Estimation of the heritability of a newly developed ketosis risk indicator and the genetic correlations to other traits in three German cattle breeds

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Goal and derivation of the KetoMIR index:

KetoMIR index:

> based on logistic regression
>
> numeric range between 0 and 1
>
> partition in three classes

„healthy":	0.00	-	0.50
„low risk":	0.50	-	0.75
„high risk":	0.75	-	1.00

	Calibration set (n=109.479)	Validation set (n=2.966)
Sensitivity:	0.70	0.72
Specificity	0.86	0.84

Probability functions of the KetoMIR index and derivaton of KetoMIR classes
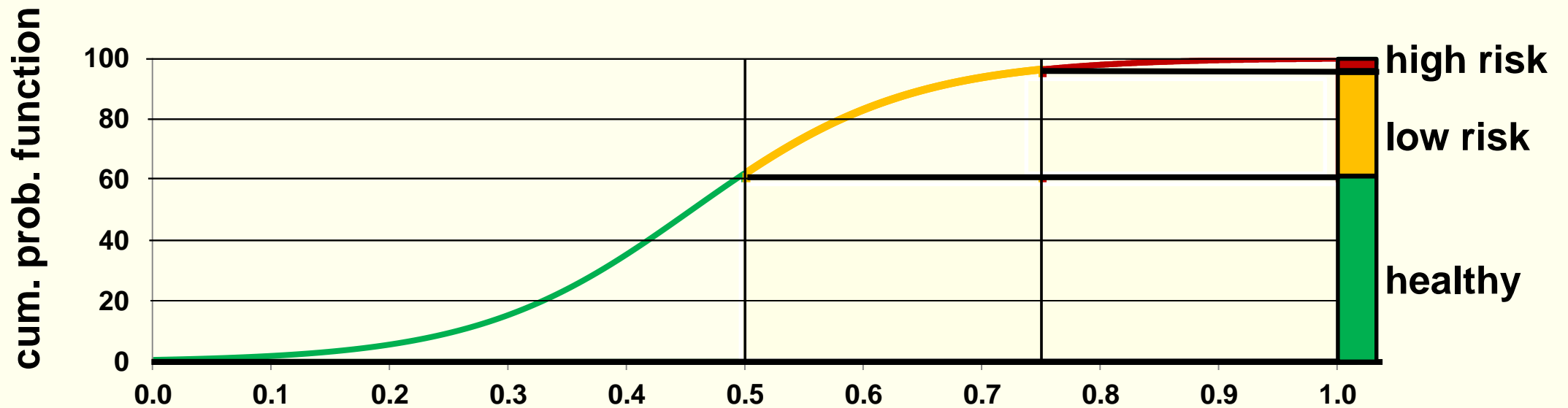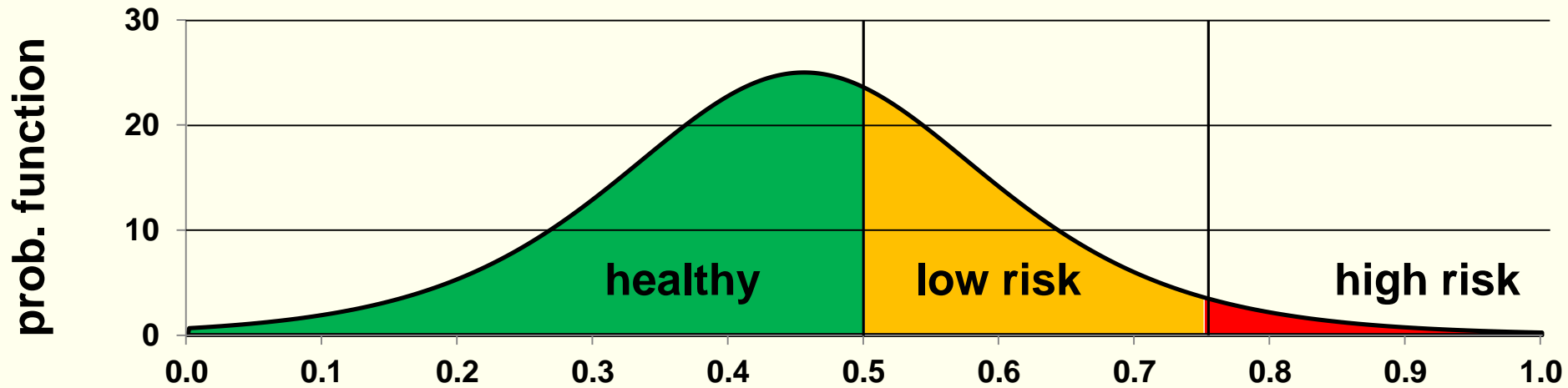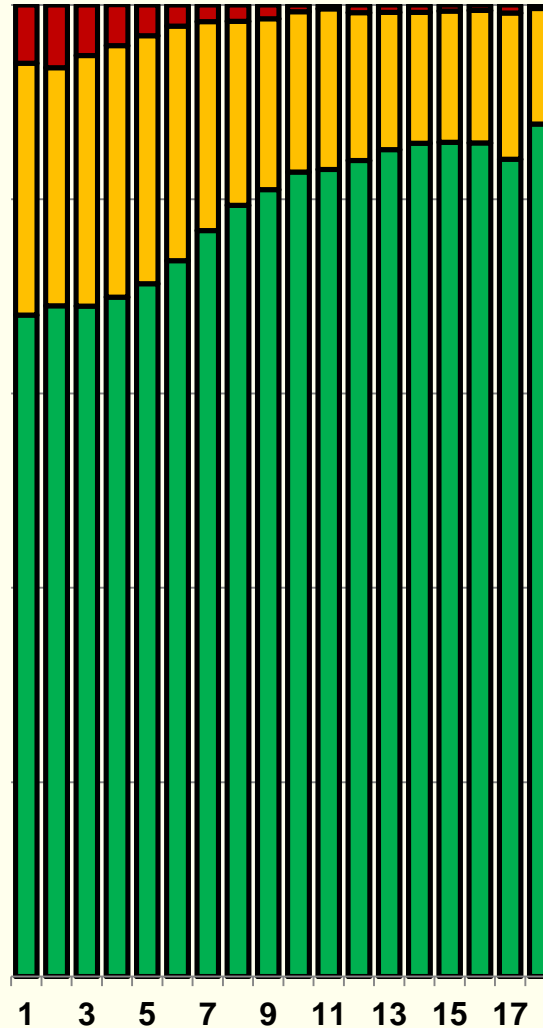
Distribution of KetoMIR classes for breeds and weeks in milk

Fleckvieh (Dual purpose Simmental)
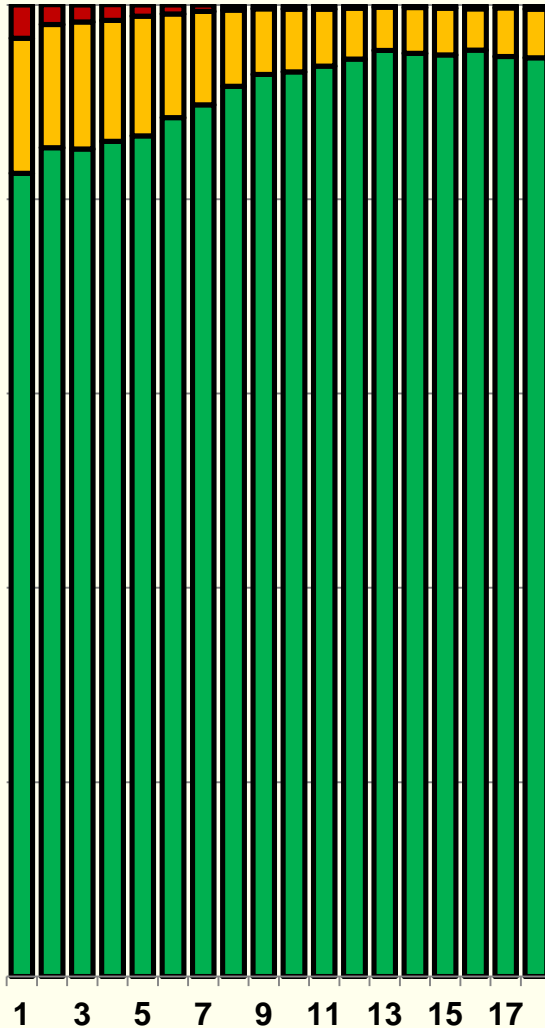
Braunvieh (German Brown)

Deutsch Holstein (German Holstein)
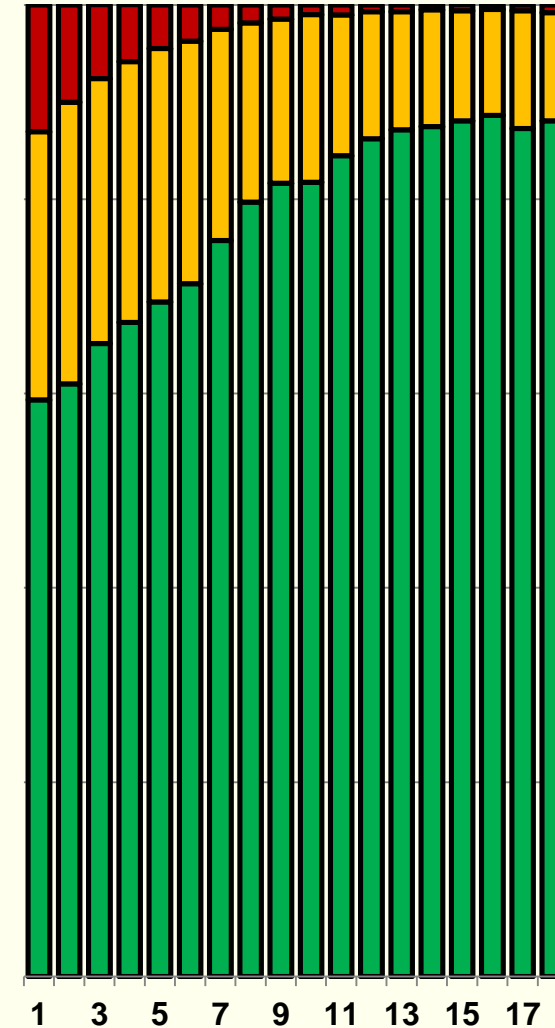
Legend:
- high risk
- low risk
- healthy

Weeks in milk

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Breeding strategies:

Selection against ketosis liability:

- based on a single (first) test day record (strategy I)

„breaking" the peaks in the KetoMIR curve

- based on the average of several test day records (strategy II)

„lowering" the general level of the KetoMIR curve

Genetic analyses:

Data:

Fleckvieh:	**37.846**	**lactations with information for the first three test**
Braunvieh:	**15.771**	**day records (analysed separately or as average)**
Deutsch Holstein:	**31.425**	

<u>Repeatability model (within breed):</u>

HYS, lactation number, days in milk, permanent environmental effect, animal effect

Genetic analyses:

How is the KetoMIR index genetically related to other traits of interest?

Genetic correlations between KetoMIR index and traits for milk components

	TD	Fleckvieh	Braunvieh	Deutsch Holstein
Milk yield	1	0.414	0.525	0.190
	2	0.251	0.354	0.195
	3	0.160	0.207	0.274
	Ø	0.276	0.394	0.200
SCS	1	0.412	0.386	0.391
	2	0.343	0.307	0.279
	3	0.417	0.402	0.266
	Ø	0.401	0.402	0.307

Genetic analyses:

How is the KetoMIR index genetically related to other traits of interest?

Genetic correlations between KetoMIR index and traits for milk components

	TD	Fleckvieh	Braunvieh	Deutsch Holstein
Fat content	1	0.024	-0.077	0.002
	2	-0.280	-0.416	-0.262
	3	-0.294	-0.460	-0.339
	Ø	-0.194	-0.370	-0.190
Protein content	1	-0.661	-0.765	-0.663
	2	-0.665	-0.709	-0.718
	3	-0.557	-0.613	-0.686
	Ø	-0.630	-0.680	-0.655
Fat-protein-ratio	1	0.468	0.463	0.385
	2	0.152	0.108	0.187
	3	0.055	-0.117	0.053
	Ø	0.239	0.143	0.212

Genetic analyses:

Data:

Fleckvieh:	**37.846**	**lactations with information for the first three test**
Braunvieh:	**15.771**	**day records (analysed separately or as average)**
Deutsch Holstein:	**31.425**	

Repeatability model (within breed):
  HYS, lactation number, days in milk, permanent environmental effect, animal effect

Multitrait model (within breed):
  HYS, lactation number, days in milk, animal effect

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Genetic analyses:

Heritabilities of the KetoMIR index (multitrait model)

	Trait	1. lact. h²	2. lact. h²	3. lact. h²
Fleckvieh	1. TD / x. l	0.256	0.264	0.233
	2. TD / x. l	0.197	0.242	0.308
	3. TD / x. l	0.247	0.358	0.332
	Ø / x. L.	0.278	0.353	0.364
Braunvieh	1. TD / x. l	0.176	0.155	0.171
	2. TD / x. l	0.278	0.272	0.332
	3. TD / x. l	0.246	0.318	0.252
	Ø / x. L.	0.289	0.374	0.348
Deutsch-Holstein	1. TD / x. l	0.292	0.254	0.201
	2. TD / x. l	0.371	0.416	0.415
	3. TD / x. l	0.302	0.298	0.263
	Ø / x. L.	0.385	0.351	0.309

Genetic analyses:

Genetic correlations of the KetoMIR index between lactations (multitrait model)

	Trait	1. to 2. lact. r_g	1. to 3. lact. r_g	2. to 3. lact. r_g
Fleckvieh	1. TD / x. l.	0.790	0.761	0.994
	2. TD / x. l.	0.978	0.967	0.966
	3. TD / x. l.	0.918	0.962	0.992
	Ø / x. L.	0.921	0.908	0.999
Braunvieh	1. TD / x. l.	0.515	0.556	0.877
	2. TD / x. l.	0.655	0.835	0.903
	3. TD / x. l.	0.935	0.932	0.973
	Ø / x. L.	0.742	0.771	0.948
Deutsch-Holstein	1. TD / x. l.	0.819	0.780	0.998
	2. TD / x. l.	0.893	0.944	0.978
	3. TD / x. l.	0.819	0.861	0.935
	Ø / x. L.	0.836	0.858	0.985

Conclusion:

Data collecting as a matter of the routine milk analyses

Genetic background of the KetoMIR index is proven

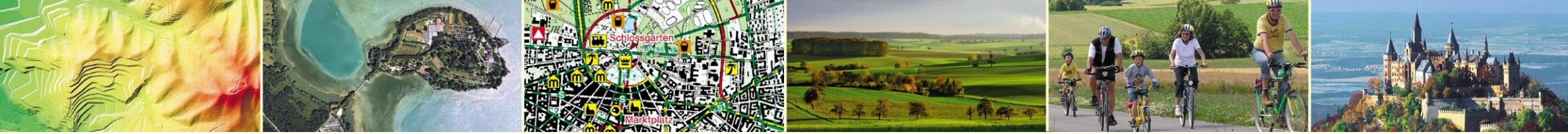Mixture of multitrait and repeatability models

Decision of a breeding value evaluation for the KetoMIR index

       - based on a single test day record

       - based on the average of several test day records

Applying random regression models to the data

Calculation of economic weights

Thank you for your attention!

Genetic analyses:

Is the KetoMIR index (classes) heritable?

Heritabilities for the KetoMIR index, catecorical and binary classes

Fleckvieh (Dual purpose Simmental)

TD	Index	C3	B050	B075
1	0.22	0.09	0.09	0.02
2	0.22	0.04	0.05	0.01
3	0.30	0.04	0.05	0.01
Ø	0.30	0.08	0.08	0.01

Braunvieh (German Brown)

TD	Index	C3	B050	B075
1	0.23	0.11	0.09	0.02
2	0.28	0.08	0.09	0.01
3	0.34	0.11	0.11	0.01
Ø	0.33	0.11	0.10	0.00

Deutsch Holstein (German Holstein)

TD	Index	C3	B050	B075
1	0.24	0.13	0.12	0.04
2	0.28	0.12	0.12	0.02
3	0.39	0.13	0.13	0.01
Ø	0.34	0.15	0.14	0.03

Genetic analyses:

How is the KetoMIR index genetically related to ketosis?

Genetic correlations between ketosis (clinical) and the KetoMIR index and categorical classes

TD	Fleckvieh		Braunvieh		Deutsch Holstein	
	Index	C3	Index	C3	Index	C3
1	1.000	1.000	0.749	1.000	0.438	0.522
2	1.000	1.000	0.376	0.368	0.045	0.122
3	1.000	1.000	0.070	-0.194	0.052	-0.065
Ø	1.000	1.000	0.240	0.153	0.319	0.445

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Genetic analyses:

Can the KetoMIR index be used as auxiliary trait in breeding programmes?

- **Is the KetoMIR index (classes) heritable?**

- **How is the KetoMIR index genetically related to ketosis?**

- **How is the KetoMIR index genetically related to other traits of interest?**