Introduction

The latest routine international evaluation for **udder traits** took place as scheduled at the Interbull Centre. Data from thirty-three (33) countries were included in this evaluation.

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

Changes in national procedures

Changes in the national genetic evaluation of udder health traits are as follows:

JPN (HOL) Decreased information of daughters due to changes of pedigree

FRA (ALL) Base change

DEU (HOL,RDC,JER) Base change

ITA (HOL) Cut off one year of data, base change

CHE (BSW,HOL,SIM) Changed pre-adjustment for pregnancy based on number of days after conception for HOL, SIM and BSW. To account for stage of pregnancy, we pre-adjust the phenotypic data. Pregnancy effect estimates (from a previous study) are used for additive pre-adjustment of test-day records. Due to an error in a program code, pre-adjustment for days pregnant didn't work properly (since the introduction of the RRTDM in 2005). As a consequence of this error, nearly all the records got the maximum correction. Now, this error is fixed and the pre-adjustment for days pregnant should work correctly.

CHE (JER) First time

AUS (ALL) Changed to the rules for the official publication resulting in many bulls changing status to N, pedigree corrections

BEL (HOL) Change the "national standards" for official publication in our country (Walloon Region of Belgium) for type of proof = 21. Now, these "national standards" for this type of proof are the same than for type of proof= 11 or 12, i.e. if REL >=45

NLD (ALL) Minor adjustment in the EDC calculation for MAS

NZL (ALL) Continuous DNA parentage testing.

HRV (HOL,SIM) Changes in heritability due to estimated variance components based on larger (new) data set. Decrease in information due to pedigree changes and completeness

CAM (RDC) Base change

CAN (ALL) Base change

ITA (SIM) Base change

ITA (BSW) Base change

SVN (ALL) base change

URY (HOL) First time with scs data

USA (RDC) Corrected an error in the system related to RDC pedigrees. Previously cow heterosis had been computed as if mating AY to Scandinavian does not cause heterosis, whereas bull heterosis assumed they were different breeds. Now the same math to both sexes is applied. The correction is a post-adjustment to the PTAs, not part of the genetic model.

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.

^LTable 1. National evaluation data considered in the Interbull evaluation for udder health (April Routine Evaluation 2018).

Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		124	7510	1500	673	
BEL			1919			
CAN	214	97	11770	690	784	
CHE	2849		3233	82		3121
CZE			3772			
DEA	5454					21704
DEU			27021		420	
DFS			12843	2076	7675	
ESP			3570			
EST			1086		411	
FRA	372		16750			448
FRM						4170
GBR	107	269	6400	667	489	82
HUN			2677			165
IRL			2306			
ISR			1366			
ITA	1851		9289			1423
JPN			5787			
KOR			1190			
LTU			757		430	
LVA			528		564	
NLD	182		15148	144	70	332
NOR					4054	
NZL	49	57	7337	4351	1265	
POL			9953			
PRT			2329			
SVK			1085			554
SVN	350		496			584
URY			1627			
USA	1037	687	36439	4295	657	43
ZAF			1163	558	122	
HRV			722			799
MEX						
CAM					37	
No.Records	12465	1234	196073	14363	17651	33425
Pub. Proofs	10174	963	150026	11852	16899	30074

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

BSW scs

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0.24									
FRA	0.93	1.03								
NLD	0.90	0.92	3.73							
USA	0.92	0.91	0.88	0.21						
CHE	0.92	0.94	0.93	0.88	10.47					
DEA	0.93	0.96	0.92	0.88	0.97	11.90				
NZL	0.87	0.87	0.87	0.86	0.87	0.87	0.38			
ITA	0.90	0.90	0.88	0.88	0.95	0.91	0.87	17.13		
GBR	0.92	0.96	0.96	0.90	0.94	0.95	0.89	0.89	12.71	
SVN	0.89	0.89	0.89	0.89	0.89	0.89	0.88	0.89	0.89	10.51

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0.24									
FRA	0.89	1.07								
NLD	0.87	0.87	3.55							
USA	0.88	0.88	0.88	0.21						
CHE	0.92	0.88	0.89	0.88	10.47					
DEA	0.91	0.86	0.89	0.87	0.97	11.90				
NZL	0.89	0.89	0.89	0.86	0.87	0.87	0.38			
ITA	0.90	0.88	0.89	0.88	0.95	0.91	0.87	17.13		
GBR	0.88	0.88	0.88	0.89	0.89	0.90	0.89	0.89	2.86	
SVN	0.90	0.89	0.89	0.89	0.89	0.89	0.88	0.89	0.89	10.51

GUE scs

	CAN	GBR	USA	AUS	NZL
CAN	0.24				
GBR	0.93	13.42			
USA	0.93	0.90	0.25		
AUS	0.87	0.93	0.86	28.75	
NZL	0.87	0.89	0.86	0.95	0.63

HOL scs

	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	0.27																												
CHE	0.88	11.17																											
DEU	0.93	0.94	12.67																										
DFS	0.92	0.93	0.96	11.97																									
EST	0.88	0.89	0.94	0.92	13.69																								
FRA	0.94	0.93	0.95	0.97	0.91	1.19																							
GBR	0.93	0.94	0.95	0.94	0.90	0.96	12.76																						
NLD	0.91	0.94	0.95	0.94	0.91	0.94	0.96	4.19																					
USA	0.94	0.88	0.89	0.88	0.90	0.90	0.90	0.88	0.21																				
ISR	0.85	0.84	0.85	0.84	0.87	0.85	0.83	0.83	0.88	0.24																			
ITA	0.89	0.89	0.94	0.92	0.93	0.92	0.90	0.88	0.89	0.85	5.82																		
AUS	0.86	0.91	0.88	0.89	0.85	0.90	0.93	0.92	0.86	0.82	0.85	30.23																	
HUN	0.88	0.90	0.92	0.91	0.91	0.91	0.89	0.88	0.92	0.88	0.93	0.85	1.43																
BEL	0.91	0.93	0.97	0.96	0.95	0.95	0.94	0.94	0.89	0.84	0.94	0.88	0.93	0.52															
JPN	0.88	0.88	0.88	0.89	0.87	0.90	0.88	0.88	0.88	0.83	0.88	0.86	0.88	0.88	0.42														
ESP	0.92	0.92	0.95	0.94	0.94	0.96	0.93	0.91	0.91	0.88	0.95	0.86	0.93	0.96	0.88	11.58													
ZAF	0.90	0.90	0.91	0.90	0.89	0.93	0.92	0.89	0.89	0.87	0.92	0.88	0.91	0.91	0.88	0.95	26.54												
NZL	0.86	0.86	0.86	0.86	0.85	0.86	0.89	0.87	0.85	0.82	0.84	0.96	0.85	0.86	0.85	0.85	0.86	0.40											
IRL	0.88	0.93	0.93	0.94	0.90	0.93	0.96	0.94	0.86	0.82	0.88	0.95	0.86	0.93	0.86	0.92	0.91	0.92	0.11										
CZE	0.88	0.88	0.90	0.89	0.89	0.89	0.88	0.88	0.88	0.85	0.90	0.86	0.89	0.89	0.88	0.91	0.88	0.86	0.86	14.32									
SVK	0.88	0.89	0.90	0.89	0.88	0.90	0.87	0.87	0.88	0.84	0.90	0.85	0.95	0.90	0.88	0.91	0.88	0.85	0.86	0.88	0.42								
POL	0.90	0.92	0.96	0.95	0.94	0.93	0.91	0.91	0.88	0.86	0.94	0.86	0.94	0.96	0.88	0.95	0.91	0.86	0.89	0.90	0.90	9.96							
LTU	0.88	0.89	0.90	0.88	0.93	0.88	0.88	0.88	0.88	0.86	0.88	0.86	0.88	0.92	0.88	0.89	0.89	0.87	0.86	0.88	0.89	0.90	0.35						
LVA	0.88	0.89	0.94	0.92	0.94	0.89	0.89	0.89	0.88	0.82	0.91	0.86	0.88	0.94	0.88	0.89	0.87	0.85	0.89	0.88	0.87	0.93	0.93	0.48					

PRT 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.84 0.88
0.86 0.88 0.88 0.88 0.88 0.88 0.86 0.86 0.88 0.88 0.88 0.88
0.88 0.47
KOR 0.88 0.87 0.88 0.89 0.88 0.88 0.88 0.87 0.88 0.83 0.89
0.85 0.88 0.89 0.88 0.90 0.88 0.85 0.85 0.88 0.87 0.92 0.89
0.90 0.88 0.34
SVN 0.88 0.87 0.88 0.87 0.87 0.87 0.87 0.87 0.88 0.84 0.88
0.85 0.88 0.88 0.88 0.88 0.87 0.85 0.86 0.88 0.87 0.88 0.89
0.88 0.88 0.87 10.77
HRV 0.88 0.88 0.88 0.88 0.88 0.87 0.87 0.88 0.88 0.84 0.88
0.85 0.88 0.88 0.88 0.88 0.88 0.85 0.85 0.88 0.87 0.88 0.88
0.88 0.88 0.87 0.88 11.77
URY 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.85 0.88
0.86 0.88 0.88 0.88 0.88 0.88 0.86 0.86 0.88 0.88 0.88 0.88
0.88 0.88 0.88 0.89 0.88 0.20

HOL mas

CAN CHE DEU DFS EST FRA GBR NLD USA ISR ITA
AUS HUN BEL JPN ESP ZAF NZL IRL CZE SVK POL LTU LVA
PRT KOR SVN HRV URY
CAN 7.68
CHE 0.86 11.16
DEU 0.86 0.94 12.68
DFS 0.94 0.86 0.87 12.01
EST 0.85 0.88 0.92 0.86 13.70
FRA 0.96 0.85 0.87 0.94 0.85 1.21
GBR 0.88 0.89 0.89 0.88 0.88 0.88 2.48
NLD 0.87 0.88 0.93 0.88 0.91 0.88 0.88 4.80
USA 0.88 0.88 0.88 0.88 0.89 0.88 0.88 0.89 0.21
ISR 0.81 0.82 0.83 0.81 0.84 0.81 0.84 0.82 0.85 0.24
ITA 0.87 0.88 0.90 0.87 0.89 0.87 0.88 0.89 0.88 0.83 6.02
AUS 0.84 0.91 0.88 0.85 0.84 0.84 0.90 0.88 0.86 0.80 0.85
30.23
HUN 0.86 0.89 0.92 0.87 0.90 0.87 0.88 0.90 0.91 0.86 0.91
0.85 1.43
BEL 0.87 0.93 0.97 0.87 0.94 0.87 0.89 0.94 0.89 0.82 0.90
0.87 0.92 0.52
JPN 0.86 0.87 0.88 0.86 0.86 0.86 0.88 0.87 0.88 0.81 0.88
0.85 0.87 0.87 0.42
ESP 0.87 0.92 0.95 0.87 0.92 0.88 0.89 0.92 0.91 0.86 0.91
0.86 0.93 0.96 0.88 11.58
ZAF 0.86 0.89 0.91 0.86 0.87 0.86 0.89 0.89 0.89 0.84 0.89
0.88 0.91 0.91 0.87 0.95 26.44
NZL 0.86 0.86 0.86 0.86 0.84 0.86 0.89 0.87 0.85 0.81 0.85
0.96 0.85 0.85 0.85 0.85 0.86 0.40
IRL 0.86 0.93 0.92 0.87 0.88 0.86 0.90 0.89 0.86 0.81 0.86
0.94 0.86 0.93 0.86 0.92 0.90 0.92 0.11
CZE 0.86 0.87 0.90 0.86 0.88 0.86 0.88 0.88 0.88 0.82 0.89
0.84 0.89 0.89 0.87 0.91 0.87 0.85 0.85 14.33
SVK 0.85 0.87 0.90 0.86 0.87 0.85 0.88 0.88 0.87 0.82 0.88
0.84 0.95 0.89 0.87 0.90 0.87 0.84 0.85 0.88 0.41
POL 0.88 0.91 0.96 0.88 0.92 0.88 0.89 0.92 0.88 0.83 0.90
0.86 0.94 0.96 0.88 0.95 0.90 0.86 0.89 0.90 0.90 9.96
LTU 0.88 0.90 0.90 0.88 0.92 0.89 0.88 0.88 0.88 0.86 0.88
0.87 0.88 0.92 0.89 0.90 0.89 0.87 0.87 0.88 0.90 0.90 0.35
LVA 0.84 0.87 0.93 0.85 0.92 0.84 0.88 0.89 0.87 0.80 0.88
0.85 0.87 0.92 0.86 0.87 0.85 0.83 0.87 0.86 0.85 0.92 0.92
0.48
PRT 0.88 0.88 0.88 0.88 0.87 0.88 0.88 0.88 0.88 0.83 0.88
0.86 0.88 0.88 0.88 0.88 0.88 0.86 0.86 0.88 0.88 0.88 0.88
0.88 0.46
KOR 0.86 0.87 0.87 0.86 0.86 0.87 0.88 0.87 0.88 0.81 0.88
0.84 0.87 0.88 0.87 0.90 0.87 0.85 0.85 0.87 0.86 0.91 0.89
0.88 0.88 0.34
SVN 0.85 0.87 0.87 0.86 0.86 0.85 0.88 0.87 0.86 0.82 0.87
0.84 0.87 0.87 0.87 0.87 0.86 0.84 0.85 0.87 0.86 0.87 0.89
0.87 0.88 0.86 10.77

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HRV       0.85    0.87    0.87    0.85    0.87    0.85    0.88    0.87    0.87    0.82    0.88
0.85    0.87    0.87    0.87    0.87    0.87    0.84    0.84    0.87    0.86    0.88    0.88
0.88    0.88    0.86    0.87   11.77
URY       0.88    0.88    0.88    0.88    0.89    0.88    0.88    0.88    0.88    0.85    0.88
0.86    0.88    0.88    0.88    0.88    0.88    0.86    0.86    0.88    0.88    0.88    0.89
0.89    0.88    0.88    0.89    0.88    0.20
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JER scs

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE
CAN	0.22								
DFS	0.91	12.51							
GBR	0.91	0.91	11.23						
NLD	0.92	0.95	0.95	3.72					
USA	0.91	0.88	0.89	0.88	0.19				
AUS	0.88	0.89	0.90	0.92	0.86	29.04			
ZAF	0.89	0.88	0.89	0.90	0.88	0.89	21.26		
NZL	0.88	0.88	0.89	0.88	0.86	0.96	0.86	0.38	
CHE	0.89	0.91	0.91	0.93	0.88	0.89	0.89	0.87	11.57

JER mas

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE
CAN	7.53								
DFS	0.94	12.36							
GBR	0.88	0.89	1.84						
NLD	0.88	0.88	0.89	4.06					
USA	0.88	0.88	0.88	0.89	0.19				
AUS	0.87	0.87	0.89	0.89	0.86	29.06			
ZAF	0.87	0.87	0.88	0.89	0.88	0.90	21.25		
NZL	0.89	0.88	0.89	0.89	0.86	0.96	0.86	0.38	
CHE	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.87	11.57

RDC scs

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU
LVA	NLD	CAM									
CAN	0.24										
DFS	0.94	12.71									
GBR	0.93	0.92	11.48								
NOR	0.92	0.93	0.89	13.69							
USA	0.92	0.88	0.89	0.89	0.24						
DEU	0.93	0.95	0.94	0.90	0.89	13.46					
AUS	0.89	0.92	0.92	0.91	0.86	0.90	31.24				
EST	0.89	0.94	0.91	0.90	0.91	0.95	0.91	12.17			
ZAF	0.89	0.90	0.90	0.93	0.89	0.92	0.88	0.90	25.01		
NZL	0.88	0.88	0.88	0.89	0.85	0.87	0.96	0.88	0.86	0.41	
LTU	0.90	0.89	0.89	0.90	0.89	0.89	0.87	0.91	0.91	0.87	0.34
LVA	0.90	0.89	0.90	0.90	0.89	0.94	0.90	0.96	0.89	0.88	0.90
0.44											
NLD	0.91	0.95	0.96	0.90	0.88	0.95	0.92	0.92	0.90	0.87	0.89
0.90	3.79										
CAM	0.94	0.94	0.94	0.93	0.90	0.94	0.93	0.94	0.93	0.90	0.93
0.93	0.94	0.18									

RDC mas

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU
LVA	NLD	CAM									
CAN	7.79										
DFS	0.91	13.07									
GBR	0.88	0.88	2.02								
NOR	0.92	0.88	0.89	13.69							
USA	0.88	0.88	0.88	0.89	0.24						
DEU	0.87	0.86	0.89	0.90	0.89	13.46					
AUS	0.86	0.84	0.90	0.90	0.86	0.89	31.30				

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EST       0.86    0.85    0.89    0.90    0.89    0.93    0.87   12.17
ZAF       0.88    0.88    0.89    0.93    0.89    0.92    0.88    0.90   25.11
NZL       0.87    0.87    0.89    0.90    0.86    0.87    0.96    0.87    0.87    0.41
LTU       0.87    0.86    0.89    0.90    0.88    0.89    0.87    0.92    0.90    0.87    0.34
LVA       0.86    0.84    0.89    0.90    0.88    0.93    0.89    0.95    0.88    0.88    0.91
0.44
NLD       0.88    0.88    0.88    0.90    0.89    0.93    0.89    0.91    0.89    0.88    0.89
0.90    4.10
CAM       0.93    0.93    0.93    0.93    0.90    0.94    0.92    0.94    0.93    0.91    0.93
0.94    0.94    0.18

--------------------------------------------------------------------------------
SIM     scs
--------------------------------------------------------------------------------
           FRM     FRA     ITA     NLD     CHE     DEA     HUN     SVK     SVN     GBR     HRV
USA
FRM       1.08
FRA       0.93    1.02
ITA       0.95    0.90   13.76
NLD       0.91    0.93    0.88    3.90
CHE       0.93    0.93    0.90    0.93   10.65
DEA       0.92    0.93    0.88    0.90    0.89   12.15
HUN       0.93    0.91    0.93    0.88    0.90    0.94   15.88
SVK       0.89    0.89    0.89    0.91    0.90    0.88    0.94    0.38
SVN       0.90    0.89    0.89    0.89    0.89    0.88    0.90    0.89    9.02
GBR       0.92    0.96    0.89    0.95    0.91    0.93    0.89    0.88    0.88   11.81
HRV       0.92    0.88    0.88    0.88    0.88    0.88    0.89    0.88    0.89    0.88   10.07
USA       0.89    0.90    0.89    0.88    0.89    0.90    0.92    0.89    0.89    0.90    0.88
0.22

--------------------------------------------------------------------------------
SIM     mas
--------------------------------------------------------------------------------
           FRM     FRA     ITA     NLD     CHE     DEA     HUN     SVK     SVN     GBR     HRV
USA
FRM       1.08
FRA       0.92    1.00
ITA       0.95    0.88   13.77
NLD       0.88    0.88    0.89    3.93
CHE       0.92    0.87    0.90    0.88   10.65
DEA       0.91    0.92    0.88    0.88    0.89   12.15
HUN       0.92    0.88    0.92    0.91    0.90    0.93   15.88
SVK       0.88    0.88    0.89    0.89    0.89    0.88    0.94    0.38
SVN       0.90    0.88    0.89    0.88    0.89    0.88    0.89    0.89    9.02
GBR       0.90    0.88    0.89    0.89    0.89    0.90    0.88    0.89    0.89    2.60
HRV       0.92    0.88    0.88    0.87    0.88    0.88    0.89    0.88    0.89    0.88   10.07
USA       0.89    0.88    0.89    0.89    0.89    0.90    0.92    0.89    0.89    0.89    0.88
0.22

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^LAPPENDIX II. Number of common bulls
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BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  FRA  NLD  USA  CHE  DEA  NZL  ITA  GBR  SVN
 ------------------------------------------------------------------------
  CAN    0   76   49  156  117  122   22  109   57   28
  FRA   65    0   80  116  151  200   21  174   50   49
  NLD   46   66    0   75   89  139   23  117   37   38
  USA  142   78   64    0  303  298   27  212   76   37
  CHE   91  113   80  284    0  543   24  407   63   68
  DEA   99  149  132  261  441    0   32  581   65   92
  NZL   20   17   16   24   19   27    0   26   17    8
  ITA   90  139   97  146  350  482   19    0   65   86
  GBR   53   41   30   72   49   45   15   47    0   20
  SVN   25   48   39   30   65   86    7   85   16    0
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BSW
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  FRA  NLD  USA  CHE  DEA  NZL  ITA  GBR  SVN
 ------------------------------------------------------------------------------
  CAN    0   70   45  156  117  122   22  109   28   28
  FRA   61    0   65  102  148  182   18  159   26   48
  NLD   40   55    0   68   81  122   23  106   18   35
  USA  142   70   57    0  303  298   27  212   34   37
  CHE   91  113   74  284    0  543   24  407   31   68
  DEA   99  137  113  261  441    0   32  581   30   92
  NZL   20   15   16   24   19   27    0   26   10    8
  ITA   90  130   86  146  350  482   19    0   32   86
  GBR   25   21   15   33   26   23    8   25    0   12
  SVN   25   47   36   30   65   86    7   85   10    0
 ------------------------------------------------------------------------------
GUE
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  USA  AUS  NZL
 ------------------------------------------------------------------------------
  CAN    0   28   67   43   13
  GBR   23    0   83   32   13
  USA   58   85    0   56   29
  AUS   41   27   53    0   26
  NZL   11   11   29   26    0
 ------------------------------------------------------------------------------
GUE
--------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEU  DFS  EST  FRA  GBR  NLD  USA  ISR  ITA  AUS  HUN  BEL  JPN  ESP  ZAF  NZL
IRL  CZE  SVK  POL  LTU  LVA  PRT  KOR  SVN  HRV  URY
 ------------------------------------------------------------------------------
  CAN    0  762 2196 1205  213 1302 1353 1265 2869   98 1480 1204  868  696 1199 1130  455  642
400  909  392 1123  204  191  921  563  171  246  648
  CHE  603    0 1070  647  147  601  611  810  892   54  653  540  407  558  430  501  253  366
310  469  217  596  106  139  479  222  124  182  286
  DEU 1376  914    0 2614  375 2425 1908 3264 3391  147 2410 1558 1166 1179 1407 1428  562  916
694 1659  700 2131  456  307 1193  543  267  564  713
  DFS  902  569 1605    0  259 1528 1383 1906 1858  129 1480 1155  828  781  898  918  481  772
587 1096  393 1406  278  209  883  418  212  355  581
  EST  112   81  259  152    0  232  220  323  304   45  240  194  181  175  186  181  101  121
106  229  107  276   72   90  177   93   81  111  123
  FRA  787  523 1168  742  105    0 1401 1834 2326  117 1613 1161  864  858 1137 1040  455  750
578 1096  403 1469  211  187  883  439  175  259  549
  GBR 1477  561 1327  976  123  820    0 1559 1877  116 1392 1210  777  782  943  962  484  823
716  889  349 1137  225  179  885  420  184  293  591
  NLD 1113  783 2879 1565  231 1063 1291    0 2250  138 1587 1327  882 1183  983 1007  493  951
686 1292  512 1565  266  228  999  409  218  394  602
  USA 2873  791 2138 1282  195 1162 1558 1881    0  150 2386 1682 1176  879 1795 1387  606  982
595 1427  509 1765  296  259 1223  730  202  329  986
  ISR   63   36  122  101   28   63   78  112  136    0  124   95  100   74   94   99   57   99
73  106   47  121   38   28   97   50   41   58   78
  ITA 1020  580 1483 1026  134  791  998 1238 1485   89    0 1096  947  755 1102 1163  466  700
502 1148  377 1417  255  223  960  516  211  348  626
  AUS 1136  475 1067  777   92  739  993 1121 1584   62  750    0  657  678  815  786  447 1084
559  738  290  896  188  163  728  367  155  253  579
  HUN  753  328  899  632  109  557  674  719 1118   74  782  480    0  499  664  703  374  465
346  804  299  852  179  139  675  393  142  230  465
  BEL  666  566 1205  718  108  833  765 1360  760   49  717  585  433    0  498  606  320  475
405  561  280  728  142  144  629  251  157  240  327
  JPN  557  279  550  465   67  388  471  495  777   45  487  437  380  316    0  833  406  517
349  736  298  899  173  149  670  474  147  193  522
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  ESP  636  408  887  659   86  733  755  880  847   62  830  545  547  598  387    0  428  493
393  740  301  929  188  166  787  399  165  253  482
  ZAF  384  205  430  361   50  312  416  413  577   38  361  381  298  269  282  374    0  352
276  344  174  392   93   99  411  242   92  138  313
  NZL  628  307  695  528   63  427  694  865  915   80  501 1073  362  387  272  371  279    0
578  529  240  599  144  113  533  269  117  192  465
  IRL  322  286  540  439   54  403  663  587  471   52  387  444  277  377  206  358  223  457
0  372  169  452  112   94  384  163   91  142  288
  CZE  583  310 1176  660  143  616  544 1085 1015   78  736  439  689  413  307  474  217  350
229    0  417 1151  212  182  708  406  184  310  471
  SVK  263  111  526  203   49  213  198  348  330   19  225  148  212  171  112  150   91  143
84  320    0  415   84   96  307  183   75  121  217
  POL  814  475 1761 1065  193  867  879 1356 1571   96 1017  622  730  657  450  634  286  440
332  882  279    0  301  251  942  485  214  408  563
  LTU   94   41  430  144   34   53  103  144  189   17  127   73  107   62   50   79   35   64
47  131   39  223    0   74  184  118   46  128  125
  LVA  109   79  207  129   63   87  102  150  207   20  152   78   99   92   66   93   58   55
52  118   47  186   52    0  190   99   44  115  119
  PRT  916  422 1085  770  123  738  816 1000 1266   72  887  564  664  635  409  742  365  430
323  566  209  947  113  143    0  416  148  290  508
  KOR  511  153  354  286   47  247  307  278  824   31  413  269  328  183  285  280  182  189
104  279  111  402   54   59  352    0   86  118  347
  SVN  120   93  253  178   49  122  135  187  153   31  176  112  109  130   86  124   64   81
66  136   43  193   21   27  119   51    0   92   92
  HRV  123  121  578  272   80  154  207  356  244   43  264  158  176  199   91  197   92  111
96  223   61  357   87   90  234   53   75    0  156
  URY  605  222  514  411   72  332  498  486 1247   43  455  455  394  267  309  391  273  373
222  308  137  470   70   79  455  278   53   89    0
 ------------------------------------------------------------------------------
HOL
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEU  DFS  EST  FRA  GBR  NLD  USA  ISR  ITA  AUS  HUN  BEL  JPN  ESP  ZAF  NZL
IRL  CZE  SVK  POL  LTU  LVA  PRT  KOR  SVN  HRV  URY
 ------------------------------------------------------------------------------
  CAN    0  487 1184  595  123  664  683  666 1432   61  909  624  538  425  675  706  228  332
221  580  218  793  144  112  571  385  127  181  386
  CHE  399    0 1067  570  144  508  568  796  889   54  600  540  406  555  429  501  252  366
310  468  215  596  106  138  478  222  124  182  283
  DEU  840  913    0 2370  373 1806 1677 3176 3381  147 2060 1552 1166 1167 1405 1424  559  909
694 1658  688 2128  454  305 1180  539  267  564  704
  DFS  547  493 1348    0  239 1130 1155 1648 1704  124 1170 1068  772  708  855  877  470  724
568 1006  348 1289  268  193  830  389  202  332  542
  EST   71   81  259  136    0  189  199  316  301   45  223  192  180  173  183  179   98  118
104  228  105  275   72   89  174   92   81  110  121
  FRA  466  435  805  559   91    0 1024 1372 1620   98 1203  899  744  706  867  872  368  580
477  946  317 1267  185  156  756  372  157  224  444
  GBR  648  540 1238  824  117  641    0 1409 1666  116 1171 1096  746  730  850  897  449  743
664  842  321 1084  213  160  828  399  176  278  554
  NLD  636  769 2758 1236  227  814 1175    0 2188  135 1346 1310  873 1159  972  994  490  945
683 1274  496 1542  266  224  979  404  214  390  595
  USA 1421  791 2136 1084  195  733 1410 1800    0  150 2048 1679 1175  868 1793 1385  602  974
595 1426  502 1763  294  258 1207  725  202  329  979
  ISR   44   36  122   91   28   55   78  109  136    0  112   95  100   74   94   99   57   99
73  106   46  121   37   28   97   50   41   58   78
  ITA  657  530 1234  819  127  603  867 1034 1336   74    0  945  880  668  991 1060  411  580
429 1064  347 1310  232  202  877  495  200  309  575
  AUS  640  475 1067  677   92  600  906 1103 1584   62  673    0  656  669  815  786  446 1080
559  737  282  896  186  162  721  364  155  253  575
  HUN  501  328  899  581  109  485  656  704 1118   74  734  480    0  495  664  703  373  464
346  803  297  852  179  138  669  393  142  230  464
  BEL  437  565 1203  633  108  674  729 1331  758   49  652  584  433    0  494  601  320  468
404  558  274  726  141  142  623  249  157  240  324
  JPN  432  279  550  421   67  341  460  490  777   45  463  437  380  316    0  833  405  514
349  735  292  899  172  147  663  472  147  193  517
  ESP  419  408  887  613   86  638  735  862  847   62  722  545  547  598  387    0  428  492
393  739  297  928  186  165  784  399  165  253  477
  ZAF  209  205  430  346   50  267  400  408  577   38  322  381  298  269  282  374    0  351
276  344  172  390   92   98  410  240   92  137  313
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  NZL  298  307  694  480   62  347  599  858  915   80  441 1073  362  387  272  371  279    0
577  528  236  598  144  111  529  267  117  192  461
  IRL  216  286  540  409   54  362  633  583  471   52  346  444  277  377  206  358  223  457
0  372  167  451  112   93  383  163   91  142  287
  CZE  404  310 1176  578  143  493  532 1067 1015   78  691  439  689  413  307  474  217  350
229    0  415 1150  211  182  703  404  184  310  468
  SVK  146  111  525  170   49  157  189  337  330   19  210  147  212  171  112  150   91  143
84  319    0  412   84   95  304  183   75  121  215
  POL  645  475 1761  932  193  752  860 1327 1571   96  945  622  730  657  450  634  286  440
332  882  279    0  300  251  938  485  214  408  561
  LTU   78   41  430  132   34   47  101  142  189   17  107   73  107   62   50   79   35   64
47  131   39  223    0   73  182  116   46  127  123
  LVA   71   79  207  115   63   77   95  147  207   20  128   78   99   92   66   93   58   54
52  118   47  186   52    0  188   99   44  115  118
  PRT  569  421 1085  708  123  644  777  987 1264   72  824  564  664  635  409  742  365  430
323  566  209  947  113  143    0  413  148  288  503
  KOR  365  153  354  258   47  216  296  271  824   31  394  269  328  183  285  280  182  189
104  279  111  402   54   59  352    0   86  118  346
  SVN   94   93  253  161   49  111  134  183  153   31  165  112  109  130   86  124   64   81
66  136   43  193   21   27  119   51    0   92   92
  HRV  106  121  578  243   80  138  204  348  244   43  214  158  176  199   91  197   92  111
96  223   61  357   87   90  234   53   75    0  155
  URY  367  222  514  366   72  268  472  473 1247   43  429  455  394  267  309  391  273  373
222  308  137  470   70   79  454  278   53   89    0
 ------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  GBR  NLD  USA  AUS  ZAF  NZL  CHE
 ------------------------------------------------------------------------------
  CAN    0   74  135   33  365  220  131  157   35
  DFS   58    0  133   88  148  120  120  113   52
  GBR  138  120    0   74  203  181  146  188   64
  NLD   26   85   68    0   73   64   65   64   37
  USA  376  117  223   77    0  434  257  328   59
  AUS  224   84  190   54  467    0  202  385   47
  ZAF  127   97  148   60  269  195    0  178   51
  NZL  167   85  194   56  398  429  187    0   47
  CHE   29   47   62   32   59   39   46   39    0
 ------------------------------------------------------------------------------
JER
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  GBR  NLD  USA  AUS  ZAF  NZL  CHE
 ------------------------------------------------------------------------------
  CAN    0   30   61   13  131   89   55   62   22
  DFS   24    0   84   73  135  107  109  104   51
  GBR   57   76    0   50  154  131  109  127   59
  NLD    8   66   46    0   67   61   63   59   35
  USA  123   95  163   72    0  434  257  327   59
  AUS   79   69  133   54  467    0  202  384   47
  ZAF   50   84  110   59  269  195    0  178   51
  NZL   61   73  129   51  398  428  187    0   47
  CHE   18   46   54   30   59   39   46   39    0
 ------------------------------------------------------------------------------
RDC
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DFS  GBR  NOR  USA  DEU  AUS  EST  ZAF  NZL  LTU  LVA  NLD  CAM
 ------------------------------------------------------------------------------
  CAN    0  136   74    5  184   15   91    2   69   78   16    7    6    0
  DFS  136    0   94  112  166   67  162   88   50  151  114   91   43    0
  GBR   74   87    0   42   98   19   72    6   36   68   26   11   27    0
  NOR    5   84   44    0   64   19   55   14    0   39   27   16   31    0
  USA  170  161   93   65    0   27  110   14   58  104   37   14   33   20
  DEU   14   57   18   19   26    0   41   25    2   21   38   29   15    0
  AUS   91  134   68   46  111   40    0   23   32  123   43   27   25    9
```

EST	2	78	5	14	13	24	22	0	0	6	25	36	13	0
ZAF	71	47	32	0	52	2	32	0	0	32	5	1	3	0
NZL	76	148	64	38	104	20	125	5	28	0	27	13	15	9
LTU	15	97	24	22	30	34	39	24	5	23	0	37	16	0
LVA	7	59	11	14	11	23	25	28	1	10	31	0	9	0
NLD	6	43	26	30	32	15	23	12	3	15	14	8	0	0
CAM	0	0	0	0	20	0	9	0	0	9	0	0	0	0

RDC

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	0	65	23	3	66	8	29	0	35	29	12	4	3	0
DFS	65	0	62	114	157	67	180	88	45	148	113	92	40	0
GBR	23	58	0	38	63	17	47	4	22	47	20	9	19	0
NOR	3	85	40	0	63	19	55	14	0	39	27	16	27	0
USA	65	153	62	64	0	27	108	14	53	101	36	14	31	20
DEU	8	57	17	19	26	0	41	25	2	21	38	29	14	0
AUS	29	154	45	46	110	40	0	23	30	122	43	27	22	9
EST	0	78	4	14	13	24	22	0	0	6	25	36	11	0
ZAF	36	45	21	0	51	2	32	0	0	30	5	1	2	0
NZL	29	143	46	38	104	20	124	5	28	0	27	13	13	9
LTU	11	96	18	22	29	34	39	24	5	23	0	37	15	0
LVA	4	59	9	14	11	23	25	28	1	10	31	0	8	0
NLD	3	39	19	26	30	14	20	10	2	13	13	7	0	0
CAM	0	0	0	0	20	0	9	0	0	9	0	0	0	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	0	3	154	112	179	222	2	56	17	65	2	28
FRA	1	0	134	54	12	250	5	53	53	0	84	0
ITA	187	121	0	160	84	751	14	134	99	44	206	20
NLD	136	54	157	0	83	227	6	60	44	47	83	15
CHE	230	9	86	86	0	291	2	31	5	51	1	18
DEA	262	209	652	237	255	0	30	359	175	46	503	17
HUN	0	4	11	6	1	19	0	9	8	0	15	0
SVK	55	45	113	51	25	366	8	0	44	10	86	3
SVN	17	50	94	42	5	161	7	42	0	0	69	0
GBR	82	0	47	47	58	49	0	5	0	0	0	18
HRV	1	78	197	82	1	526	13	69	59	0	0	0
USA	43	0	27	18	19	24	0	3	0	25	0	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVK	SVN	GBR	HRV	USA
FRM	0	2	151	103	171	209	2	56	17	24	2	28
FRA	1	0	86	31	8	159	3	39	34	0	58	0
ITA	185	75	0	151	84	751	14	134	99	18	206	20
NLD	124	30	147	0	79	207	6	57	41	17	78	15
CHE	222	5	86	79	0	291	2	31	5	20	1	18
DEA	250	122	652	217	255	0	30	359	175	17	503	17
HUN	0	2	11	6	1	19	0	9	8	0	15	0
SVK	55	31	113	48	25	366	8	0	44	4	86	3
SVN	17	29	94	39	5	161	7	42	0	0	69	0
GBR	29	0	20	18	23	21	0	4	0	0	0	16
HRV	1	51	197	79	1	526	13	69	59	0	0	0
USA	43	0	27	18	19	24	0	3	0	20	0	0