



Choose your model wisely - the comparison of genomically enhanced breeding values predicted by different single-step models

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Purpose of the study

- Differences in GEBV prediction between models
- Differences in computational resources
- Correlation between EBVs of validation bulls
- Top 50 bulls from each model



Models

- ssGTaBLUP
- ssAPYGBLUP
 - APY3000top
 - APY3000random
 - APY15000top
 - APY15000random
- ssSNPBLUP

MiXBLUP 3.0

Residual polygenic effect – 20%



Computing server

- Linux Red hat
- 260GB RAM
- 16 x Intel CPUs with 2.20GHZ
- 600GB hard disk space



Materials



	Sex	Number of animals
Phenotype data (stature) $h^2=0.54$	Cows with phenotypes	1,098,611
	Bulls with MACE-DRP	141,397
Phenotype data (Foot angle) $h^2=0.09$	Cows with phenotypes	1,098,766
	Bulls with MACE-DRP	117,482
Genotype data	Cows	70,134
	Bulls	64,826
Pedigree data	Cows	1,368,487
	Bulls	187,508

- Polish national evaluation December 2021, including MACE.



Model validation (Stature)

2,975 validation bulls, $h^2=0.54$

Models	\hat{b}_0	\hat{b}_1	R ²
ssSNPBLUP	5.84	0.86	0.87
ssGTaBLUP	5.93	<u>0.88</u>	<u>0.89</u>
ssAPYGBLUP3000top	7.73	0.73	0.72
ssAPYGBLUP3000random	7.48	0.73	0.75
ssAPYGBLUP15000top	5.66	0.86	0.85
ssAPYGBLUP15000random	5.85	0.83	0.84



Model validation (Foot Angle)

3,026 validation bulls, $h^2=0.09$

Models	\hat{b}_0	\hat{b}_1	R^2
ssSNPBLUP	3.56	0.81	0.84
ssGTaBLUP	3.47	<u>0.81</u>	<u>0.85</u>
ssAPYGBLUP3000top	3.49	0.73	0.74
ssAPYGBLUP3000random	3.36	0.69	0.73
ssAPYGBLUP15000top	3.66	0.81	0.84
ssAPYGBLUP15000random	3.71	0.79	0.83



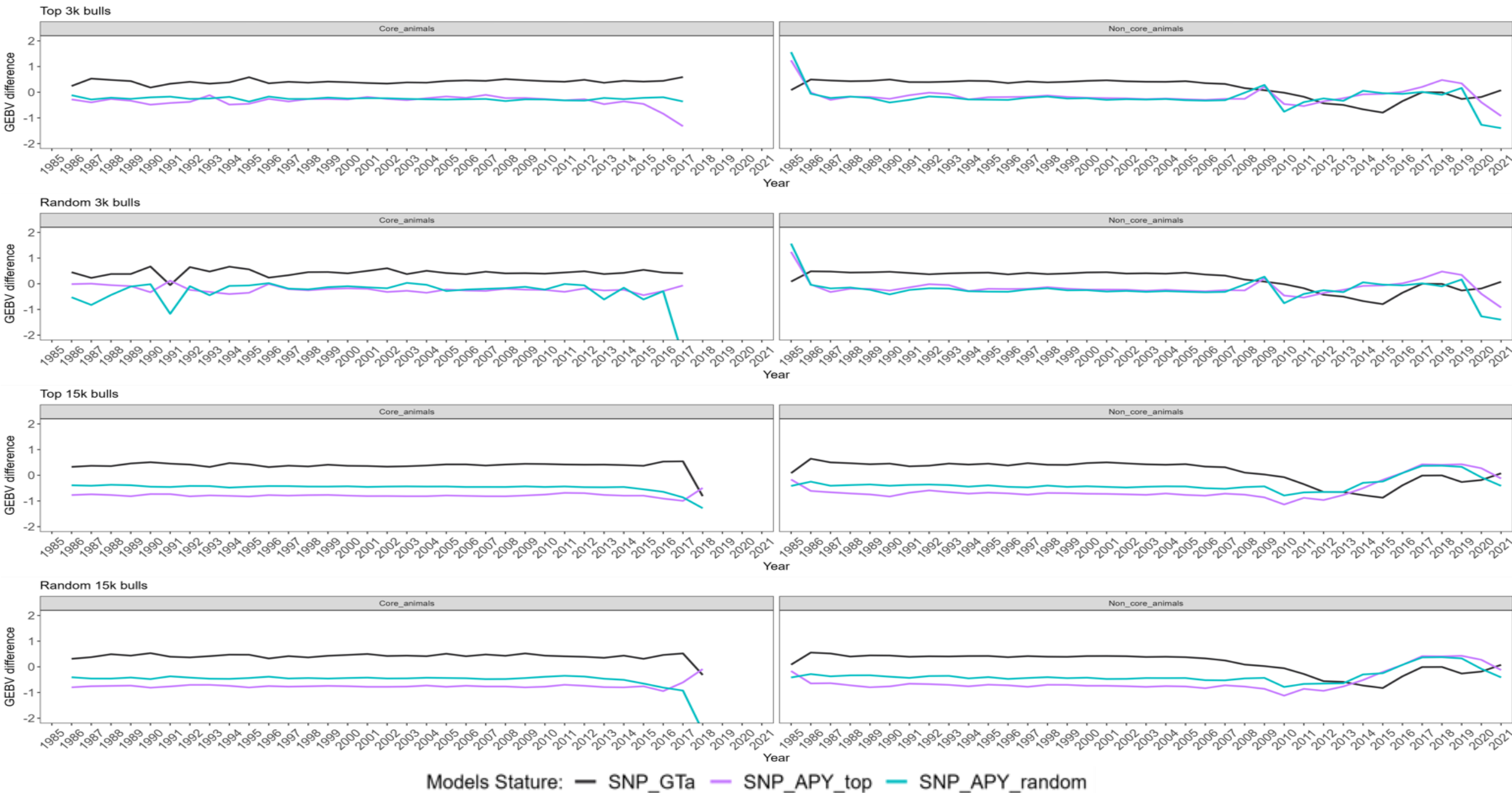
Correlation between validation bulls from truncated data set between models



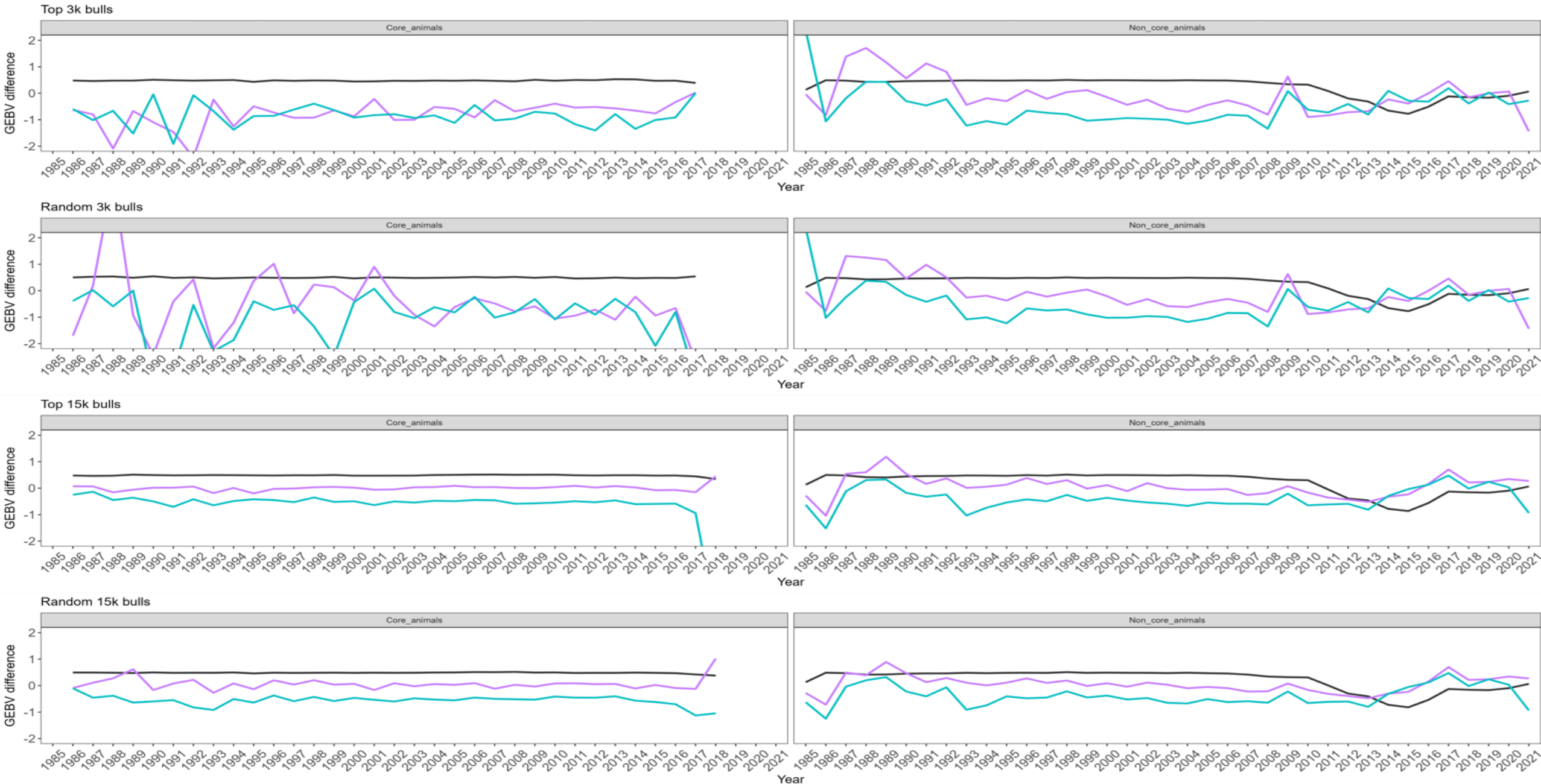
Models	Stature	Foot angle
ssSNPBLUP – GTaBLUP	<u>0.999</u>	<u>0.999</u>
ssSNPBLUP – ssAPYGBLUP3000top	0.911	0.924
ssSNPBLUP – ssAPYGBLUP3000random	0.920	0.925
ssSNPBLUP – ssAPYGBLUP15000top	<i>0.986</i>	<i>0.994</i>
ssSNPBLUP – ssAPYGBLUP15000random	0.979	0.989
ssGTaBLUP – ssAPYGBLUP3000top	0.912	0.924
ssGTaBLUP – ssAPYGBLUP3000random	0.921	0.925
ssGTaBLUP – ssAPYGBLUP15000top	<i>0.985</i>	<i>0.994</i>
ssGTaBLUP – ssAPYGBLUP15000random	0.979	0.989
ssAPYGBLUP3000top – ssAPYGBLUP3000random	0.909	0.926
ssAPYGBLUP3000top – ssAPYGBLUP15000top	0.899	0.922
ssAPYGBLUP3000top – ssAPYGBLUP15000random	0.913	0.929
ssAPYGBLUP3000random – ssAPYGBLUP15000top	0.910	0.924
ssAPYGBLUP3000random – ssAPYGBLUP15000random	0.920	0.933
ssAPYGBLUP15000top – ssAPYGBLUP15000random	0.972	0.991



Differences in GEBV (Stature)



Differences in GEBV (foot angle)

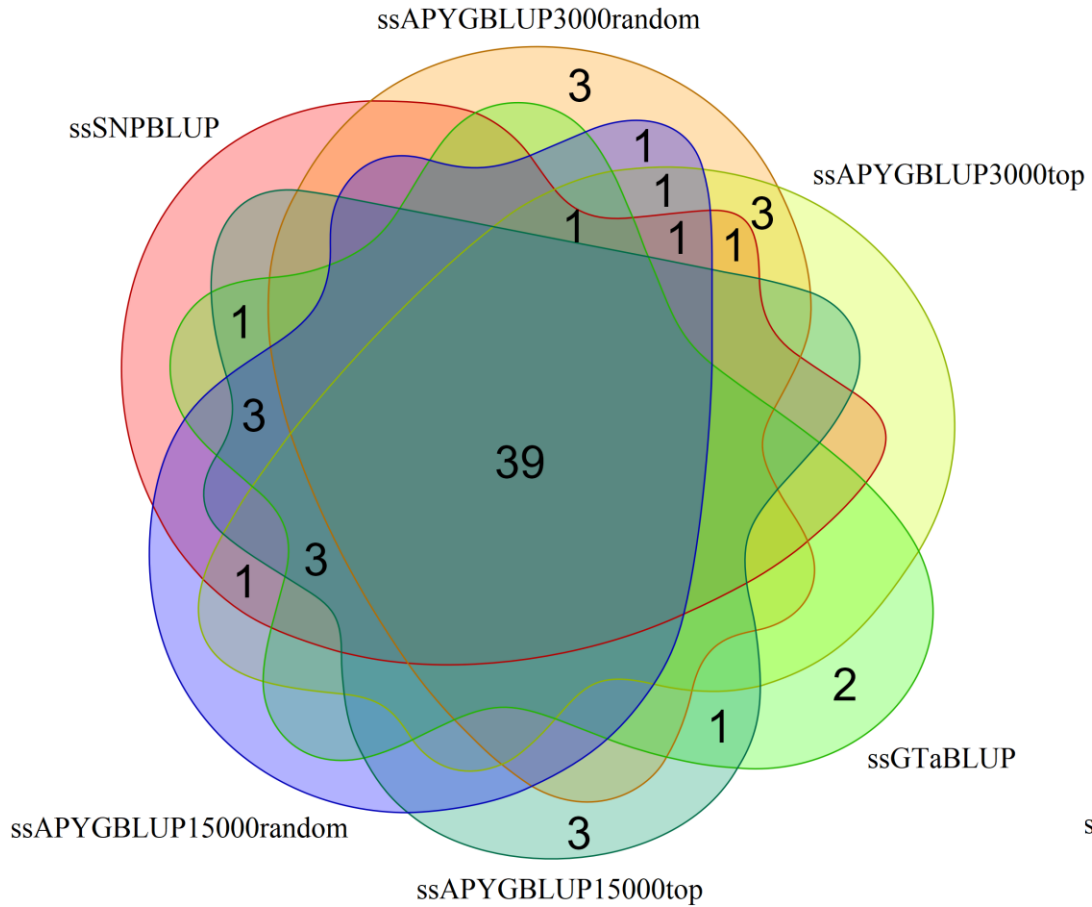


Models foot_angle: — SNP_GTa — SNP_APY_top — SNP_APY_random

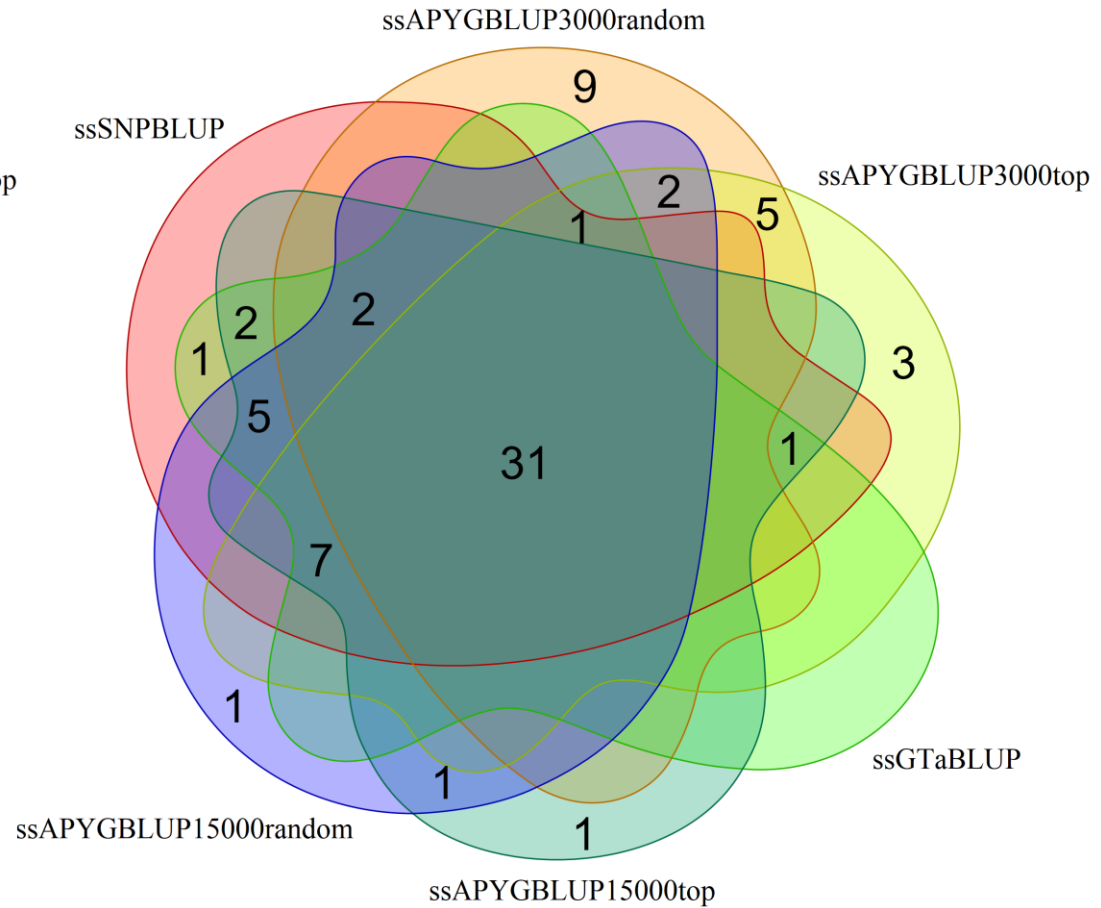
Top 50 EBVs of bulls by each model



Stature



Foot angle



Computational Resources

Models	Wall clock time (min)		Peak RAM consumption (GB)	
	Stature	Foot angle	Stature	Foot angle
ssSNPBLUP	<u>23</u>	<u>32</u>	<u>5.81</u>	<u>5.81</u>
ssGTaBLUP	138	143	63.89	63.88
ssAPYGBLUP3000top	23	29	49.48	49.47
ssAPYGBLUP3000random	23	32	49.48	49.47
ssAPYGBLUP15000top	68	70	61.56	61.56
ssAPYGBLUP15000random	54	57	61.56	61.56



Conclusions

- High correlations of GEBV between models
- Core animals subsets affect APY-based single-step model results
- Large number of core animals recommended
- Choice of solver should consider available resources
- Ranking of top bulls differs between models



Thank You!



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