

## Introduction

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The latest routine international evaluation for longevity trait took place as scheduled at the Interbull Centre. Data from twenty one (21) populations were included in this evaluation.

International genetic evaluations for direct longevity trait of bulls from Australia, Belgium, Canada, Switzerland, Germany, Denmark-Finland-Sweden Spain, France, The United Kingdom, Ireland, Israel, Italy, New Zealand, The Netherlands, The United States of America Hungary, Norway, Slovenia and Czech Republic 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 longevity traits are as follows:

ITA: some bulls lost herds/daughters/edc because of some pedigree corrections

DEU: some bulls lost herds/daughters/edc

ESP: Reliability decreased for some old bulls because of some changes in database edits

## INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

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- 1) Data submission for pedigree, EBV/PTA, and parameters is possible only through uploading of the data to the Interbull Data Exchange Area (IDEA);
- 2) Interbull Centre has moved to a completely new MACE evaluation software called "Dairy System for International Evaluation (DAISIE)", partly because of the extended use of IDEA for EBV/PTA, and partly because of our continuous efforts to make the system more effective than before;
- 3) All trait groups (including conformation traits) are now evaluated in-house.
- 4) The file containing heritability values now contain more decimal places for heritability, and one extra field for the definition of reference base population;
- 5) The file containing genetic correlations has changed name from rG\_columns\_all to cor{RUNID}.csv, and also contains one extra field for the number of common bulls;
- 6) The file containing sire genetic standard deviations has changed name from sire\_std\_columns\_all to std{RUNID}.csv;
- 7) Sire-MGS based pedigree files are not distributed anymore;
- 8) Parent averages in the "ipa" format are not distributed anymore;
- 9) An import AI bull (type of proof = 21) with official publication status 'Y' from a given country is included in the distribution file if the bull has a first country proof included from a different country OR a second country proof is included with minimum required number of daughters or EDC (20, 10, 150, 20, 20, and 80) and herds (20, 10, 150, 20, 20, and 80) for different breeds (BSW, GUE, HOL, JER, RDC and SIM), respectively;
- 10) Bulls with some missing pedigree information (sires and/or dam and/or birthdate) are excluded from evaluations;
- 11) Standardization factors are not used anymore;
- 12) Post-processing of genetic correlation are now applied to all trait groups.

## DATA AND METHOD OF ANALYSIS

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

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

Table 2 presents the date of evaluation as supplied by each country in the 0lx-proof file.

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

## SCIENTIFIC LITERATURE

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

International genetic evaluation computation:

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

Verification and Genetic trend validation:

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

Weighting factors:

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

De-regression:

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

Genetic parameter estimation:

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

Post-processing of estimated genetic correlations:

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

Time edits

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

International reliability estimation

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

## NEXT ROUTINE INTERNATIONAL EVALUATION

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

## NEXT TEST INTERNATIONAL EVALUATION

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

## PUBLICATION OF INTERBULL TEST RUN

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

^LTable 1. National evaluation data considered in the Interbull evaluation for Longevity (August Routine Evaluation 2015).  
Number of records for direct longevity by breed

| Country     | BSW   | GUE  | HOL    | JER   | RDC   | SIM  |
|-------------|-------|------|--------|-------|-------|------|
| ARG         |       |      |        |       |       |      |
| AUS         |       | 126  | 6863   | 1513  | 594   |      |
| BEL         |       |      | 896    |       |       |      |
| CAN         | 191   | 96   | 10402  | 563   | 745   |      |
| CHE         | 2981  |      | 2807   |       |       |      |
| CZE         |       |      | 4067   |       |       | 3204 |
| DEA         | 5978  |      |        |       |       |      |
| DEU         |       |      | 23581  |       | 364   |      |
| DFS         |       |      | 11389  | 2165  | 8105  |      |
| ESP         |       |      | 2869   |       |       |      |
| EST         |       |      |        |       |       |      |
| FRA         | 318   |      | 15264  |       |       |      |
| FRM         |       |      |        |       |       | 4013 |
| FRR         |       |      |        |       |       |      |
| GBR         | 83    | 272  | 6436   | 689   | 433   | 65   |
| HUN         |       |      | 2853   |       |       |      |
| IRL         |       |      | 2225   | 118   | 45    |      |
| ISR         |       |      | 1172   |       |       |      |
| ITA         | 1905  |      | 8686   |       |       |      |
| JPN         |       |      |        |       |       |      |
| KOR         |       |      |        |       |       |      |
| LTU         |       |      |        |       |       |      |
| LVA         |       |      |        |       |       |      |
| NLD         | 151   |      | 12825  | 114   | 52    | 237  |
| NOR         |       |      |        |       |       |      |
| NZL         | 41    | 55   | 6365   | 4032  | 1088  |      |
| POL         |       |      | 8224   |       |       |      |
| PRT         |       |      |        |       |       |      |
| SVK         |       |      |        |       |       |      |
| SVN         | 326   |      | 388    |       |       | 485  |
| URY         |       |      |        |       |       |      |
| USA         | 971   | 726  | 32382  | 3666  | 587   |      |
| ZAF         |       | 28   | 1123   | 540   | 112   |      |
| HRV         |       |      |        |       |       |      |
| No. Records | 12945 | 1303 | 160817 | 13400 | 12125 | 8004 |
| Pub. Proofs | 10783 | 1045 | 131904 | 11086 | 11049 | 7143 |

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

| BSW | dlo  |       |       |        |        |      |       |      |      |       |
|-----|------|-------|-------|--------|--------|------|-------|------|------|-------|
|     | CAN  | CHE   | DEA   | NLD    | NZL    | USA  | ITA   | FRA  | GBR  | SVN   |
| CAN | 8.07 |       |       |        |        |      |       |      |      |       |
| CHE | 0.77 | 11.00 |       |        |        |      |       |      |      |       |
| DEA | 0.82 | 0.84  | 14.00 |        |        |      |       |      |      |       |
| NLD | 0.74 | 0.68  | 0.70  | 354.92 |        |      |       |      |      |       |
| NZL | 0.45 | 0.47  | 0.36  | 0.44   | 295.36 |      |       |      |      |       |
| USA | 0.93 | 0.66  | 0.77  | 0.80   | 0.54   | 2.81 |       |      |      |       |
| ITA | 0.78 | 0.63  | 0.80  | 0.58   | 0.29   | 0.67 | 17.04 |      |      |       |
| FRA | 0.68 | 0.72  | 0.76  | 0.67   | 0.36   | 0.65 | 0.57  | 0.93 |      |       |
| GBR | 0.81 | 0.55  | 0.44  | 0.68   | 0.52   | 0.82 | 0.59  | 0.52 | 0.34 |       |
| SVN | 0.72 | 0.66  | 0.81  | 0.78   | 0.47   | 0.72 | 0.79  | 0.67 | 0.55 | 25.31 |

GUE dlo

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|     | AUS  | CAN  | NZL    | USA  | GBR  | ZAF   |
|-----|------|------|--------|------|------|-------|
| AUS | 6.96 |      |        |      |      |       |
| CAN | 0.71 | 7.92 |        |      |      |       |
| NZL | 0.66 | 0.56 | 350.91 |      |      |       |
| USA | 0.64 | 0.91 | 0.48   | 2.79 |      |       |
| GBR | 0.71 | 0.90 | 0.57   | 0.87 | 0.37 |       |
| ZAF | 0.67 | 0.80 | 0.59   | 0.83 | 0.79 | 18.53 |

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HOL dlo

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|      | AUS    | BEL    | CAN  | CHE   | DEU   | DFS   | ESP   | FRA   | GBR  | IRL  | ISR    |
|------|--------|--------|------|-------|-------|-------|-------|-------|------|------|--------|
| ITA  | NLD    | NZL    | USA  | HUN   | CZE   | SVN   | ZAF   | POL   |      |      |        |
| AUS  | 4.44   |        |      |       |       |       |       |       |      |      |        |
| BEL  | 0.76   | 0.36   |      |       |       |       |       |       |      |      |        |
| CAN  | 0.73   | 0.85   | 6.34 |       |       |       |       |       |      |      |        |
| CHE  | 0.77   | 0.78   | 0.84 | 12.36 |       |       |       |       |      |      |        |
| DEU  | 0.65   | 0.86   | 0.90 | 0.80  | 13.13 |       |       |       |      |      |        |
| DFS  | 0.76   | 0.86   | 0.87 | 0.79  | 0.86  | 12.49 |       |       |      |      |        |
| ESP  | 0.46   | 0.68   | 0.78 | 0.73  | 0.81  | 0.66  | 13.36 |       |      |      |        |
| FRA  | 0.68   | 0.63   | 0.63 | 0.73  | 0.61  | 0.69  | 0.52  | 1.00  |      |      |        |
| GBR  | 0.69   | 0.87   | 0.87 | 0.76  | 0.84  | 0.81  | 0.75  | 0.54  | 0.31 |      |        |
| IRL  | 0.52   | 0.75   | 0.77 | 0.60  | 0.73  | 0.65  | 0.69  | 0.36  | 0.80 | 2.15 |        |
| ISR  | 0.62   | 0.59   | 0.54 | 0.48  | 0.53  | 0.66  | 0.49  | 0.73  | 0.54 | 0.43 | 101.77 |
| ITA  | 0.44   | 0.61   | 0.75 | 0.67  | 0.75  | 0.62  | 0.83  | 0.60  | 0.71 | 0.63 | 0.43   |
| 6.57 |        |        |      |       |       |       |       |       |      |      |        |
| NLD  | 0.73   | 0.75   | 0.70 | 0.66  | 0.68  | 0.82  | 0.52  | 0.66  | 0.65 | 0.51 | 0.66   |
| 0.48 | 309.59 |        |      |       |       |       |       |       |      |      |        |
| NZL  | 0.66   | 0.65   | 0.52 | 0.52  | 0.52  | 0.59  | 0.43  | 0.37  | 0.55 | 0.55 | 0.30   |
| 0.30 | 0.43   | 212.01 |      |       |       |       |       |       |      |      |        |
| USA  | 0.69   | 0.84   | 0.91 | 0.75  | 0.85  | 0.88  | 0.77  | 0.63  | 0.84 | 0.74 | 0.64   |
| 0.72 | 0.79   | 0.53   | 2.33 |       |       |       |       |       |      |      |        |
| HUN  | 0.32   | 0.49   | 0.59 | 0.38  | 0.53  | 0.48  | 0.61  | 0.41  | 0.60 | 0.51 | 0.35   |
| 0.65 | 0.49   | 0.30   | 0.68 | 1.16  |       |       |       |       |      |      |        |
| CZE  | 0.37   | 0.48   | 0.60 | 0.60  | 0.63  | 0.47  | 0.62  | 0.33  | 0.55 | 0.58 | 0.28   |
| 0.64 | 0.34   | 0.30   | 0.58 | 0.52  | 20.17 |       |       |       |      |      |        |
| SVN  | 0.53   | 0.71   | 0.72 | 0.58  | 0.75  | 0.74  | 0.73  | 0.48  | 0.69 | 0.58 | 0.57   |
| 0.53 | 0.73   | 0.59   | 0.80 | 0.58  | 0.38  | 25.52 |       |       |      |      |        |
| ZAF  | 0.73   | 0.82   | 0.89 | 0.72  | 0.85  | 0.80  | 0.76  | 0.56  | 0.89 | 0.87 | 0.55   |
| 0.71 | 0.59   | 0.62   | 0.86 | 0.59  | 0.56  | 0.65  | 26.27 |       |      |      |        |
| POL  | 0.53   | 0.44   | 0.64 | 0.63  | 0.64  | 0.57  | 0.55  | 0.42  | 0.54 | 0.49 | 0.28   |
| 0.59 | 0.44   | 0.37   | 0.54 | 0.38  | 0.53  | 0.51  | 0.51  | 13.45 |      |      |        |

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JER dlo

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|     | AUS  | CAN  | DFS   | NLD    | NZL    | USA  | GBR  | ZAF   | IRL  |
|-----|------|------|-------|--------|--------|------|------|-------|------|
| AUS | 5.37 |      |       |        |        |      |      |       |      |
| CAN | 0.42 | 6.77 |       |        |        |      |      |       |      |
| DFS | 0.72 | 0.68 | 12.17 |        |        |      |      |       |      |
| NLD | 0.59 | 0.71 | 0.73  | 329.68 |        |      |      |       |      |
| NZL | 0.64 | 0.37 | 0.62  | 0.44   | 191.14 |      |      |       |      |
| USA | 0.70 | 0.84 | 0.82  | 0.79   | 0.56   | 2.47 |      |       |      |
| GBR | 0.49 | 0.83 | 0.75  | 0.67   | 0.37   | 0.79 | 0.28 |       |      |
| ZAF | 0.38 | 0.56 | 0.68  | 0.56   | 0.33   | 0.63 | 0.82 | 29.52 |      |
| IRL | 0.51 | 0.73 | 0.57  | 0.46   | 0.42   | 0.60 | 0.71 | 0.51  | 1.75 |

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RDC dlo

|     | AUS  | CAN  | DEU   | DFS   | NZL    | USA  | GBR  | NLD    | ZAF   | IRL  |
|-----|------|------|-------|-------|--------|------|------|--------|-------|------|
| AUS | 5.59 |      |       |       |        |      |      |        |       |      |
| CAN | 0.64 | 6.83 |       |       |        |      |      |        |       |      |
| DEU | 0.59 | 0.88 | 11.57 |       |        |      |      |        |       |      |
| DFS | 0.78 | 0.74 | 0.81  | 13.03 |        |      |      |        |       |      |
| NZL | 0.64 | 0.39 | 0.49  | 0.49  | 228.79 |      |      |        |       |      |
| USA | 0.63 | 0.91 | 0.85  | 0.81  | 0.40   | 2.70 |      |        |       |      |
| GBR | 0.59 | 0.87 | 0.86  | 0.78  | 0.41   | 0.81 | 0.30 |        |       |      |
| NLD | 0.72 | 0.71 | 0.69  | 0.80  | 0.45   | 0.79 | 0.67 | 347.36 |       |      |
| ZAF | 0.55 | 0.84 | 0.79  | 0.59  | 0.39   | 0.86 | 0.71 | 0.60   | 27.85 |      |
| IRL | 0.63 | 0.79 | 0.76  | 0.71  | 0.59   | 0.70 | 0.80 | 0.57   | 0.80  | 1.55 |

SIM dlo

|     | FRM  | NLD    | CZE   | SVN   | GBR  |
|-----|------|--------|-------|-------|------|
| FRM | 1.00 |        |       |       |      |
| NLD | 0.54 | 290.94 |       |       |      |
| CZE | 0.33 | 0.38   | 20.09 |       |      |
| SVN | 0.43 | 0.78   | 0.31  | 22.54 |      |
| GBR | 0.47 | 0.61   | 0.51  | 0.66  | 0.24 |

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal  
common three quarter sib group above diagonal

|     | CAN | CHE | DEA | NLD | NZL | USA | ITA | FRA | GBR | SVN |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| CAN | 0   | 101 | 111 | 43  | 19  | 135 | 101 | 70  | 50  | 23  |
| CHE | 84  | 0   | 513 | 76  | 17  | 291 | 400 | 134 | 53  | 53  |
| DEA | 93  | 403 | 0   | 118 | 23  | 296 | 604 | 174 | 54  | 76  |
| NLD | 37  | 67  | 110 | 0   | 17  | 67  | 103 | 69  | 28  | 34  |
| NZL | 19  | 14  | 17  | 10  | 0   | 23  | 19  | 15  | 13  | 6   |
| USA | 131 | 273 | 260 | 58  | 19  | 0   | 213 | 112 | 65  | 30  |
| ITA | 89  | 346 | 501 | 85  | 16  | 148 | 0   | 155 | 55  | 72  |
| FRA | 62  | 98  | 128 | 53  | 12  | 73  | 121 | 0   | 41  | 38  |
| GBR | 52  | 44  | 39  | 24  | 11  | 66  | 43  | 36  | 0   | 14  |
| SVN | 21  | 53  | 71  | 34  | 4   | 24  | 73  | 37  | 12  | 0   |

GUE

common bulls below diagonal  
common three quarter sib group above diagonal

|     | AUS | CAN | NZL | USA | GBR | ZAF |
|-----|-----|-----|-----|-----|-----|-----|
| AUS | 0   | 43  | 26  | 55  | 34  | 3   |
| CAN | 43  | 0   | 13  | 61  | 27  | 2   |
| NZL | 26  | 11  | 0   | 28  | 14  | 2   |
| USA | 51  | 51  | 26  | 0   | 72  | 7   |
| GBR | 29  | 22  | 12  | 75  | 0   | 3   |
| ZAF | 2   | 0   | 0   | 4   | 2   | 0   |

HOL

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common bulls below diagonal  
common three quarter sib group above diagonal

|     | AUS  | BEL | CAN  | CHE | DEU  | DFS  | ESP  | FRA  | GBR  | IRL | ISR | ITA  | NLD  | NZL | USA  | HUN  | CZE  | SVN |
|-----|------|-----|------|-----|------|------|------|------|------|-----|-----|------|------|-----|------|------|------|-----|
| ZAF |      |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| POL |      |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| AUS | 0    | 392 | 952  | 420 | 1261 | 949  | 638  | 969  | 1126 | 560 | 77  | 950  | 1081 | 941 | 1388 | 552  | 704  | 126 |
| 398 | 702  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| BEL | 291  | 0   | 359  | 292 | 549  | 409  | 336  | 465  | 478  | 280 | 42  | 422  | 585  | 274 | 459  | 276  | 356  | 87  |
| 196 | 349  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| CAN | 806  | 308 | 0    | 586 | 1771 | 912  | 951  | 1038 | 1273 | 393 | 74  | 1240 | 942  | 541 | 2337 | 728  | 858  | 126 |
| 403 | 867  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| CHE | 341  | 252 | 415  | 0   | 829  | 467  | 401  | 429  | 543  | 288 | 45  | 526  | 618  | 289 | 704  | 336  | 427  | 99  |
| 208 | 437  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| DEU | 734  | 425 | 773  | 629 | 0    | 2127 | 1177 | 1944 | 1830 | 691 | 114 | 2100 | 2323 | 752 | 2792 | 992  | 1633 | 205 |
| 493 | 1605 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| DFS | 537  | 310 | 525  | 374 | 978  | 0    | 737  | 1254 | 1296 | 596 | 111 | 1259 | 1460 | 637 | 1518 | 696  | 1025 | 167 |
| 432 | 1067 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| ESP | 432  | 299 | 480  | 304 | 672  | 500  | 0    | 839  | 880  | 390 | 80  | 972  | 802  | 415 | 1171 | 585  | 716  | 131 |
| 373 | 731  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| FRA | 540  | 398 | 517  | 355 | 734  | 453  | 550  | 0    | 1315 | 590 | 96  | 1506 | 1453 | 625 | 2044 | 737  | 1071 | 135 |
| 398 | 1108 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| GBR | 930  | 410 | 1396 | 507 | 1226 | 911  | 740  | 732  | 0    | 813 | 108 | 1381 | 1492 | 799 | 1846 | 755  | 1023 | 169 |
| 463 | 1069 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| IRL | 450  | 249 | 326  | 283 | 545  | 440  | 371  | 414  | 834  | 0   | 71  | 549  | 707  | 553 | 619  | 358  | 454  | 87  |
| 273 | 440  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| ISR | 53   | 23  | 41   | 30  | 87   | 86   | 52   | 46   | 83   | 59  | 0   | 104  | 113  | 81  | 122  | 81   | 95   | 34  |
| 53  | 101  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| ITA | 573  | 312 | 705  | 445 | 1086 | 765  | 653  | 619  | 1034 | 443 | 78  | 0    | 1360 | 629 | 2164 | 824  | 1104 | 171 |
| 440 | 1143 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| NLD | 828  | 572 | 663  | 552 | 1477 | 1020 | 637  | 667  | 1275 | 617 | 92  | 887  | 0    | 800 | 1822 | 748  | 1229 | 176 |
| 419 | 1195 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| NZL | 895  | 197 | 534  | 227 | 500  | 388  | 300  | 306  | 702  | 454 | 67  | 434  | 687  | 0   | 858  | 408  | 544  | 94  |
| 305 | 483  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| USA | 1188 | 347 | 2110 | 595 | 1367 | 860  | 689  | 871  | 1610 | 516 | 99  | 1130 | 1206 | 780 | 0    | 1033 | 1416 | 161 |
| 547 | 1399 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| HUN | 398  | 207 | 583  | 263 | 707  | 508  | 466  | 444  | 703  | 318 | 64  | 674  | 564  | 320 | 945  | 0    | 795  | 119 |
| 333 | 718  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| CZE | 421  | 253 | 528  | 302 | 1164 | 603  | 517  | 606  | 798  | 356 | 74  | 735  | 1000 | 378 | 1034 | 728  | 0    | 156 |
| 365 | 1033 |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| SVN | 86   | 69  | 86   | 72  | 178  | 132  | 100  | 86   | 138  | 65  | 27  | 142  | 140  | 66  | 124  | 94   | 120  | 0   |
| 79  | 159  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| ZAF | 332  | 151 | 328  | 166 | 346  | 309  | 318  | 247  | 410  | 236 | 39  | 317  | 330  | 241 | 505  | 271  | 252  | 58  |
| 0   | 338  |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |
| POL | 438  | 271 | 554  | 327 | 1135 | 720  | 481  | 526  | 875  | 331 | 76  | 785  | 934  | 326 | 1096 | 596  | 789  | 138 |
| 240 | 0    |     |      |     |      |      |      |      |      |     |     |      |      |     |      |      |      |     |

JER

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common bulls below diagonal  
common three quarter sib group above diagonal

|     | AUS | CAN | DFS | NLD | NZL | USA | GBR | ZAF | IRL |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| AUS | 0   | 178 | 112 | 52  | 343 | 375 | 173 | 177 | 37  |
| CAN | 184 | 0   | 74  | 28  | 132 | 284 | 131 | 111 | 5   |
| DFS | 81  | 63  | 0   | 63  | 119 | 158 | 140 | 112 | 24  |
| NLD | 47  | 22  | 60  | 0   | 54  | 63  | 64  | 56  | 17  |
| NZL | 384 | 147 | 98  | 46  | 0   | 282 | 169 | 158 | 70  |
| USA | 403 | 288 | 137 | 68  | 353 | 0   | 197 | 224 | 32  |
| GBR | 184 | 138 | 139 | 64  | 183 | 234 | 0   | 141 | 41  |
| ZAF | 168 | 109 | 91  | 49  | 161 | 232 | 149 | 0   | 26  |
| IRL | 34  | 4   | 20  | 16  | 77  | 34  | 43  | 26  | 0   |

## RDC

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common bulls below diagonal

common three quarter sib group above diagonal

|     | AUS | CAN | DEU | DFS | NZL | USA | GBR | NLD | ZAF | IRL |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| AUS | 0   | 78  | 24  | 153 | 103 | 85  | 52  | 16  | 28  | 7   |
| CAN | 78  | 0   | 9   | 90  | 65  | 168 | 72  | 4   | 61  | 2   |
| DEU | 22  | 8   | 0   | 44  | 7   | 9   | 4   | 11  | 1   | 3   |
| DFS | 134 | 87  | 35  | 0   | 126 | 118 | 56  | 32  | 38  | 11  |
| NZL | 104 | 64  | 7   | 122 | 0   | 79  | 51  | 6   | 29  | 5   |
| USA | 86  | 151 | 9   | 117 | 79  | 0   | 77  | 22  | 53  | 12  |
| GBR | 51  | 71  | 4   | 55  | 48  | 73  | 0   | 10  | 42  | 7   |
| NLD | 14  | 4   | 10  | 32  | 6   | 21  | 10  | 0   | 2   | 7   |
| ZAF | 28  | 61  | 1   | 37  | 27  | 47  | 36  | 2   | 0   | 1   |
| IRL | 6   | 2   | 3   | 8   | 5   | 12  | 7   | 6   | 1   | 0   |

## SIM

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common bulls below diagonal

common three quarter sib group above diagonal

|     | FRM | NLD | CZE | SVN | GBR |
|-----|-----|-----|-----|-----|-----|
| FRM | 0   | 101 | 162 | 0   | 53  |
| NLD | 123 | 0   | 123 | 25  | 43  |
| CZE | 189 | 119 | 0   | 51  | 41  |
| SVN | 0   | 25  | 49  | 0   | 0   |
| GBR | 65  | 41  | 36  | 0   | 0   |