Measurement error variance of test-day observations from automatic milking systems

Pitkänen, T., Mäntysaari, E. A., Nielsen, U. S., Aamand, G. P., Madsen, P. and Lidauer, M. H.

Nordisk Avlsværdivurdering

Outline

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- Approach to estimate AMS measurement error covariance matrices
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Background

- The number of herds using automated milking system (AMS) is increasing
- The test-day observations are obtained in different manner for AMS and for herds having conventional milking system (CMS)
- Milk yield test-day observations used in Nordic yield evaluation are sum of morning and evening milking for CMS and average of one week milkings for AMS
- Protein and fat content observations are based mainly on one sample, however fat content depends on milking interval
- Due to differencies, different measurement error variance for both milking systems should be considered

Estimation of measurement error covariance matrices

Data

- Data sampled from Danish Holstein yield evaluation data from years 2001 – 2010
- It has 40 AMS and 60 CMS herds
- In this presentation milk, protein and fat yield observations are used

First lactation statistics

	AMS	CMS	total
N herds	40	60	100
N Animals	12267	38084	49145
N obs	91839	320596	
mean			
Milk kg	28.2	26.8	
Protein kg	0.95	0.89	
Fat kg	1.12	1.09	
Sd			
Milk kg	6.24	5.98	
Protein kg	0.19	0.18	
Fat kg	0.25	0.24	

Variance component estimation

- Variance components were fitted using model

$$Y_{ms} = Xb + HTD + \Phi_p p + \Phi_p a + e_{MS}$$

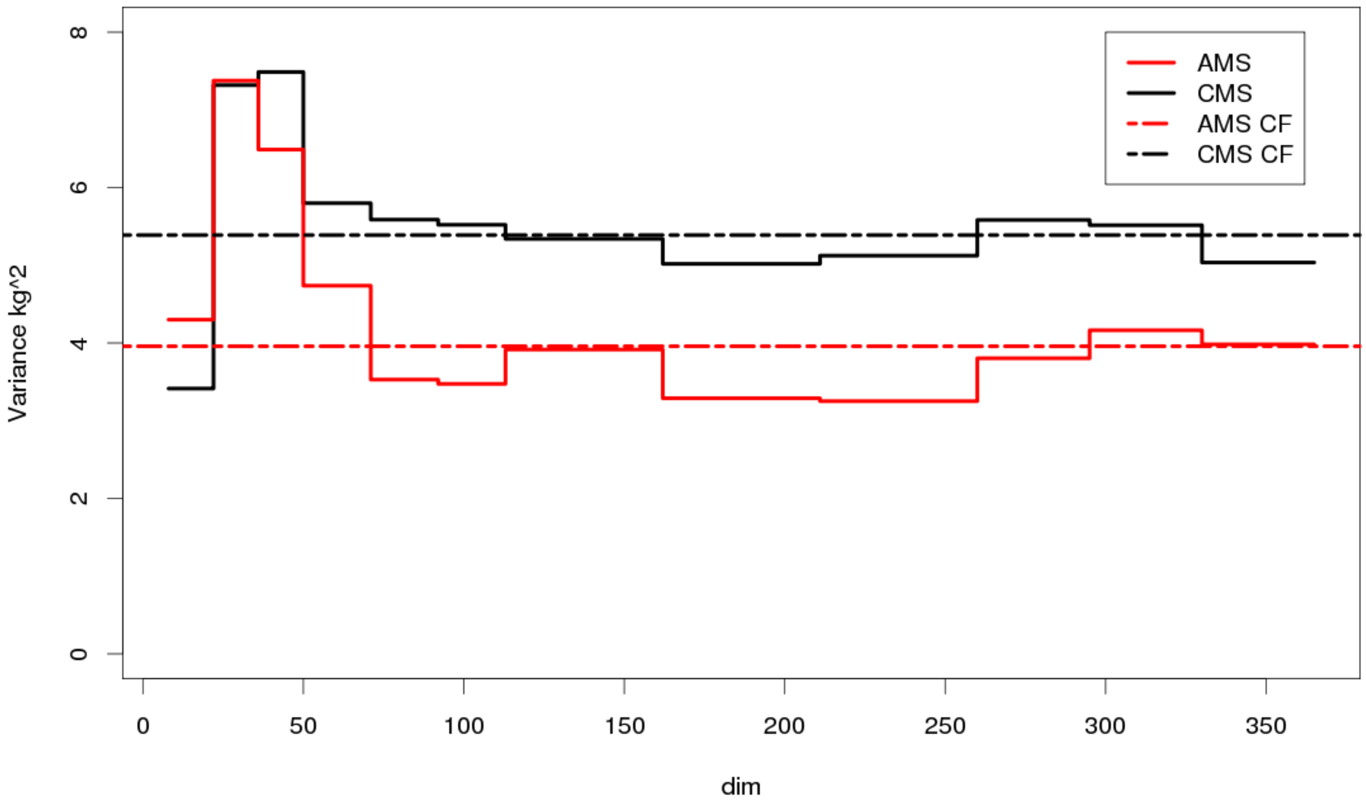
- X is an indicence matrix for fixed effects **b**
- HTD is random herd-test-day effect
- $\boldsymbol{\Phi}_p$ and $\boldsymbol{\Phi}_a$ are matrices associating non-genetic animal effects **p** and genetic animal effects **a** to an observation
- e_{MS} is random residual error vector for milking system MS
- Separate residual (co)variance matrices for milk, protein and fat were estimated for 12 intervals

MTT

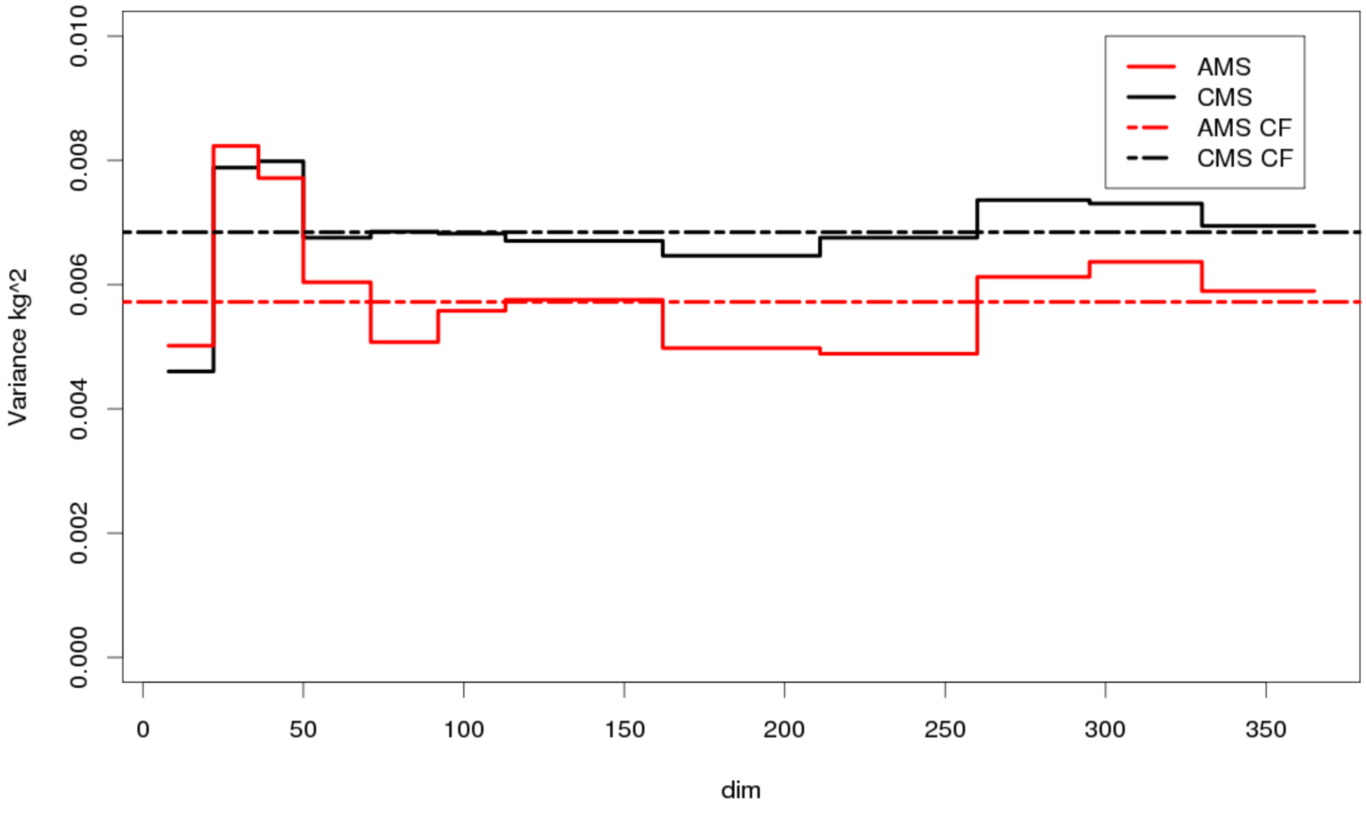
Covariance functions

- Covariance functions for both milking systems were fitted
- During fitting the rank of genetic and non-genetic covariance matrices were reduced from 12 to 7
- Part of residual variation is included in the non-genetic variation and only one measurement error matrix is left for both milking systems (E_{AMS} , E_{CMS})

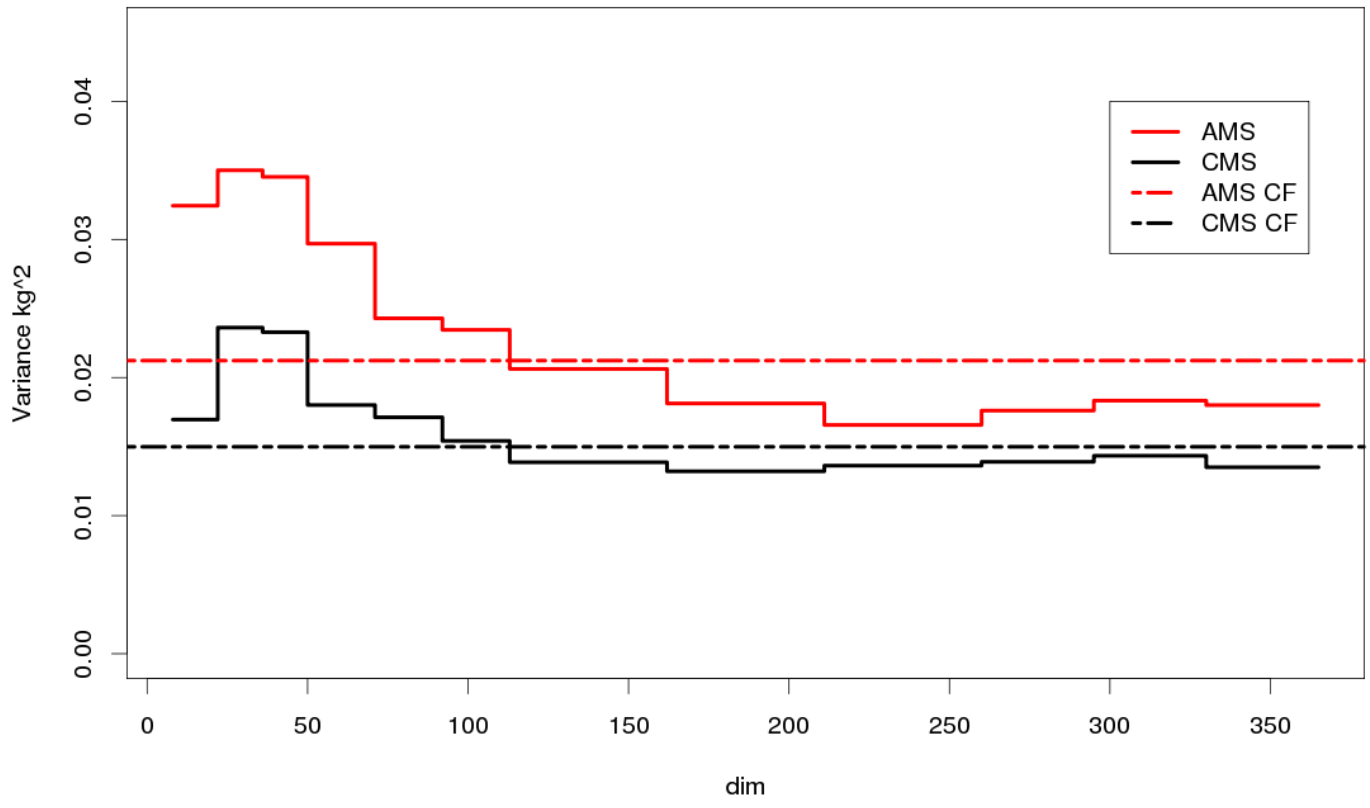
Residual variance estimates milk



Residual variance estimates protein



Residual variance estimates fat

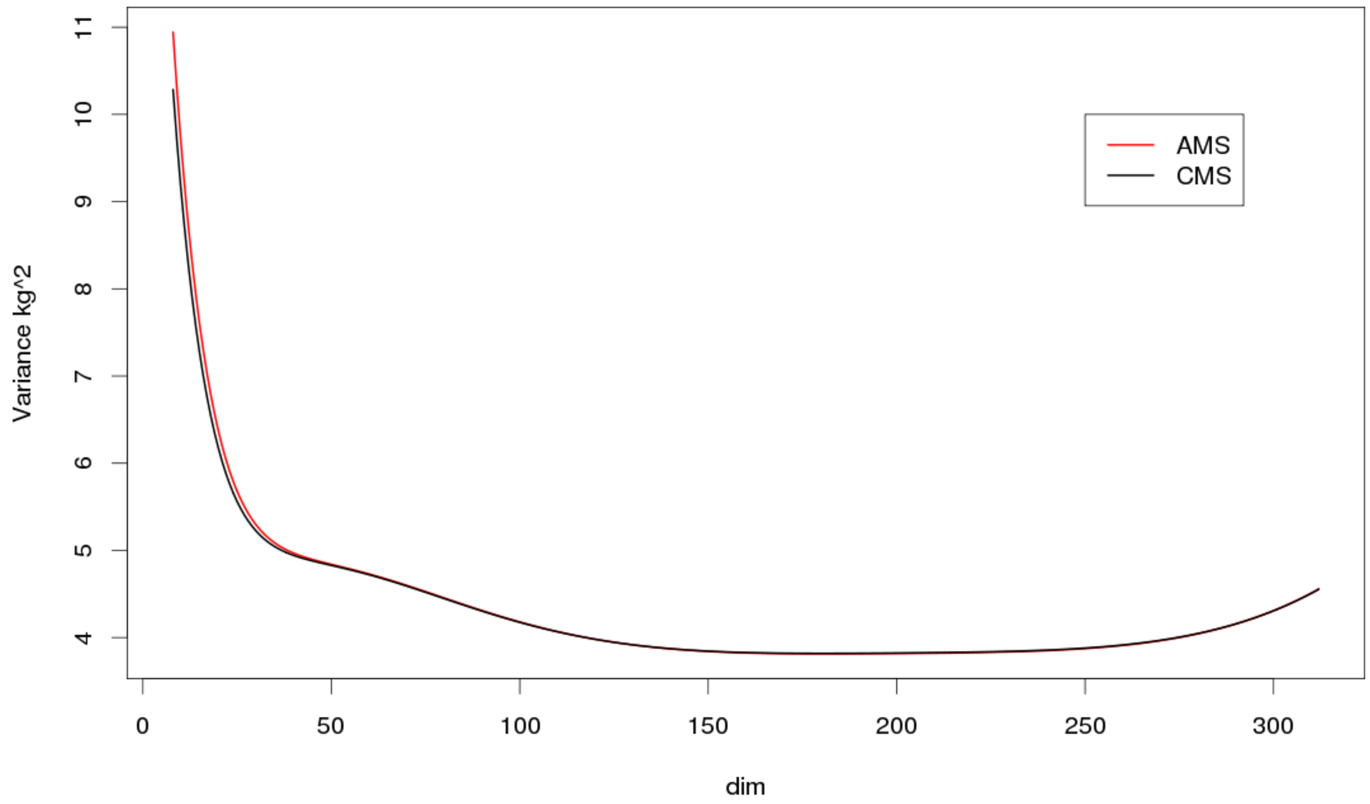


Measurement error covariances and correlations

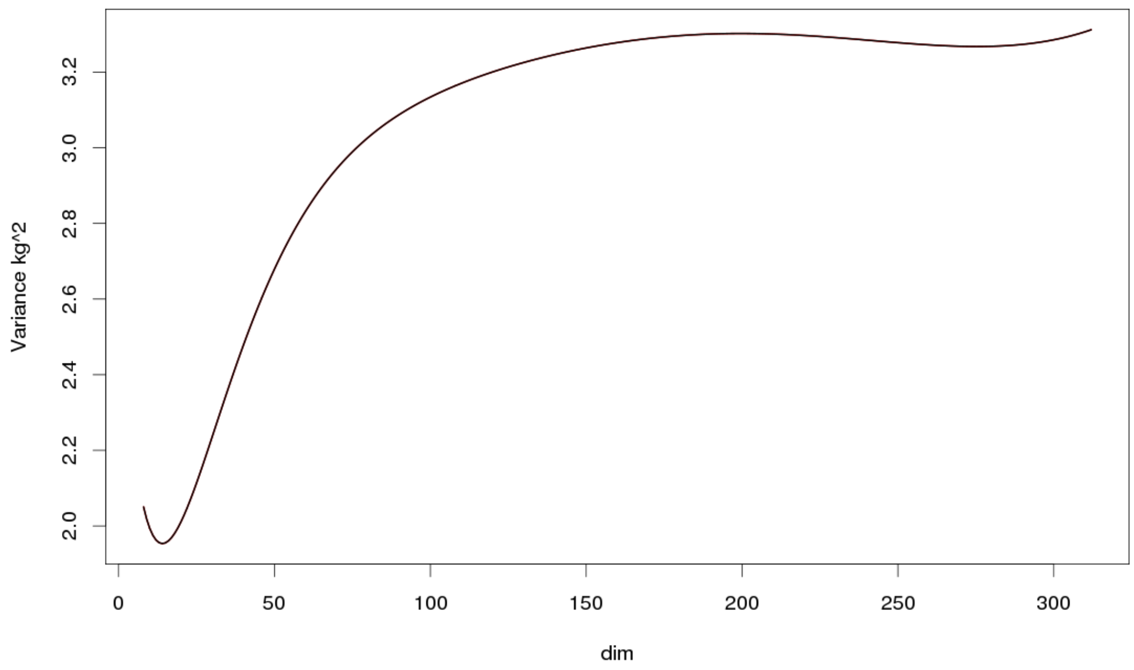
	E_{AMS}			E_{CMS}		
	Milk	**Protein**	**Fat**	**Milk**	**Protein**	**Fat**
Milk	3.96	0.126	0.128	5.39	0.176	0.189
Protein	0.84	0.006	0.005	0.92	0.007	0.007
Fat	0.44	0.48	0.021	0.66	0.67	0.015

Covariances are above and correlations below diagonal

Non-genetic variance from AMS and CMS CF’s Milk

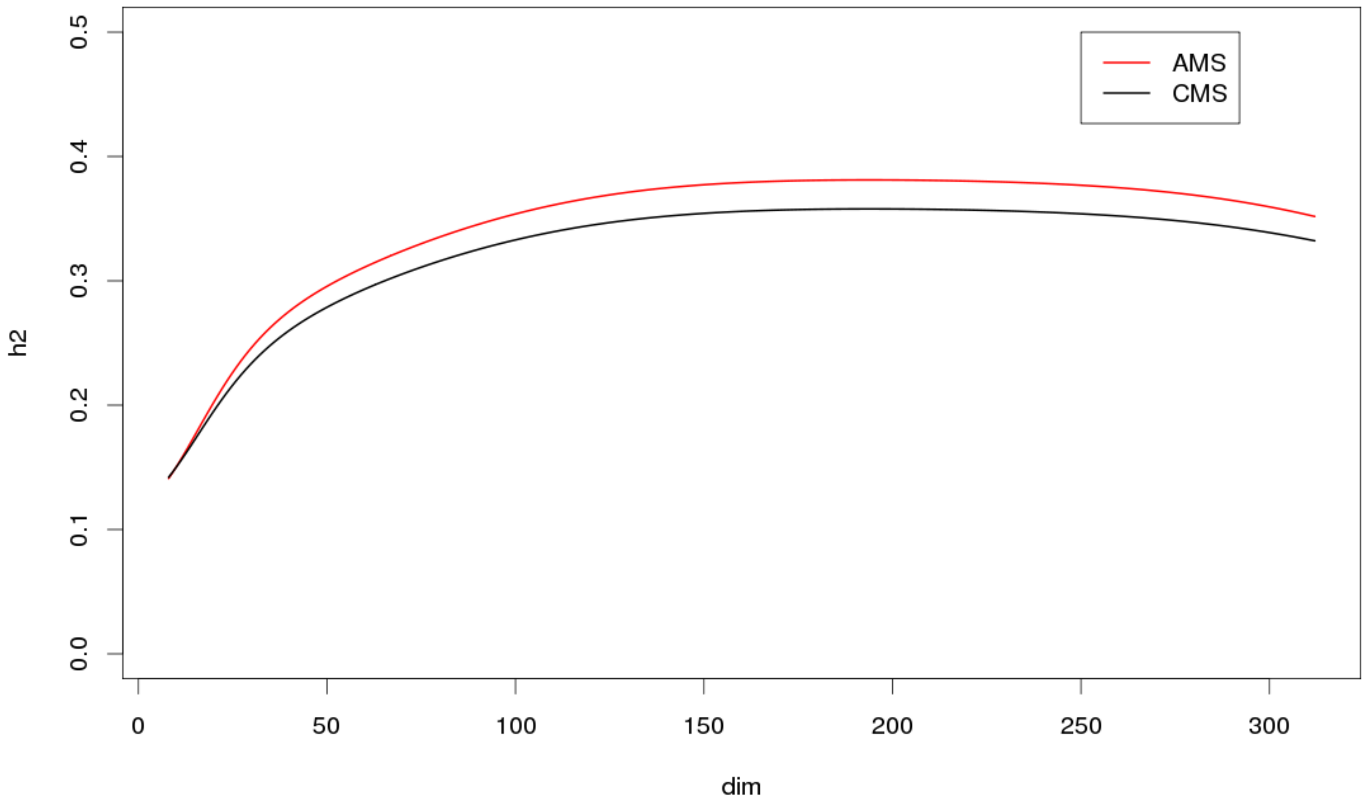


Genetic variance from AMS and CMS CF's, Milk



Curves for AMS and CMS are exactly the same due to common genetic effect

Heritabilities milk



Approach to estimate AMS residual covariance matrices

Assumptions

- Constant differences between residual variances for different milking systems
- No milking system interaction between other variance components in the model

If assumptions hold then

- Estimate measurement error variance components by using already available CF and corresponding variance components as fixed and estimate only measurement error covariance matrices for AMS and CMS

The procedure for example data

1. Estimate measurement error variance components by using CF from Nordic TDM
2. Estimate measurement error covariance matrices for all three lactations
3. Compare variance component estimates to E_{ams} and E_{cms} obtained earlier

Measurement error variance estimates for three lactations, based on TDM CF

	Lactation 1			Lactation 2			Lactation 3		
	AMS	**CMS**	**Ratio**	**AMS**	**CMS**	**ratio**	**AMS**	**CMS**	**ratio**
Milk	3.85	5.39	0.71	5.38	7.55	0.71	6.01	9.06	0.66
Protein	0.006	0.007	0.83	0.008	0.009	0.81	0.008	0.011	0.77
Fat	0.021	0.015	1.40	0.033	0.022	1.51	0.038	0.027	1.44

Measurement error variance estimates Comparison of 1. lactation results

	TDM CF			Original CF		
	AMS	CMS	ratio	AMS	CMS	ratio
Milk	3.85	5.39	0.71	3.96	5.39	0.73
Protein	0.006	0.009	0.83	0.006	0.007	0.84
Fat	0.0205	0.015	1.40	0.021	0.015	1.42

- The estimates and ratios are close to each other
- The estimation approach will produce usable results even the CF is based on different data

Conclusions

- Measurement error variances differ between milking systems
  - AMS has lower measurement error variances for milk and protein and higher for fat
  - AMS has lower correlation between traits
- Measurement error covariance matrix estimation can be done by using the proposed approach

Thank you for your attention!