Genomic validation software: USA update including truncated MACE

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Take home messages from Mota et al. (2023) - IB

- Larger breeds and more heritable traits had more stable results
- Smaller breeds and less heritable traits are hard to validate. Tests often fail:
  - b1 more or less than expected from S.E., which may be underestimated
  - Upper biological limit of 1.2 should allow for S.E. of b1
  - R2 of parent average may exceed GEBV with small sample sizes
- TMACE and extra regressions could help test other biases (trend, parent average, etc.)

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GEBV test software (Sullivan): new version

- gebvtest_2023C2.py (Bootstrapping)
- Minimum birth year: 2015
- Foreign bulls included for smaller breeds
- Predicted deregressed dGEBV instead of dEBV
  - - - target dGEBV: uses the method of VanRaden, 2021 (Interbull Bulletin)
- Base adjustments to the breeding values (- - baseadj GEBV)

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Apply new validation to 5 breeds and 9 traits

- Validation of USA genomic predictions (GEBV)
  - August 2023 official GEBV including MACE input
  - August 2019 truncated GEBV using TMACE input
- Breeds tested were HOL, JER, BSW, RDC, and GUE
- Traits tested were mil, fat, pro, dlo(*), scs, mas (BS, JE, HO), hco, cc1, and int

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Validation results: Holstein

Trait	Bulls*	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
Milk	2,767	1.08	0.01	68	36	Pass
Fat	2,767	1.07	0.01	74	48	Pass
Protein	2,767	1.03	0.01	70	44	Pass
Longevity (dlo)	2,509	1.18	0.02	65	43	Pass
SCS	2,731	1.09	0.01	75	36	Pass
Mastitis	1,738	1.08	0.03	50	10	Pass
HCR (hco)	3,277	1.32	0.02	53	20	Fail
CCR (cc1)	3,277	1.10	0.02	68	31	Pass
DPR (int)	3,277	1.03	0.01	65	27	Pass

NOTE: pass=hiSE indicates an inconclusive statistical PASS due to high SE(b1) while FAILING the practical test: b1<0.8 or b1>1.2.

* Candidate bulls with foreign daughters in the reduced dataset were excluded from the test

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Validation results: Jersey

Trait	Bulls*	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
Milk	486	1.07	0.03	79	51	Pass
Fat	486	1.05	0.03	75	44	Pass
Protein	486	1.02	0.03	76	51	Pass
Longevity (dlo)	435	0.86	0.05	41	36	Pass
SCS	481	1.09	0.04	63	37	Pass
Mastitis	222	0.81	0.15	13	12	Pass
HCR (hco)	516	0.98	0.08	27	10	Pass
CCR (cc1)	445	0.83	0.05	40	28	Fail
DPR (int)	480	0.81	0.04	45	32	Fail

NOTE: pass=hiSE indicates an inconclusive statistical PASS due to high SE(b1) while FAILING the practical test: b1<0.8 or b1>1.2.

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Validation results: Brown Swiss

Trait	Bulls*	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
Milk	71	0.86	0.07	66	46	Pass
Fat	71	0.77	0.08	54	31	Fail
Protein	71	0.82	0.08	60	45	Pass
Longevity (dlo)	63	0.73	0.15	33	18	hiSE
SCS	69	0.74	0.10	39	32	Fail
Mastitis				NA		
HCR (hco)	75	1.04	0.20	22	6	Pass
CCR (cc1)	63	0.93	0.13	35	27	Pass
DPR (int)	71	0.84	0.11	43	31	Pass

NOTE: pass=hiSE indicates an inconclusive statistical PASS due to high SE(b1) while FAILING the practical test: b1<0.8 or b1>1.2.

* Candidate bulls with foreign daughters in the reduced dataset were excluded from the test

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Validation results: Red Dairy Cattle (RDC)

Trait	Bulls*	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
Milk	18	0.68	0.15	43	43	hiSE
Fat	18	0.83	0.22	55	57	Pass
Protein	18	0.75	0.16	52	53	hiSE
Longevity (dlo)	9	0.59	1.19	5	13	hiSE
SCS	18	0.90	0.51	16	30	Pass
Mastitis	NA					
HCR (hco)	16	2.18	0.84	30	5	hiSE
CCR (cc1)	16	-0.21	0.76	1	4	hiSE
DPR (int)	17	-0.04	0.52	4	0.1	Fail

NOTE: pass=hiSE indicates an inconclusive statistical PASS due to high SE(b1) while FAILING the practical test: b1<0.8 or b1>1.2.

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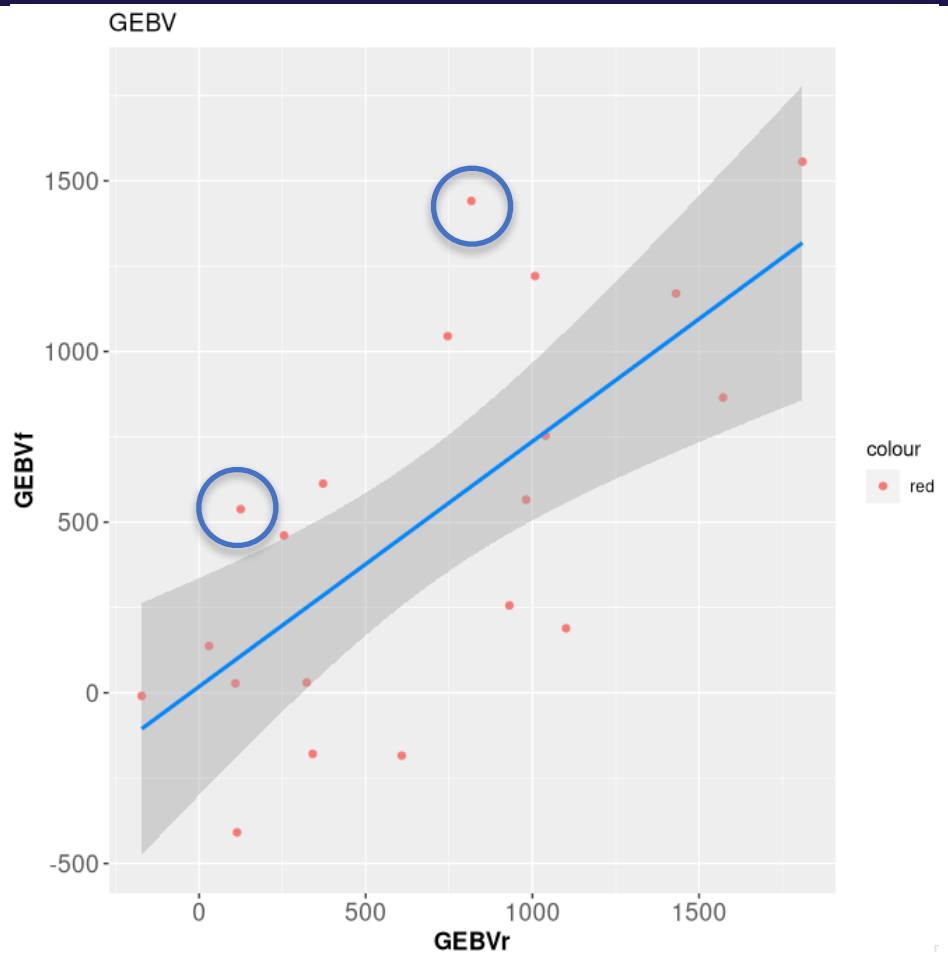
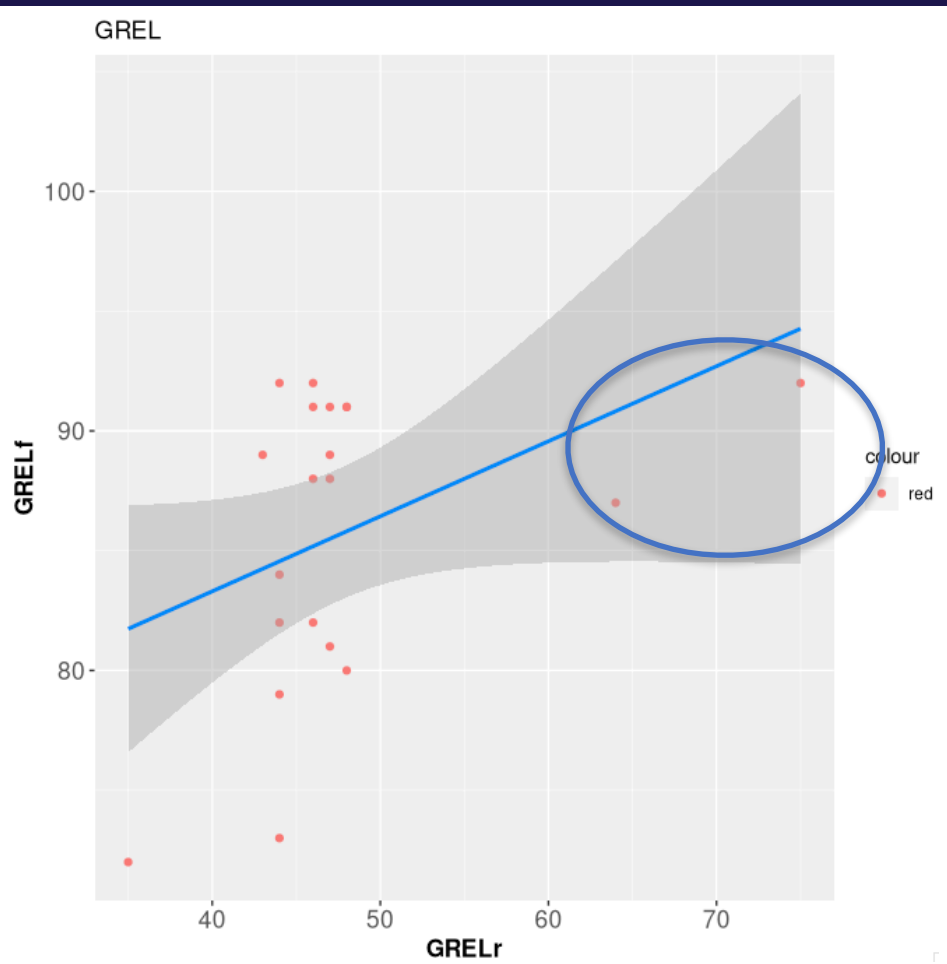
RDC candidate bulls (n=20; USA=8; CAN=12) - milk





- **Two young CAN bulls with unexpectedly high GREL**
  - **Domestic DAU = 0 but foreign DAU > 0**

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Validation results: Guernsey

Trait	Bulls*	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
Milk	16	0.87	0.25	35	8	Pass
Fat	16	0.31	0.33	5	4	hiSE
Protein	16	0.08	0.54	0.3	0.1	hiSE
Longevity (dlo)				NA		
SCS	16	1.79	0.59	41	22	hiSE
Mastitis				NA		
HCR (hco)				NA		
CCR (cc1)	12	2.19	0.58	68	77	Fail
DPR (int)	16	1.87	0.31	70	52	Fail

NOTE: pass=hiSE indicates an inconclusive statistical PASS due to high SE(b1) while FAILING the practical test: b1<0.8 or b1>1.2.

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Validation results in 3 scenarios: DPR (int)

Scenarios	Bulls	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
BSW						
2022-2018 off GEBV	88	0.64	0.16	16	27	Fail
2023-2019 off GEBV	77	1.30	0.19	40	40	hiSE
2023-2019 TMACE	71	0.84	0.11	43	31	Pass
JER						
2022-2018 off GEBV	588	0.79	0.03	47	31	Fail
2023-2019 off GEBV	500	0.71	0.04	32	32	Fail
2023-2019 TMACE	480	0.81	0.04	45	32	Fail

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Validation results in 3 scenarios: Mastitis

Scenarios	Bulls	b1	S.E.(b1)	R^2 GEBV	R^2 PA	Pass / Fail
HOL						
2022-2018 off GEBV	2,379	1.30	0.03	40	17	Fail
2023-2019 off GEBV	1,548	0.60	0.05	9	10	Fail
2023-2019 TMACE	1,738	1.08	0.03	50	10	Pass
JER						
2022-2018 off GEBV	NA					
2023-2019 off GEBV	NA					
2023-2019 TMACE	222	0.81	0.15	13	12	Pass

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Summary

- Use bulls with no daughters from 4 years ago (EDC=0)
- Tests continued to fail for smaller breeds and less heritable traits due to…
  - b1 underestimation;
  - Biological interval between 0.8 and 1.2;
  - Not enough bulls to validate
- As in CAN, bootstrapping provided trivial differences
- TMACE resulted in a more fair GEBV test

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- **Purebred breed associations** for providing pedigree data

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Thank you!

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