Introduction

The latest routine international evaluation for udder traits took place as scheduled at the Interbull Centre. Data from thirty-two (32) countries were included in this evaluation.

International genetic evaluations for udder health traits of bulls from Australia, Austria-Germany, Belgium, Canada, 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.

Countries sending real MAS data (other countries participate to the MAS evaluation using SCS data as predictor):

HOL : DFS, NLD, FRA, CAN, ITA, CHE, USA, DEU, GBR, AUS
RDC : DFS, NLD, CAN, GBR, AUS
BSW : NLD, FRA, CHE, GBR, USA
JER : DFS, NLD, CAN, GBR, AUS, USA
SIM : NLD, CHE, GBR
GUE : No evaluation for MAS yet

Changes in national procedures

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

JPN (HOL)	Small changes in proofs caused by additional records and in EDCs caused by modification of pedigree.
FRA (ALL)	Applied new MACE coding according to Interbull recommendations. Optimized data processing. Number of daughters, herds and EDC are now calculated directly from the pipeline based on the univariate model without permanent environment effects on single-step preadjusted performances in genomic-free EBVs computation. Before they were still computed from the traditional polygenic approach. Pedigree corrections.
NOR (RDC)	Changes in the data extraction pipeline caused many bulls to loose from 1 to 10 daughters, depending on size of the progeny group.The National Herd Recording System is introducing new farmer reporting tools and central storage system. Data extraction pipeline is being modified to cope with this change
CHE (ALL)	Breeding organizations have recently put more emphasis on correcting data, which contributes to some higher variation in data. This increased activity is related to the merge of two databases planned, which took place by the end of June 2026 which caused some decrease in information.
ISR (HOL)	Decrease in information due to data editings and pedigree verification
POL (HOL)	Decrease in information due to data editings and pedigree verification
DEA (BSW, SIM)	Small changes in information due to pedigree verification. SIM: inclusion of ITA,HRV and HUN data
GBR (HOL)	Drops in herds/daughters due to changes from data suppliers resulting in some of those bulls' daughters failing validation.
AUS (ALL)	Updated type of proofs according to the latest interbull recommendation. Drops in information due to pedigree verification and changes in status of bulls that are no longer qualifying for the evaluation.
USA (ALL)	Decrease in information due to pedigree validation and daughterâ\200\223herdâ\200\223year minimum edits.
DEU (ALL)	Overall base change, some drops in information due to data edits
BEL (HOL)	Drops in information due to pedigree verification, causing some bulls to no longer qualifying for inclusion.
NZL (ALL)	Decrease in information due to continuous pedigree verification and herd records being updated
ITA (HOL)	Cut off of data causing drops in information and bulls missing in this submission.
CZE (HOL)	Dropping in reliability due to current software update (AACF90gs1/ACCF90rr to new ACCF90gs3).

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

A new document called confdoc_DEFINITION{runid}.itb has been introduced reporting all the trait definitions applied by countries as reported in the PREP.

Direct Gestation Length (ges) has been added as the fifth trait in the calving evaluation starting from the August 2025 MACE routine evaluation, and therefore added in the calv{BRD}{RUNID}.itb and calv{BRD}{RUNID}.ipr.

During 2023-2024, Interbull Centre and the Interbull Technical Committee (ITC) have worked on developing a new procedures for adjusting of the international correlations after a given test run in case countries would decide NOT TO implement the changes tested in the next routine run.
Until now, the relative difference between the previous routineâ\200\231s and test runâ\200\231s correlations, for each pair of countries, was assessed and the average value of the two was used whenever such difference did exceed a threshold of 0.01. Otherwise, correlations from the latest test run were used.
However, in some cases, the difference in correlations between routine/test runs were way above a 1% difference so that by using the average value the newly derived correlations would still be greatly affected by the changes tested but not implemented. This remark has been made in few occasions by some participating countries.
A new approach proposed by Peter Sullivan, was developed and extensively tested. The new approach is based on first identifying the relative impact of the changes tested by a country during the test run (but not implemented in a routine run) and then correcting the whole correlation matrix detracting such estimated impact.

This new approach would assure that the new correlations would be free from any effect from any changes tested but not implemented.
The new procedure has been fully developed during 2023 and extensively tested during 2024 and introduced officially in the April 2025 routine evaluation.

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
https://interbull.org/ib/servicecalendar

NEXT TEST INTERNATIONAL EVALUATION

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

From 2025 an extra MACE test run has been scheduled in May, data submissions' deadline and target for distribution of results are all reported in the above link.

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 udder health (August Routine Evaluation 2026).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		156	9164	1832	875	
BEL			2517			
CAN	302	114	14763	973	917	
CHE	3380		3630	109		3883
CZE			4767			
DEA	6395					27992
DEU			25644		329	
DFS			15337	2468	8493	
ESP			5045			
EST			1698		517	
FRA	549		18039			527
FRM						3943
GBR	168	325	8188	843	656	112
HUN			3622			
IRL			3569			
ISR			1962			
ITA	2379		9607	61		
JPN			7583			
KOR			1770			
LTU			1029		389	
LVA			1561		686	
NLD	286		18129	333	124	610
NOR					4494	
NZL	89		9722	5566	1539	
POL			13675			
PRT			3778			
SVK			1252			
SVN	385		741			681
URY			2338			
USA	1259	776	44491	5733	829	127
ZAF			1207	632	126	
CAM					50	
No.Records	15192	1371	234828	18550	20024	37875

Pub. Proofs 11881 1093 162989 14830 18643 35428

^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	6.87									
FRA	0.91	1.01								
NLD	0.88	0.92	3.73							
USA	0.88	0.89	0.84	0.21						
CHE	0.89	0.95	0.93	0.79	10.49					
DEA	0.86	0.97	0.92	0.84	0.97	11.94				
NZL	0.69	0.73	0.73	0.65	0.70	0.61	0.37			
ITA	0.88	0.90	0.89	0.82	0.95	0.91	0.65	14.96		
GBR	0.93	0.96	0.93	0.89	0.93	0.93	0.78	0.89	11.42	
SVN	0.80	0.79	0.81	0.79	0.78	0.78	0.64	0.79	0.80	11.08

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.78									
FRA	0.81	1.03								
NLD	0.79	0.78	4.24							
USA	0.81	0.85	0.73	2.68						
CHE	0.87	0.90	0.85	0.80	11.68					
DEA	0.89	0.70	0.88	0.71	0.88	11.94				
NZL	0.69	0.64	0.64	0.63	0.67	0.73	0.37			
ITA	0.87	0.76	0.82	0.74	0.89	0.92	0.69	14.96		
GBR	0.83	0.83	0.84	0.80	0.80	0.73	0.63	0.76	2.27	
SVN	0.79	0.71	0.76	0.71	0.71	0.84	0.75	0.81	0.73	11.08

GUE scs

	CAN	GBR	USA	AUS
CAN	5.96			
GBR	0.92	13.67		
USA	0.92	0.90	0.25	
AUS	0.85	0.91	0.81	0.27

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	URY
CAN	5.79																											
CHE	0.91	10.85																										
DEU	0.95	0.95	12.90																									
DFS	0.94	0.92	0.97	11.82																								
EST	0.90	0.87	0.93	0.92	17.59																							
FRA	0.95	0.95	0.97	0.96	0.90	1.14																						
GBR	0.94	0.93	0.96	0.94	0.90	0.96	12.92																					
NLD	0.92	0.94	0.96	0.94	0.90	0.94	0.95	4.23																				
USA	0.93	0.84	0.89	0.88	0.89	0.90	0.91	0.87	0.20																			
ISR	0.85	0.82	0.83	0.82	0.83	0.83	0.80	0.79	0.87	0.24																		
ITA	0.90	0.90	0.94	0.92	0.92	0.94	0.91	0.89	0.88	0.81	6.01																	
AUS	0.84	0.89	0.86	0.86	0.79	0.90	0.91	0.88	0.78	0.70	0.81	0.28																
HUN	0.89	0.88	0.92	0.90	0.91	0.91	0.89	0.87	0.91	0.86	0.92	0.76	1.28															
BEL	0.92	0.92	0.97	0.95	0.93	0.96	0.93	0.94	0.89	0.80	0.94	0.84	0.92	0.52														
JPN	0.85	0.78	0.83	0.85	0.80	0.89	0.84	0.80	0.85	0.75	0.81	0.78	0.78	0.83	0.45													
ESP	0.92	0.90	0.95	0.94	0.90	0.95	0.93	0.91	0.91	0.85	0.94	0.81	0.92	0.96	0.81	11.96												
ZAF	0.90	0.88	0.91	0.89	0.85	0.93	0.91	0.87	0.89	0.80	0.92	0.86	0.90	0.91	0.83	0.94	26.36											
NZL	0.74	0.79	0.76	0.77	0.68	0.79	0.83	0.78	0.68	0.62	0.70	0.92	0.64	0.73	0.75	0.71	0.78	0.40										
IRL	0.81	0.90	0.86	0.86	0.79	0.86	0.88	0.87	0.78	0.74	0.80	0.86	0.81	0.85	0.76	0.83	0.83	0.79	0.12									
CZE	0.90	0.87	0.94	0.91	0.89	0.92	0.89	0.88	0.89	0.80	0.93	0.76	0.94	0.94	0.79	0.93	0.90	0.66	0.77	17.83								

SVK	0.83	0.83	0.89	0.88	0.86	0.88	0.83	0.82	0.84	0.77	0.89	0.73	0.92	0.91	0.77	0.89	0.88	0.60	0.79	0.92	0.40								
POL	0.89	0.87	0.93	0.92	0.92	0.92	0.89	0.88	0.86	0.81	0.91	0.79	0.93	0.94	0.79	0.92	0.86	0.68	0.82	0.92	0.86	14.27							
LTU	0.83	0.85	0.90	0.88	0.90	0.87	0.83	0.85	0.78	0.82	0.86	0.77	0.86	0.90	0.77	0.88	0.83	0.68	0.78	0.89	0.88	0.87	0.34						
LVA	0.87	0.89	0.93	0.93	0.94	0.91	0.91	0.90	0.86	0.80	0.91	0.84	0.92	0.94	0.79	0.91	0.88	0.76	0.83	0.91	0.86	0.92	0.88	476.38					
PRT	0.77	0.77	0.78	0.77	0.77	0.77	0.77	0.77	0.77	0.75	0.77	0.68	0.77	0.78	0.77	0.77	0.78	0.62	0.72	0.78	0.77	0.77	0.77	0.77	0.45				
KOR	0.87	0.82	0.87	0.89	0.85	0.87	0.89	0.83	0.86	0.79	0.86	0.83	0.83	0.85	0.81	0.86	0.82	0.75	0.72	0.83	0.77	0.85	0.79	0.88	0.77	0.33			
SVN	0.79	0.81	0.85	0.84	0.80	0.81	0.79	0.80	0.77	0.73	0.83	0.77	0.78	0.84	0.77	0.79	0.77	0.61	0.81	0.79	0.79	0.81	0.79	0.82	0.77	0.77	11.42		
URY	0.77	0.80	0.82	0.79	0.78	0.81	0.78	0.78	0.77	0.75	0.78	0.79	0.78	0.82	0.77	0.79	0.83	0.73	0.74	0.77	0.81	0.80	0.79	0.78	0.77	0.77	0.77	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	URY
CAN	7.74																											
CHE	0.93	10.99																										
DEU	0.89	0.88	9.43																									
DFS	0.94	0.88	0.88	12.12																								
EST	0.80	0.83	0.79	0.84	17.60																							
FRA	0.95	0.94	0.89	0.92	0.79	1.15																						
GBR	0.88	0.88	0.82	0.85	0.77	0.88	2.33																					
NLD	0.83	0.90	0.80	0.84	0.80	0.86	0.83	5.02																				
USA	0.87	0.82	0.84	0.83	0.75	0.88	0.82	0.78	2.57																			
ISR	0.74	0.71	0.71	0.79	0.82	0.71	0.70	0.73	0.70	0.24																		
ITA	0.85	0.90	0.76	0.80	0.82	0.87	0.80	0.90	0.75	0.71	7.34																	
AUS	0.76	0.78	0.65	0.74	0.78	0.73	0.73	0.70	0.64	0.74	0.71	0.20																
HUN	0.84	0.84	0.74	0.82	0.89	0.83	0.81	0.85	0.75	0.83	0.89	0.79	1.28															
BEL	0.87	0.93	0.81	0.87	0.92	0.87	0.83	0.88	0.74	0.79	0.89	0.88	0.92	0.52														
JPN	0.74	0.81	0.68	0.72	0.76	0.71	0.70	0.78	0.68	0.75	0.73	0.81	0.79	0.84	0.45													
ESP	0.84	0.89	0.74	0.84	0.87	0.86	0.81	0.86	0.75	0.82	0.88	0.86	0.93	0.96	0.83	11.96												
ZAF	0.82	0.88	0.74	0.77	0.80	0.82	0.80	0.83	0.73	0.77	0.85	0.88	0.90	0.93	0.85	0.94	26.04											
NZL	0.63	0.66	0.61	0.62	0.70	0.62	0.62	0.62	0.62	0.71	0.62	0.90	0.71	0.75	0.75	0.74	0.79	0.40										
IRL	0.77	0.85	0.75	0.77	0.84	0.77	0.77	0.77	0.65	0.77	0.78	0.92	0.85	0.93	0.82	0.91	0.90	0.88	0.11									
CZE	0.84	0.87	0.77	0.82	0.89	0.83	0.81	0.86	0.73	0.79	0.88	0.81	0.94	0.95	0.81	0.93	0.91	0.71	0.86	17.83								
SVK	0.82	0.83	0.76	0.80	0.86	0.81	0.79	0.86	0.74	0.75	0.90	0.78	0.92	0.92	0.77	0.89	0.87	0.70	0.83	0.91	0.39							
POL	0.84	0.87	0.73	0.84	0.92	0.83	0.80	0.82	0.72	0.81	0.86	0.84	0.93	0.95	0.80	0.93	0.86	0.71	0.89	0.93	0.87	14.28						
LTU	0.78	0.76	0.71	0.78	0.86	0.76	0.75	0.75	0.68	0.77	0.78	0.78	0.86	0.89	0.77	0.86	0.80	0.70	0.81	0.89	0.86	0.87	0.33					
LVA	0.78	0.81	0.72	0.80	0.91	0.76	0.78	0.81	0.70	0.78	0.83	0.85	0.91	0.93	0.77	0.90	0.85	0.77	0.90	0.91	0.86	0.93	0.87	479.43				
PRT	0.71	0.79	0.69	0.71	0.77	0.70	0.69	0.74	0.68	0.75	0.72	0.75	0.79	0.82	0.77	0.79	0.81	0.71	0.80	0.82	0.76	0.78	0.76	0.80	0.45			
KOR	0.76	0.80	0.68	0.78	0.82	0.76	0.74	0.73	0.70	0.80	0.73	0.85	0.84	0.87	0.83	0.87	0.83	0.77	0.84	0.84	0.78	0.87	0.81	0.87	0.77	0.33		
SVN	0.77	0.78	0.73	0.78	0.76	0.77	0.72	0.72	0.67	0.71	0.76	0.77	0.78	0.84	0.75	0.79	0.73	0.69	0.82	0.82	0.74	0.82	0.79	0.82	0.76	0.76	11.42	
URY	0.70	0.74	0.70	0.68	0.78	0.68	0.70	0.71	0.68	0.74	0.70	0.80	0.78	0.84	0.77	0.79	0.84	0.75	0.83	0.80	0.81	0.82	0.78	0.81	0.77	0.77	0.74	0.20

JER scs

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	5.96									
DFS	0.90	12.43								
GBR	0.92	0.93	11.61							
NLD	0.92	0.94	0.95	4.15						
USA	0.90	0.83	0.88	0.84	0.17					
AUS	0.79	0.87	0.86	0.88	0.75	0.27				
ZAF	0.85	0.87	0.86	0.89	0.83	0.83	21.03			
NZL	0.66	0.72	0.77	0.78	0.65	0.90	0.72	0.38		
CHE	0.86	0.85	0.85	0.89	0.81	0.73	0.81	0.66	13.93	
ITA	0.87	0.91	0.86	0.87	0.86	0.78	0.85	0.65	0.86	5.11

JER mas

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	7.50									
DFS	0.90	11.59								
GBR	0.78	0.84	1.99							
NLD	0.82	0.84	0.80	4.81						
USA	0.79	0.75	0.73	0.71	2.59					
AUS	0.68	0.69	0.69	0.79	0.64	0.19				
ZAF	0.72	0.72	0.72	0.83	0.70	0.88	21.04			
NZL	0.63	0.63	0.63	0.69	0.63	0.91	0.75	0.38		

CHE	0.81	0.78	0.74	0.77	0.74	0.72	0.79	0.72	13.91	
ITA	0.82	0.76	0.77	0.86	0.74	0.72	0.81	0.69	0.83	5.11

RDC scs

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	6.06													
DFS	0.93	12.97												
GBR	0.94	0.92	11.85											
NOR	0.85	0.92	0.82	13.60										
USA	0.92	0.85	0.88	0.78	0.23									
DEU	0.94	0.96	0.95	0.89	0.88	14.75								
AUS	0.85	0.89	0.90	0.86	0.75	0.87	0.29							
EST	0.89	0.89	0.90	0.84	0.84	0.91	0.84	17.21						
ZAF	0.83	0.87	0.85	0.87	0.86	0.91	0.80	0.86	25.11					
NZL	0.75	0.75	0.80	0.73	0.68	0.76	0.90	0.70	0.74	0.42				
LTU	0.83	0.89	0.86	0.89	0.79	0.88	0.83	0.86	0.86	0.73	0.36			
LVA	0.87	0.88	0.90	0.83	0.84	0.92	0.84	0.95	0.88	0.73	0.86	432.90		
NLD	0.92	0.94	0.94	0.87	0.86	0.96	0.87	0.86	0.87	0.77	0.85	0.87	4.25	
CAM	0.88	0.88	0.88	0.87	0.86	0.88	0.83	0.87	0.88	0.78	0.87	0.87	0.89	6.19

RDC mas

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	9.19												
DFS	0.86	13.31											
GBR	0.87	0.82	2.02										
NOR	0.79	0.69	0.72	13.60									
USA	0.80	0.74	0.79	0.78	0.22								
AUS	0.73	0.67	0.73	0.89	0.71	0.21							
EST	0.80	0.71	0.80	0.85	0.78	0.85	17.21						
ZAF	0.82	0.79	0.84	0.86	0.79	0.83	0.81	25.18					
NZL	0.64	0.63	0.64	0.76	0.70	0.91	0.76	0.76	0.42				
LTU	0.75	0.71	0.74	0.87	0.78	0.87	0.88	0.83	0.79	0.36			
LVA	0.78	0.71	0.79	0.87	0.75	0.86	0.95	0.86	0.78	0.89	435.86		
NLD	0.83	0.80	0.85	0.86	0.84	0.79	0.83	0.83	0.68	0.81	0.82	4.85	
CAM	0.82	0.83	0.83	0.87	0.83	0.89	0.87	0.87	0.83	0.88	0.87	0.84	6.19

SIM scs

	FRM	FRA	NLD	CHE	DEA	SVN	GBR	USA
FRM	1.05							
FRA	0.89	1.02						
NLD	0.91	0.94	3.95					
CHE	0.93	0.93	0.93	10.49				
DEA	0.92	0.96	0.92	0.88	12.28			
SVN	0.87	0.79	0.79	0.82	0.79	10.14		
GBR	0.90	0.96	0.95	0.91	0.91	0.81	10.66	
USA	0.86	0.90	0.86	0.83	0.83	0.78	0.90	0.20

SIM mas

	NLD	CHE	DEA	SVN	GBR	USA
NLD	4.27					
CHE	0.85	10.09				
DEA	0.89	0.75	12.28			
SVN	0.74	0.79	0.79	10.14		
GBR	0.82	0.88	0.75	0.74	2.50	
USA	0.81	0.81	0.84	0.71	0.80	0.19

^LAPPENDIX II. Number of common bulls

BSW scs

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0	107	64	212	165	178	37	160	80	40
FRA	100	0	114	149	220	294	36	260	86	64
NLD	59	99	0	107	135	199	40	170	62	59
USA	211	113	98	0	349	373	45	264	111	49
CHE	143	178	123	327	0	728	41	574	96	99
DEA	160	243	187	342	619	0	62	817	104	134
NZL	37	29	33	42	32	56	0	52	31	15
ITA	143	220	144	194	517	713	43	0	104	117
GBR	79	84	58	108	79	77	29	83	0	34
SVN	35	62	58	39	94	120	14	109	29	0

BSW mas

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0	92	60	66	88	176	37	159	40	40
FRA	83	0	89	31	94	240	30	218	44	61
NLD	53	76	0	29	70	179	39	155	35	57
USA	67	29	27	0	35	61	18	52	25	16
CHE	82	79	65	31	0	325	22	277	31	82
DEA	160	186	166	56	292	0	62	815	55	134
NZL	37	24	32	17	18	56	0	52	17	15
ITA	142	179	129	42	249	713	43	0	58	117
GBR	37	40	32	22	26	42	15	48	0	23
SVN	35	56	56	15	79	120	14	109	21	0

GUE scs

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	GBR	USA	AUS
CAN	0	37	83	58
GBR	32	0	95	48
USA	75	97	0	79
AUS	56	41	77	0

GUE mas

HOL scs

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	URY
CAN	0	1052	2955	2033	448	1792	2055	2128	4515	210	2213	1783	1326	1014	1646	1598	507	947	648	1331	494	2124	352	627	1516	831	230	993
CHE	979	0	1347	893	233	836	831	1103	1174	77	846	735	503	712	564	660	257	488	441	534	258	883	149	293	669	314	146	388
DEU	2450	1287	0	3417	683	2793	2442	4248	4213	226	2983	1963	1573	1520	1674	1872	551	1190	935	2093	759	3849	640	916	1813	732	402	992
DFS	1882	852	2771	0	531	2023	1889	2857	2825	208	1949	1579	1200	1120	1230	1349	507	1039	814	1470	477	2579	427	615	1443	590	295	827
EST	328	145	540	391	0	357	403	590	576	83	452	314	309	272	290	293	114	208	166	381	151	578	133	219	308	156	108	209
FRA	1409	798	1852	1366	209	0	1772	2397	2788	153	1692	1479	1126	1174	1368	1503	507	930	748	1315	466	2340	302	507	1361	624	218	724
GBR	2315	801	1967	1528	264	1286	0	2168	2745	200	1710	1674	1059	1038	1226	1256	509	1094	1106	1156	415	1948	367	523	1277	575	207	862
NLD	2114	1104	4135	2651	457	1819	1970	0	3224	221	2110	1764	1254	1587	1335	1458	517	1312	984	1740	618	2852	439	643	1589	594	307	877
USA	5221	1108	3364	2427	461	1765	2572	2997	0	358	3122	2360	1704	1194	2324	1891	635	1363	896	1954	631	3248	472	864	1935	1009	266	1460
ISR	149	44	172	155	44	94	147	174	358	0	194	153	158	108	155	136	66	151	124	168	63	246	74	100	153	81	51	126
ITA	2078	786	2452	1781	319	1274	1485	2002	2871	141	0	1257	1309	932	1279	1479	366	721	572	1448	435	2525	403	646	1367	664	303	792
AUS	1824	656	1550	1207	179	1085	1491	1572	2447	98	1055	0	868	889	1075	1051	482	1402	784	901	342	1455	289	466	1101	533	166	844
HUN	1274	421	1325	1022	193	879	916	1102	1720	106	1229	669	0	657	874	962	394	593	469	1050	370	1428	304	456	1015	535	177	624
BEL	1020	726	1576	1072	178	1227	1030	1823	1091	68	960	791	576	0	664	824	338	612	547	711	333	1171	211	346	916	361	176	434
JPN	976	398	872	757	127	600	697	813	1258	81	762	659	534	457	0	1075	430	675	469	951	350	1338	254	449	959	648	165	711
ESP	1145	556	1293	1098	155	1296	1016	1337	1354	84	1157	784	794	814	577	0	449	646	520	963	357	1607	271	447	1187	574	200	641
ZAF	466	216	430	390	56	404	444	439	619	42	295	420	315	288	300	401	0	369	296	333	180	449	102	164	468	267	53	326
NZL	931	412	934	768	115	620	948	1202	1319	119	593	1407	460	502	392	499	299	0	823	645	276	933	211	303	746	352	124	674

IRL	582	424	777	654	85	596	1070	885	783	94	501	652	373	504	303	470	246	691	0	468	218	758	161	226	574	235	103	411
CZE	1017	376	1649	1061	251	892	787	1550	1608	132	1191	598	935	547	502	661	216	451	317	0	480	1794	342	491	1016	530	225	614
SVK	348	133	578	265	65	271	242	446	439	26	288	173	261	207	139	186	97	165	103	384	0	564	116	179	400	222	79	264
POL	2001	802	3944	2388	461	1931	1811	2879	3370	206	2412	1208	1365	1160	816	1350	372	762	633	1602	431	0	524	845	1693	711	341	910
LTU	221	66	598	278	68	142	214	294	348	39	245	143	198	109	100	123	38	109	87	231	53	427	0	225	290	170	87	205
LVA	409	156	750	397	121	289	302	451	769	66	437	241	333	209	206	251	94	170	122	321	86	728	149	0	541	287	117	328
PRT	1562	620	1760	1378	212	1341	1196	1640	2052	102	1371	943	1014	950	620	1211	418	609	481	858	271	1840	188	440	0	584	186	708
KOR	811	224	519	447	76	406	424	441	1141	42	561	390	430	272	413	418	198	259	157	377	133	608	76	174	503	0	107	459
SVN	179	109	398	243	64	171	149	270	215	34	274	117	133	141	95	147	37	87	82	163	37	308	40	68	146	71	0	104
URY	953	302	755	601	124	498	717	729	1762	71	621	673	492	342	438	505	292	559	316	418	153	776	109	191	601	356	56	0

HOL mas

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	URY
CAN	0	349	889	1141	301	1029	1193	478	1661	144	1421	972	894	679	1036	1082	252	552	348	915	281	1472	262	373	975	597	192	617
CHE	314	0	325	338	105	321	314	205	314	30	323	262	166	271	224	253	66	183	137	197	79	351	70	89	238	134	88	143
DEU	734	301	0	1221	334	992	923	703	857	106	1064	687	707	710	639	828	201	469	337	837	254	1810	335	428	760	335	310	403
DFS	1175	319	1106	0	483	1530	1610	959	1360	193	1355	1326	1093	1004	1152	1256	489	960	700	1337	391	2330	387	470	1324	543	264	702
EST	225	65	250	358	0	297	377	257	375	82	371	285	298	261	283	288	111	202	140	374	137	564	126	188	295	151	106	195
FRA	883	297	778	1055	173	0	1372	637	1026	131	1177	1072	987	1014	1092	1285	419	746	596	1160	352	2039	253	395	1170	530	202	564
GBR	1223	293	775	1326	253	1047	0	708	1446	199	1378	1419	1016	968	1126	1190	467	1009	927	1114	363	1855	335	420	1195	535	199	759
NLD	467	195	648	983	193	549	696	0	496	114	612	533	461	666	452	558	208	572	378	782	194	1183	199	254	625	232	160	335
USA	1914	276	745	1386	314	863	1568	461	0	275	1707	1134	1120	682	1224	1069	351	718	440	1154	330	2006	314	500	1200	715	203	876
ISR	94	14	71	136	44	79	145	91	271	0	164	146	153	107	153	136	64	150	98	168	61	244	69	78	153	80	50	119
ITA	1271	285	846	1261	262	915	1222	568	1767	113	0	935	1091	770	1057	1208	296	591	409	1178	330	1943	322	419	1119	571	246	620
AUS	1041	234	579	1007	173	811	1260	480	1256	92	818	0	799	790	986	977	444	1260	667	822	286	1303	256	367	997	476	159	725
HUN	857	129	578	933	193	758	895	394	1186	104	1051	628	0	642	864	952	382	585	415	1045	347	1404	290	375	994	515	171	558
BEL	713	265	724	958	176	1031	984	697	663	68	788	714	573	0	643	811	330	597	493	699	304	1143	198	297	894	352	176	405
JPN	743	167	426	691	127	540	679	341	1004	81	682	625	534	457	0	1075	427	667	433	951	324	1325	238	391	938	623	163	635
ESP	779	204	600	1019	155	1071	991	528	902	84	945	746	792	814	577	0	440	644	480	962	327	1597	253	400	1169	560	198	585
ZAF	237	52	158	374	56	331	429	185	395	42	251	396	315	288	300	400	0	363	284	328	168	439	95	162	456	254	53	300
NZL	491	158	381	703	114	523	852	520	691	119	501	1219	458	499	392	498	297	0	719	645	264	917	200	266	732	342	124	626
IRL	345	134	308	533	74	491	908	359	425	71	365	558	336	465	272	438	234	589	0	426	191	668	144	200	517	229	87	357
CZE	720	140	662	934	251	736	770	739	1099	132	982	549	935	547	502	661	216	451	276	0	453	1775	324	419	998	512	225	560
SVK	200	30	155	224	65	211	233	109	236	26	224	154	257	200	139	186	96	163	96	384	0	515	104	158	378	207	75	236
POL	1430	302	1968	2123	459	1663	1762	1238	2276	205	1866	1114	1358	1151	816	1350	372	757	560	1602	419	0	495	672	1650	682	336	829
LTU	174	28	281	262	67	127	210	131	238	39	196	141	197	109	100	123	38	107	70	231	52	421	0	190	270	154	83	186
LVA	229	34	341	284	107	206	250	157	417	49	257	185	279	176	177	223	94	147	107	273	79	575	127	0	461	258	104	277
PRT	1003	207	700	1251	211	1154	1153	651	1309	102	1132	858	1005	947	620	1211	417	607	446	858	264	1816	186	374	0	563	185	649
KOR	586	104	245	415	76	365	408	173	779	42	502	356	426	272	413	418	197	255	158	377	130	594	74	157	497	0	106	413
SVN	151	67	309	213	64	160	147	130	162	34	214	115	133	141	95	147	37	87	67	163	37	308	40	61	146	71	0	100
URY	586	101	312	538	124	414	682	275	965	71	510	636	478	340	438	505	289	555	296	418	152	758	109	170	591	347	56	0

JER scs

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	0	180	211	78	570	312	169	238	49	29
DFS	176	0	229	223	281	195	172	215	66	34
GBR	210	222	0	130	297	266	182	281	80	38
NLD	70	227	123	0	150	96	92	125	46	23
USA	602	267	320	155	0	574	313	468	82	38
AUS	320	167	267	86	623	0	251	513	65	37
ZAF	165	155	183	88	327	240	0	221	59	34
NZL	248	194	286	119	541	566	228	0	62	33
CHE	43	65	75	39	83	55	52	53	0	26
ITA	25	33	37	21	38	33	31	31	27	0

JER mas

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA

CAN	0	69	100	29	123	134	80	113	32	21
DFS	65	0	156	181	87	148	151	176	62	31
GBR	98	149	0	100	109	187	145	213	69	37
NLD	22	178	96	0	61	83	87	112	43	23
USA	114	80	112	55	0	179	134	172	47	24
AUS	124	117	188	75	187	0	226	456	57	35
ZAF	73	131	146	84	145	223	0	216	56	34
NZL	106	149	219	106	171	504	225	0	58	33
CHE	30	59	65	37	41	50	51	52	0	26
ITA	16	29	34	21	23	31	31	31	27	0

RDC scs

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	217	104	8	233	14	115	3	70	106	22	10	8	0
DFS	224	0	144	160	237	78	234	163	51	221	113	137	76	0
GBR	104	138	0	95	144	16	116	19	40	112	31	16	53	0
NOR	7	135	99	0	92	22	90	39	0	65	28	23	63	0
USA	223	235	139	93	0	32	164	34	59	148	44	28	57	32
DEU	13	69	16	21	30	0	50	37	1	27	27	40	24	0
AUS	115	206	111	79	167	49	0	53	34	184	50	42	54	14
EST	2	150	17	38	32	36	48	0	0	26	28	56	33	0
ZAF	72	48	35	0	53	1	34	0	0	35	5	2	3	0
NZL	105	217	108	64	148	26	184	24	30	0	31	23	38	13
LTU	21	100	29	25	39	27	47	27	5	29	0	48	22	0
LVA	10	95	16	21	25	33	38	48	2	19	43	0	20	0
NLD	8	74	52	62	56	23	52	32	3	37	21	19	0	0
CAM	0	0	0	0	32	0	14	0	0	13	0	0	0	0

RDC mas

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	0	92	36	3	86	32	0	35	41	18	7	3	0
DFS	93	0	103	161	230	222	163	46	218	112	126	72	0
GBR	35	100	0	80	106	74	15	27	78	25	14	42	0
NOR	3	135	84	0	92	87	39	0	65	28	19	56	0
USA	86	228	105	93	0	130	34	54	145	44	25	54	32
AUS	32	197	73	77	132	0	51	29	158	45	38	51	12
EST	0	150	14	38	32	47	0	0	26	28	49	31	0
ZAF	36	46	26	0	52	30	0	0	33	5	2	2	0
NZL	41	212	79	64	148	159	24	30	0	31	17	33	13
LTU	17	99	23	25	39	43	27	5	29	0	46	21	0
LVA	7	84	14	17	22	35	41	2	14	41	0	15	0
NLD	3	70	42	55	54	49	30	2	32	20	14	0	0
CAM	0	0	0	0	32	12	0	0	13	0	0	0	0

SIM scs

common bulls below diagonal
common three quarter sib group above diagonal

	FRM	FRA	NLD	CHE	DEA	SVN	GBR	USA
FRM	0	0	141	261	270	0	68	103
FRA	0	0	94	15	290	57	0	3
NLD	168	89	0	99	486	96	50	35
CHE	311	12	102	0	418	1	53	35
DEA	296	246	510	385	0	307	58	50
SVN	0	54	89	1	290	0	0	2
GBR	86	0	50	60	68	0	0	20
USA	117	3	36	34	54	2	27	0

SIM mas

common bulls below diagonal
common three quarter sib group above diagonal

	NLD	CHE	DEA	SVN	GBR	USA
NLD	0	10	449	92	19	35
CHE	10	0	124	0	1	5
DEA	467	117	0	307	25	49
SVN	85	0	290	0	0	2
GBR	21	1	33	0	0	17
USA	36	5	53	2	23	0