EAAP 2019
Ghent

Potential use of MIR spectra in the prediction of hoof disorders in Holstein Friesians

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[3] Walloon Agricultural Research Center (CRA-W)

Context

Context

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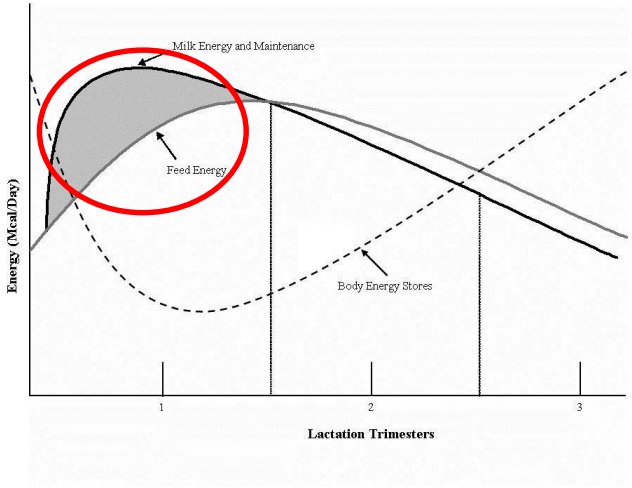
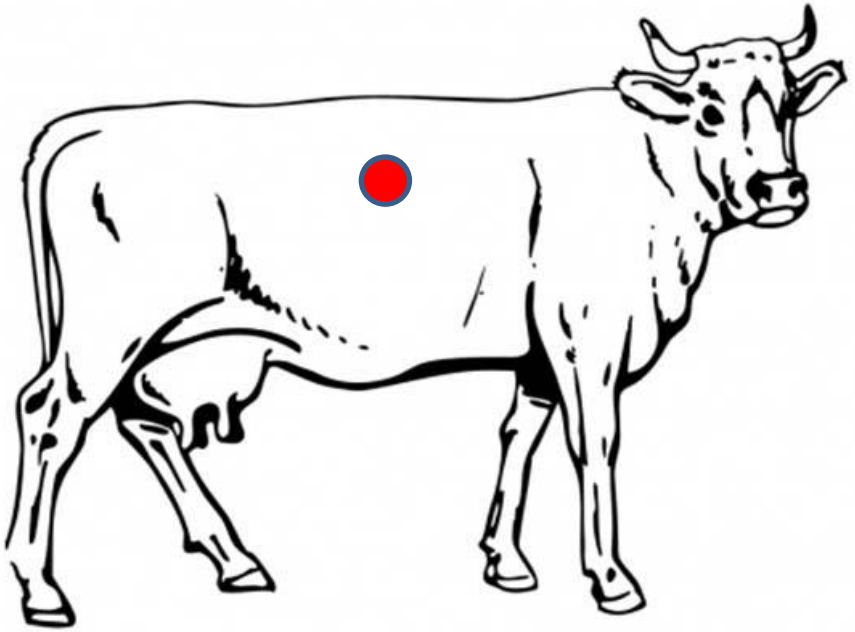
Hypothesis


Milk Energy and Maintenance
Feed Energy
Body Energy Stores
Energy (Meal/Day)
1
2
3
Lactation Trimesters



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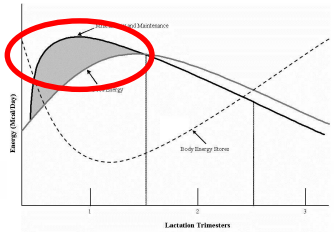
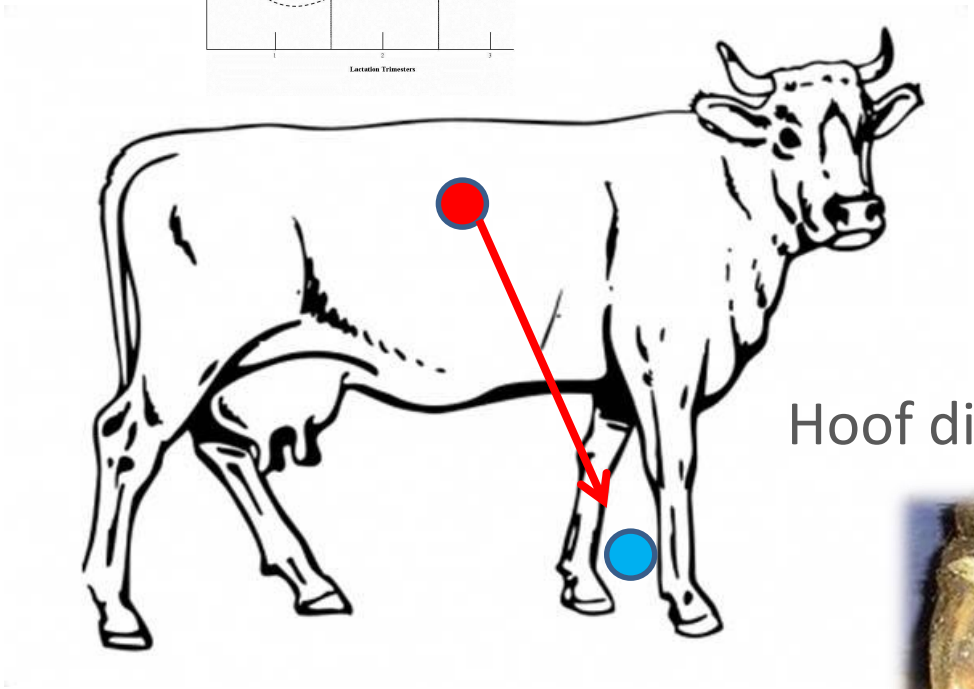




Hoof disease score

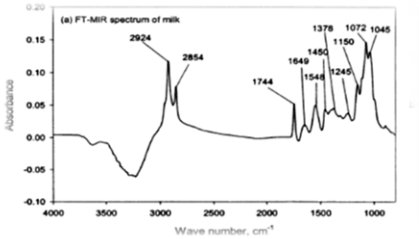
(CRV 2019)

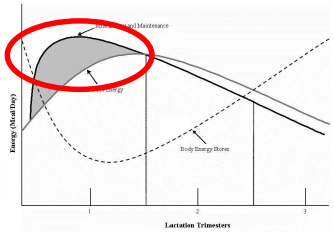
Hypothesis

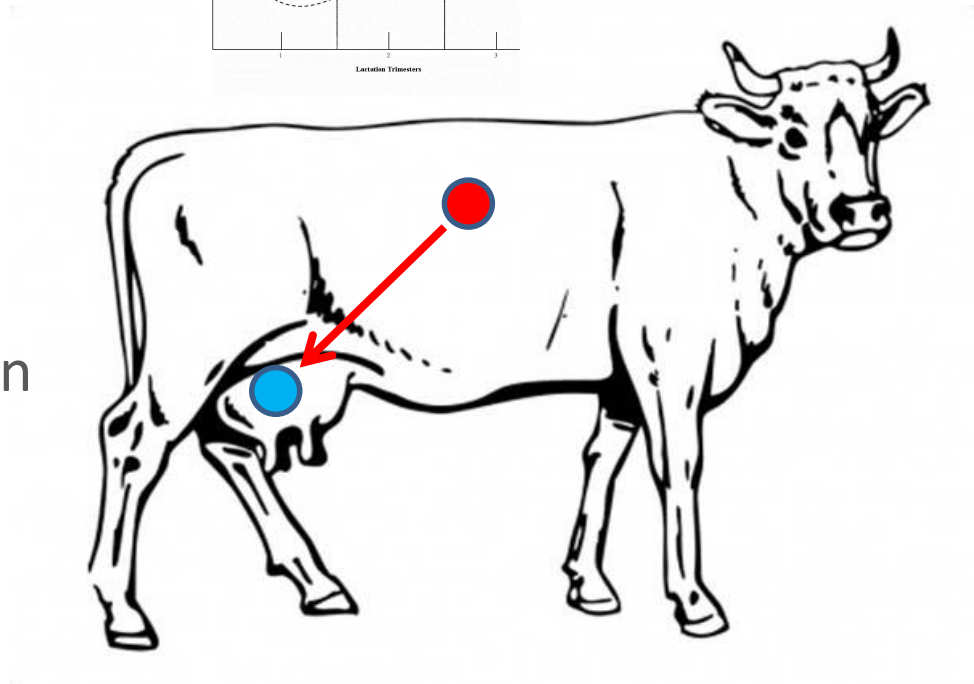
Milk composition

=

MIR spectra







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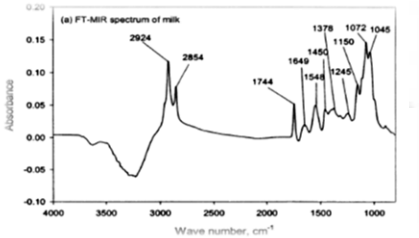
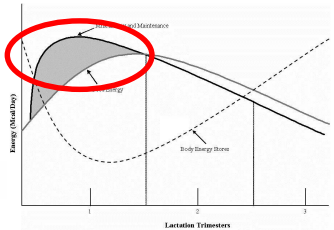
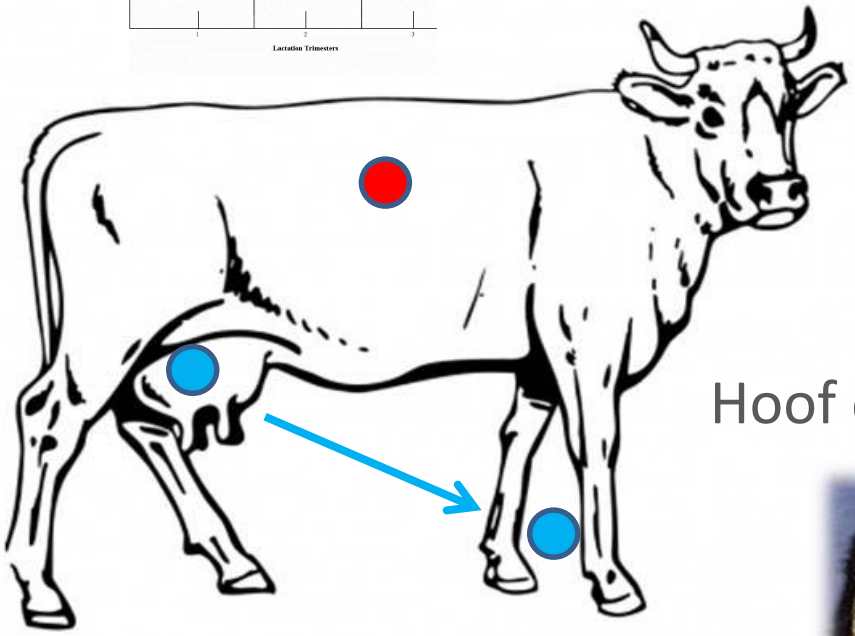






Hoof disease score

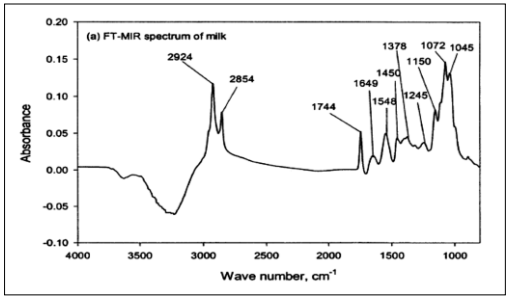
(CRV 2019)

Mid-infrared technology

Milk samples

MIR analysis

MIR spectra



Prediction

Novel components

- BHB, acetone …

Cow health status

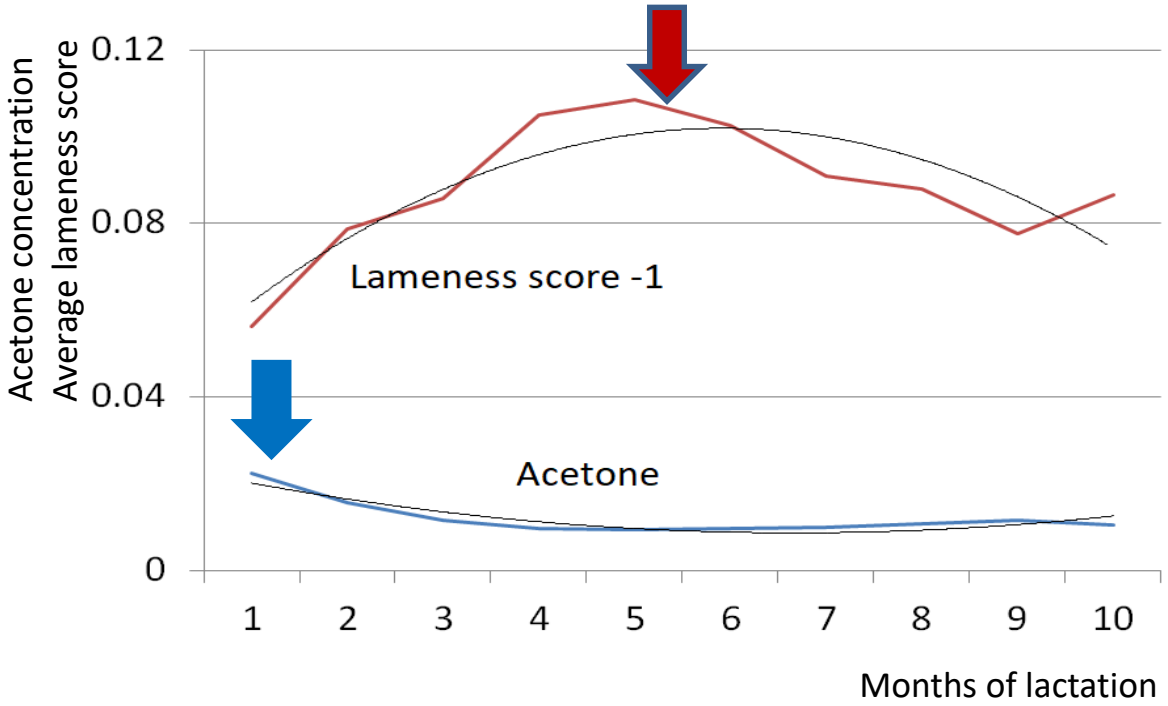
Calibration

Reference values

A. Mineur *et al.*, EAAP 2018

Previous research

- Milk Metabolites
- Locomotion scores



A. Mineur *et al.*, EAAP 2018

Previous research

Austrian data

A. Mineur *et al.*, EAAP 2018

Present research

Dutch data

Previous research

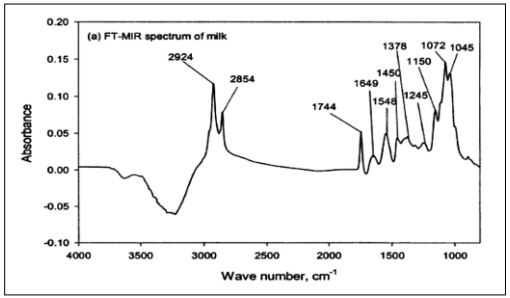
- Austrian data
- MIR based metabolites

[BHB]
[acetone]
[citrate]

A. Mineur *et al.*, EAAP 2018

Present research

- Dutch data
- MIR spectra



Previous research

- Austrian data
- MIR based metabolites
- Locomotion score

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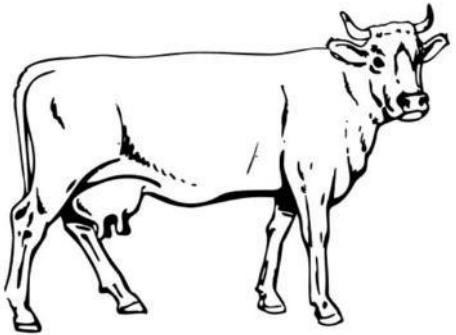
Present research

- Dutch data
- MIR spectra
- Hoof disease scores

(CRV 2019)

Data

- Holstein Friesian, 2013 - 2018
  - 267 009 cows
  - 2299 herds



Material and methods

- Holstein Friesian, 2013 - 2018
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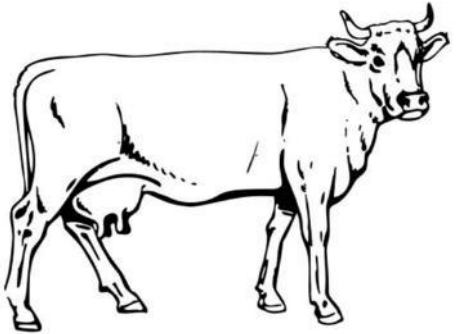
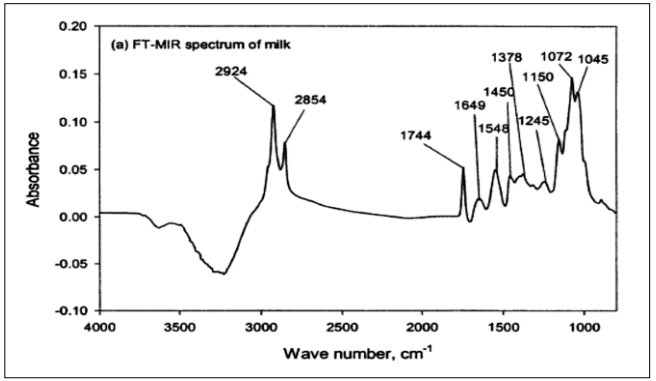


- MIR spectra: 3 154 241
  - 1060 total wavenumbers
  - First derivative
  - 212 selected wavenumbers



Data

- Hoof scores: 386 676
  - 0 = healthy
  - 1 = light, 2 = moderate, 3 = severe disorder
  - 6 diseases

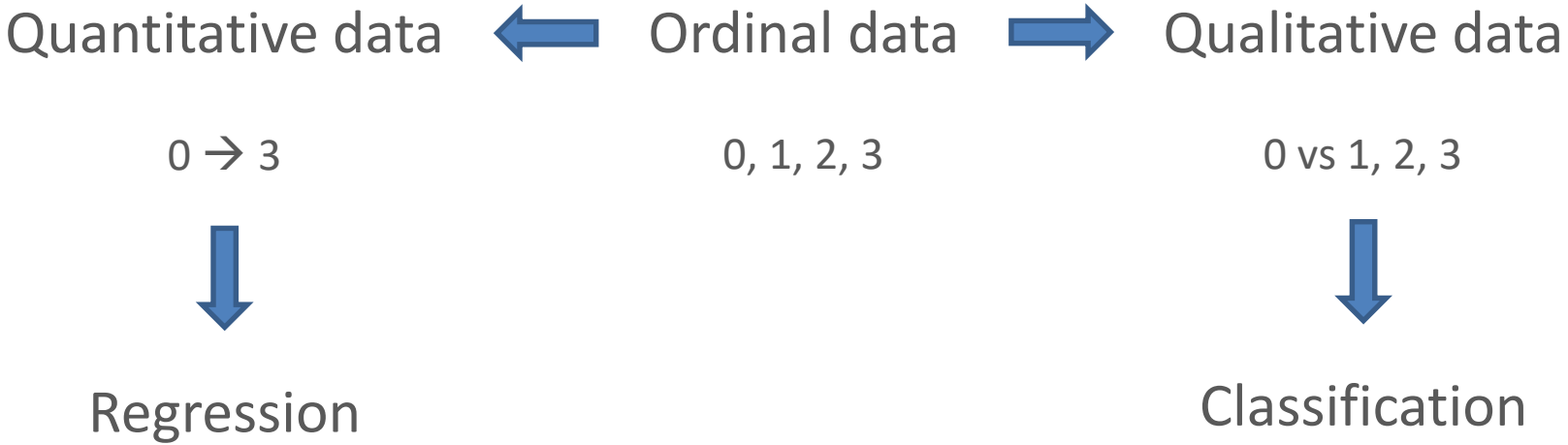
(CRV 2019)

DD = digital dermatitis
ID = interdigital dermatitis
IH = interdigital hyperplasia

SH = sole haemorrhage
SU = sole ulcer
WL = white line disease

HD = hoof disorder

Material and methods



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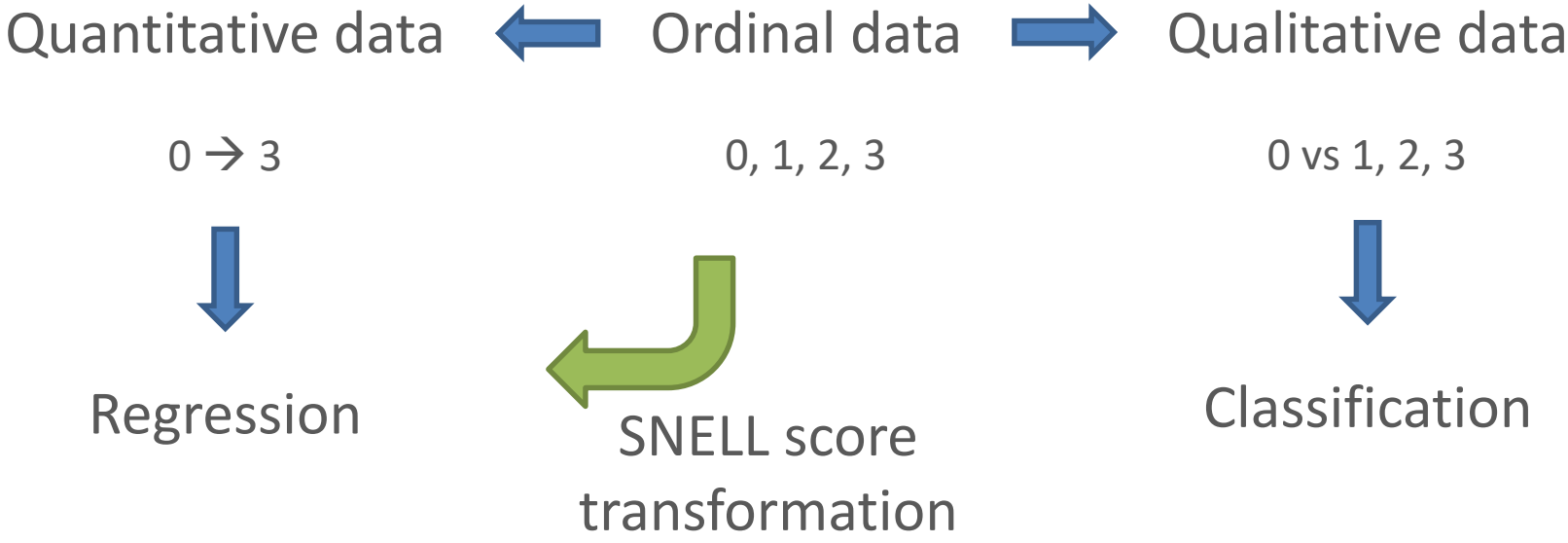


Material and methods

- SNELL scores
  - Scaling procedure, ordinal data to numerical scores
  - Better assumption of normality (distribution)

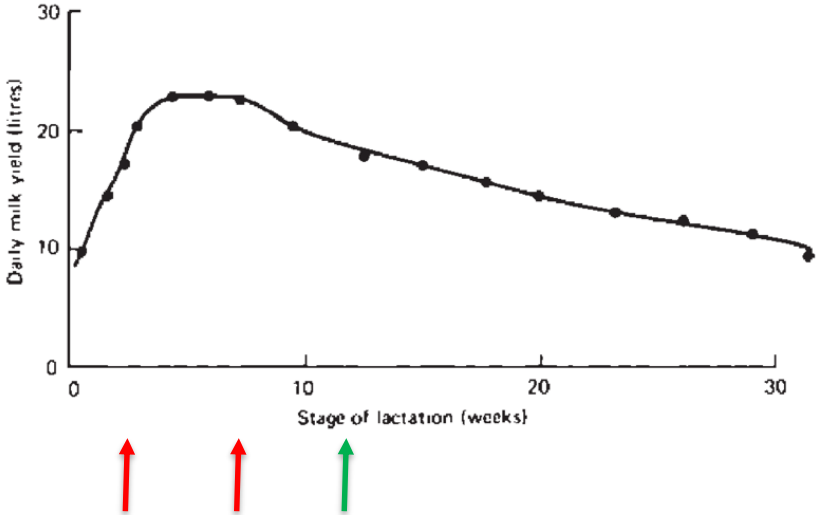
SH 2013		0	1	2	3	
	Absolute frequency	79225	22771	7005	911	109912
	Relative frequency	0,72	0,21	0,06	0,01	
SNELL 2013		-0,36	0,93	1,75	2,64	

Model

- Fixed effect correction of MIR spectra
  - Herd-test day
  - Lactation group: 1, 2, 3+
  - Month of lactation
- Equal numbers of 0, 1, 2, 3 hoof scores

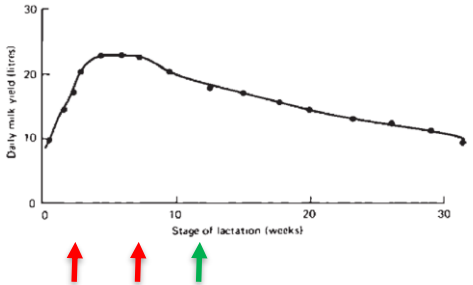
Model

- Predictive variables
  - MIR 1 – 212 per months
- Predicted variable
  - Hoof score in following month



Model

- Predictive variables
  - MIR 1 – 212 per months
  - Outliers: GH > 5



- Predicted variable
  - Hoof score in following month

- Regression
  - SNELL scores

- Classification
  - Hoof scores
  - 0 = healthy
  - 1, 2, 3 = diseased

Results

- Regression (PLS)
  - N=5200

  - HD = combined disease
  - SH = sole haemorrhage
  - SU = sole ulcer
  - WL = white line disorder

  - Month 5, predicted by MIR month 1, 2, 3, 4

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hoof lesion	R^2	R^2cv
HD SNELL 5	0,094	0,042
SH SNELL 5	0,039	-0,22
SU SNELL 5	0,100	0,048
WL SNELL 5	0,062	0,004

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	healthy	diseased	total	sensitivity (%)	specificity (%)	global accuracy (%)
predicted healthy	1173	735	1908	61%	62%	61%
predicted diseased	760	1203	1963			
total	1933	1938	3871			

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Conclusion

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Conclusion & future research

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  - Phenotypes as proxies

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  - EBV calculation

Acknowledgements

- CRV
- National Fund for Scientific Research

LIÈGE université
Gembloux
Agro-Bio Tech

CRV

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Thank you

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