318	106	195	187	114	114	193	113	105	120	28
ISR	89	122	108	63	78	119	162	36	92	88	69	54	70	63	89	36	29	0	106	136	64	97	66	47	56	99	59	68	65	15
HUN	952	943	696	614	810	796	1263	350	748	392	540	469	381	600	811	123	120	78	0	951	399	698	335	314	225	711	453	374	252	110
POL	1154	2108	1227	1021	1141	1655	1911	549	1094	488	756	748	480	710	1083	226	228	107	835	0	418	949	614	447	439	1007	563	420	444	104
ZAF	471	429	384	331	346	435	626	219	447	304	420	286	297	399	266	70	54	43	328	311	0	422	172	183	118	435	269	274	152	103
JPN	623	549	471	392	481	503	779	280	488	276	451	335	264	398	341	89	64	41	374	487	276	0	340	298	210	682	545	385	209	126
LVA	288	609	299	191	309	359	515	143	247	141	191	187	125	197	299	76	118	46	249	502	98	145	0	182	229	401	226	185	247	44
SVK	301	496	208	216	219	368	354	118	212	153	154	185	102	156	381	48	53	20	223	310	100	103	92	0	134	320	208	182	140	58
LTU	160	560	208	102	168	239	271	78	156	82	112	110	77	96	215	44	58	27	136	343	48	69	163	68	0	235	143	121	164	25
PRT	1075	1098	807	761	879	1046	1351	444	861	463	621	666	438	783	653	132	135	74	706	1007	391	396	313	222	151	0	461	395	309	125
KOR	658	408	340	290	456	338	974	184	358	232	323	218	164	335	340	62	55	36	373	469	203	313	134	129	62	389	0	296	136	99
URY	488	350	298	235	313	336	839	161	370	281	328	194	217	290	285	46	64	35	318	360	232	227	112	119	71	359	240	0	138	102
HRV	171	611	293	166	251	376	275	127	227	124	177	215	122	202	254	84	87	45	187	392	99	95	194	68	113	247	58	88	0	45
MEX	173	145	125	125	125	136	189	94	152	98	124	116	99	136	77	28	16	11	116	104	114	124	29	42	7	149	101	107	29	0

JER
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common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	USA	NZL	AUS	GBR	NLD	ZAF	ITA	DEU	IRL	CHE
CAN	0	79	434	174	257	159	39	156	70	68	9	36

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    DFS   65    0  153  125  125  148  109  131   97   93   31   55
    USA  455  123    0  358  481  233   85  296  100  119   37   63
    NZL  181   99  432    0  442  213   74  202   84   78  101   49
    AUS  262   90  524  492    0  219   73  233   84   81   49   51
    GBR  156  129  248  210  214    0   84  167  104   91   59   67
    NLD   35  106   91   68   64   75    0   73   56   65   24   39
    ZAF  151  106  309  207  221  164   69    0   90   81   31   55
    ITA   67   94  107   82   79  105   55   83    0   60   20   45
    DEU   64   87  120   72   72   86   60   76   60    0   18   47
    IRL    6   24   38  112   46   60   22   30   19   18    0   16
    CHE   29   51   63   40   42   64   33   48   42   43   12    0
    ------------------------------------------------------------------------
JER
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 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DFS  USA  NZL  AUS  GBR  NLD  ZAF  ITA  DEU  IRL  CHE
    ------------------------------------------------------------------------
    CAN    0   79  434  174  257  158   39  156   70   68    9   36
    DFS   65    0  153  125  125  148  109  130   97   93   31   55
    USA  455  123    0  358  481  232   85  296  100  119   37   63
    NZL  181   99  432    0  442  213   74  202   84   78  101   50
    AUS  262   90  524  492    0  218   73  232   84   81   49   51
    GBR  156  129  248  210  214    0   84  166  104   91   59   67
    NLD   35  106   91   68   64   75    0   72   56   65   24   39
    ZAF  151  105  309  207  220  163   68    0   90   80   31   55
    ITA   67   94  107   82   79  105   55   83    0   60   20   45
    DEU   64   87  120   72   72   86   60   75   60    0   18   47
    IRL    6   24   38  112   46   60   22   30   19   18    0   16
    CHE   29   51   63   40   42   64   33   48   42   43   12    0
    ------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  DFS  USA  NZL  AUS  GBR  NLD  ZAF  ITA  DEU  IRL  CHE
    ------------------------------------------------------------------------
    CAN    0   79  434  174  257  159   39  156   70   68    9   36
    DFS   65    0  153  125  125  148  109  130   97   93   31   55
    USA  455  123    0  358  481  233   85  296  100  119   37   63
    NZL  181   99  432    0  442  213   74  202   84   78  101   49
    AUS  262   90  524  492    0  219   73  232   84   81   49   51
    GBR  156  129  248  210  214    0   84  166  104   91   59   67
    NLD   35  106   91   68   64   75    0   72   56   65   24   39
    ZAF  151  105  309  207  220  163   68    0   90   80   31   55
    ITA   67   94  107   82   79  105   55   83    0   60   20   45
    DEU   64   87  120   72   72   86   60   75   60    0   18   47
    IRL    6   24   38  112   46   60   22   30   19   18    0   16
    CHE   29   51   63   40   42   64   33   48   42   43   12    0
    ------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
         CAN  NOR  USA  NZL  AUS  GBR  DFS  DEU  ZAF  EST  LVA  LTU  IRL  NLD  CAM
    ------------------------------------------------------------------------
    CAN    0    6  206   85  100   81  160   13   75    2   10   17    2    6    0
    NOR    6    0   70   40   65   52  129   14    0   23   19   25   47   43    0
    USA  190   72    0  120  127  107  183   20   64   18   23   34   23   38   24
    NZL   84   40  121    0  138   79  168   16   39    8   17   27    8   19   12
    AUS  100   55  128  138    0   82  176   38   38   34   33   42   13   30   11
    GBR   77   54   98   74   81    0   99   14   40    8   17   26   17   33    0
    DFS  162  102  177  166  150   91    0   49   52  108  119  104   13   47    0
    DEU   12   13   20   16   38   14   40    0    1   21   33   29    4   14    0
    ZAF   77    0   58   34   38   35   49    1    0    0    2    5    2    3    0
    EST    2   23   17    7   31    7   96   21    0    0   48   25    0   18    0
```

```
LVA   10   17   20   14   31   16   80   27    2   41    0   52    2   11    0
LTU   16   22   29   25   42   24   99   28    5   25   48    0    4   15    0
IRL    2   46   23    8   12   16   10    4    2    0    2    4    0    9    0
NLD    6   43   37   19   28   32   45   14    3   17   10   13    9    0    0
CAM    0    0   24   12   11    0    0    0    0    0    0    0    0    0    0
-----------------------------------------------------------------------------
RDC
--------
common bulls below diagonal
common three quarter sib group above diagonal
       CAN  NOR  USA  NZL  AUS  GBR  DFS  DEU  ZAF  EST  LVA  LTU  IRL  NLD  CAM
-----------------------------------------------------------------------------
CAN      0    6  206   85  100   80  160   13   75    2   10   17    2    6    0
NOR      6    0   70   40   65   52  129   14    0   23   19   25   47   43    0
USA    190   72    0  120  127  106  183   20   64   18   23   34   23   38   24
NZL     84   40  121    0  138   79  168   16   39    8   17   27    8   19   12
AUS    100   55  128  138    0   82  176   38   38   34   33   42   13   30   11
GBR     77   54   98   74   81    0   98   14   40    8   17   26   17   33    0
DFS    162  102  177  166  150   91    0   49   52  108  119  104   13   47    0
DEU     12   13   20   16   38   14   40    0    1   21   33   29    4   14    0
ZAF     77    0   58   34   38   35   49    1    0    0    2    5    2    3    0
EST      2   23   17    7   31    7   96   21    0    0   48   25    0   18    0
LVA     10   17   20   14   31   16   80   27    2   41    0   52    2   11    0
LTU     16   22   29   25   42   24   99   28    5   25   48    0    4   15    0
IRL      2   46   23    8   12   16   10    4    2    0    2    4    0    9    0
NLD      6   43   37   19   28   32   45   14    3   17   10   13    9    0    0
CAM      0    0   24   12   11    0    0    0    0    0    0    0    0    0    0
-----------------------------------------------------------------------------
RDC
--------
common bulls below diagonal
common three quarter sib group above diagonal
       CAN  NOR  USA  NZL  AUS  GBR  DFS  DEU  ZAF  EST  LVA  LTU  IRL  NLD  CAM
-----------------------------------------------------------------------------
CAN      0    6  206   85  100   80  160   13   75    2   10   17    2    6    0
NOR      6    0   70   40   65   52  129   14    0   23   19   25   47   43    0
USA    190   72    0  120  127  106  183   20   64   18   23   34   23   38   24
NZL     84   40  121    0  138   79  168   16   39    8   17   27    8   19   12
AUS    100   55  128  138    0   82  176   38   38   34   33   42   13   30   11
GBR     77   54   98   74   81    0   98   14   40    8   17   26   17   33    0
DFS    162  102  177  166  150   91    0   49   52  108  119  103   13   47    0
DEU     12   13   20   16   38   14   40    0    1   21   33   29    4   14    0
ZAF     77    0   58   34   38   35   49    1    0    0    2    5    2    3    0
EST      2   23   17    7   31    7   96   21    0    0   48   25    0   18    0
LVA     10   17   20   14   31   16   80   27    2   41    0   52    2   11    0
LTU     16   22   29   25   42   24   98   28    5   25   48    0    4   15    0
IRL      2   46   23    8   12   16   10    4    2    0    2    4    0    9    0
NLD      6   43   37   19   28   32   45   14    3   17   10   13    9    0    0
CAM      0    0   24   12   11    0    0    0    0    0    0    0    0    0    0
-----------------------------------------------------------------------------
SIM
--------
common bulls below diagonal
common three quarter sib group above diagonal
       CHE  DEA  FRM  ITA  SVN  FRA  HUN  NLD  IRL  GBR  HRV  USA
-----------------------------------------------------------------------------
CHE      0  347  201   93    6   12    2   88   53   55    2   26
DEA    306    0  268  937  193  267   49  319   58   54  549   26
FRM    252  303    0  168   17    3    3  119   65   72    2   51
ITA     96  840  201    0  118  152   23  209   59   47  242   28
SVN      6  179   17  112    0   57   13   55    4    0   78    0
FRA      9  227    1  138   54    0   12   70    3    0   92    1
HUN      1   35    1   19   11    9    0    7    2    0   22    0
NLD     90  329  141  203   53   68    7    0   53   52  107   21
IRL     50   54   71   57    4    3    2   48    0   39    6   17
GBR     63   57   93   53    0    0    0   53   34    0    0   19
```

```
   HRV    2  573    1  227   65   83   20  102    5    0    0    2
   USA   25   28   66   33    0    1    0   23   16   27    2    0
   -------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CHE  DEA  FRM  ITA  SVN  FRA  HUN  NLD  IRL  GBR  HRV  USA
   -------------------------------------------------------------------
   CHE    0  346  201   93    6   12    2   88   53   55    2   26
   DEA  306    0  268  937  193  267   49  319   58   54  547   26
   FRM  252  303    0  168   17    3    3  119   65   72    2   51
   ITA   96  840  201    0  118  152   23  209   59   47  240   28
   SVN    6  179   17  112    0   57   13   55    4    0   78    0
   FRA    9  227    1  138   54    0   12   70    3    0   92    1
   HUN    1   35    1   19   11    9    0    7    2    0   22    0
   NLD   90  329  141  203   53   68    7    0   53   52  107   21
   IRL   50   54   71   57    4    3    2   48    0   39    6   17
   GBR   63   57   93   53    0    0    0   53   34    0    0   19
   HRV    2  571    1  225   65   83   20  102    5    0    0    2
   USA   25   28   66   33    0    1    0   23   16   27    2    0
   -------------------------------------------------------------------
SIM
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
        CHE  DEA  FRM  ITA  SVN  FRA  HUN  NLD  IRL  GBR  HRV  USA
   -------------------------------------------------------------------
   CHE    0  346  201   93    6   12    2   88   53   55    2   26
   DEA  306    0  268  937  193  267   49  319   58   54  548   26
   FRM  252  303    0  168   17    3    3  119   65   72    2   51
   ITA   96  840  201    0  118  152   23  209   59   47  241   28
   SVN    6  179   17  112    0   57   13   55    4    0   78    0
   FRA    9  227    1  138   54    0   12   70    3    0   92    1
   HUN    1   35    1   19   11    9    0    7    2    0   22    0
   NLD   90  329  141  203   53   68    7    0   53   52  107   21
   IRL   50   54   71   57    4    3    2   48    0   39    6   17
   GBR   63   57   93   53    0    0    0   53   34    0    0   19
   HRV    2  572    1  226   65   83   20  102    5    0    0    2
   USA   25   28   66   33    0    1    0   23   16   27    2    0
   -------------------------------------------------------------------
```