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# European TMI estimation

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# Outline

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- ✓ Available data
- ✓ Principal component analysis (PCA)
- ✓ Predicting 1st component from combined proofs on phantom scale
  - ✓ 4 groups of traits
  - ✓ Definition of European TMI...



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# Available Data



# European populations

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- TMI from 6 European « populations » available:
  - France
  - Germany
  - Walloon Region of Belgium
  - Italy
  - Netherlands
  - Nordic countries (Denmark, Finland, Sweden)



# European populations: statistics

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- Six European « populations » provided their own published global (Total Merit) indexes

	N	Index	Descriptive Statistics			
			Minimum	Mean	Std Dev	Maximum
France	81165	ISU	-44.00	86.71	27.33	195.00
Germany	95292	RZG	40.57	91.89	13.43	148.69
Walloon Region	105014	V€G	-936.00	-17.63	140.52	502.00
Italy	8201	PFT	-2273.00	0.64	787.30	2795.00
Netherlands	120717	NVI	-510.00	-94.71	83.45	297.00
Nordic countries	7490	NTM	-59.00	-13.25	11.81	35.00

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# Principal Component Analysis



# Used Data for PCA

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- Six European « populations »: Common bulls ???
  - 458 common bulls (birth years from 1986 to 2003)

	Index	Descriptive statistics			
		Minimum	Mean	Std Dev	Maximum
France	ISU	31.00	106.82	22.38	189.00
Germany	RZG	61.09	102.56	12.74	148.69
Walloon Region	V€G	-335.00	112.26	120.59	452.00
Italy	PFT	-1630.00	467.08	690.16	2760.00
Netherlands	NVI	-282.00	-24.60	75.94	297.00
Nordic countries	NTM	-50.00	-8.28	11.66	32.00

# Correlations across “populations”

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- Six European « populations »
  - 458 common bulls: Correlation Matrix

	France	Germany	Walloon Region	Italy	Netherlands
Germany	0.89				
Walloon Region	0.82	0.87			
Italy	0.83	0.83	0.79		
Netherlands	0.82	0.90	0.87	0.78	
Nordic countries	0.79	0.87	0.79	0.75	0.85

# Eigenvalues & Eigenvectors

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## ➤ Six European « populations »

### ➤ 458 common bulls: eigenvalues and eigenvectors

	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6
Eigenvalue	5.15	0.29	0.21	0.17	0.12	0.08
Relative variance	85.76	4.76	3.40	2.77	1.94	1.27
France	0.41	0.33	0.17	-0.75	0.01	0.35
Germany	0.42	-0.08	0.03	-0.20	-0.12	-0.87
Walloon Region	0.41	-0.08	-0.73	0.06	0.53	0.09
Italy	0.39	0.70	0.16	0.56	-0.04	0.01
Netherlands	0.41	-0.35	-0.21	0.15	-0.74	0.30
Nordic countries	0.40	-0.51	0.60	0.21	0.40	0.15

# Eigenvalues & Eigenvectors

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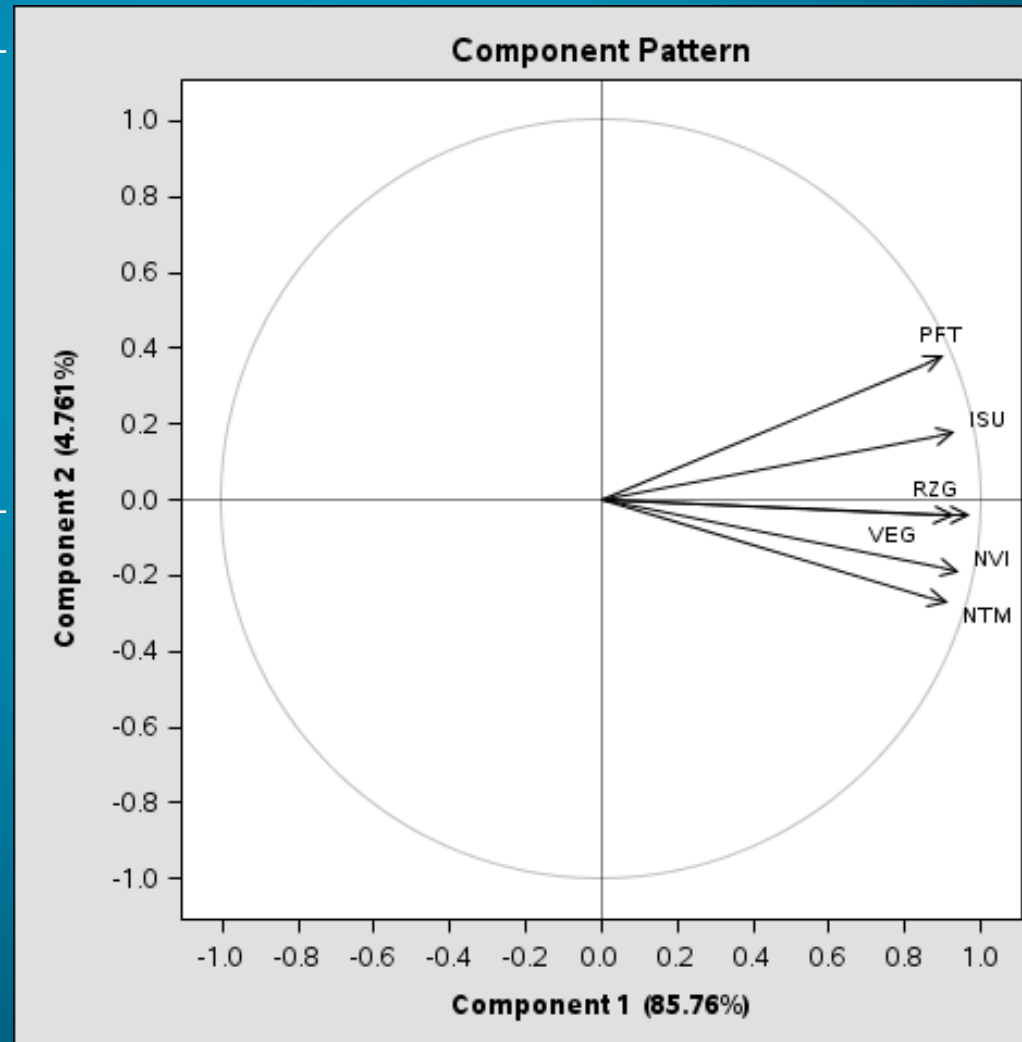
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Nordic countries	0.40	-0.51	0.60	0.21	0.40	0.15

# Correlations with global indexes

	Prin1	Prin2
France (ISU)	0.93	0.18
Germany (RZG)	0.97	-0.04
Walloon Region (VEG)	0.92	-0.04
Italy (PFT)	0.89	0.38
The Netherlands (NVI)	0.94	-0.19
Nordic countries (NTM)	0.91	-0.27



# Correlations with all principal components (1)

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- ✓ On combined proofs on phantom scale provided by Helge in March 2011

	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6
Milk	0.44	0.00	0.10	-0.48	0.04	-0.34
Fat	0.55	0.06	0.01	-0.29	-0.05	0.01
Protein	0.68	-0.12	0.10	-0.42	0.01	-0.11
Udder Health	0.38	0.22	-0.07	0.04	0.15	0.09
Female Fertility (C2)	0.20	-0.25	0.14	0.32	-0.08	0.11
Milking Speed	0.06	0.06	0.13	0.13	0.16	-0.09
Temperament	0.06	0.06	0.13	0.13	0.16	-0.09

# Correlations with all principal components (2)

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	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6
Angularity	0.02	0.41	0.07	-0.07	-0.02	-0.11
Body Condition Score	0.14	0.46	0.24	0.01	-0.05	0.03
Body Depth	-0.20	0.42	0.21	-0.14	-0.07	0.06
Chest Width	-0.09	0.32	0.17	-0.10	-0.07	0.17
Foot Angle	0.23	0.29	-0.06	0.16	-0.08	-0.17
Fore Teat Length	0.02	0.06	0.11	-0.15	-0.06	-0.07
Fore Teat Placement	0.28	0.24	-0.01	0.09	-0.04	0.04
Fore Udder Attachment	0.15	0.28	-0.15	0.23	0.09	0.01
Locomotion	0.37	0.12	-0.22	0.20	-0.17	-0.12
Overall Feet & Legs	0.42	0.12	-0.23	0.29	-0.11	-0.16

# Correlations with all principal components (3)

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	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6
Overall Udder Score	0.40	0.41	-0.15	0.23	0.09	0.06
Rump Angle	0.08	-0.07	-0.01	-0.09	-0.21	0.12
Rear Leg Rear view	0.28	0.08	-0.24	0.16	-0.13	-0.14
Rear Leg Set	-0.26	-0.03	0.23	-0.18	0.08	0.09
Rear Teat placement	0.12	0.30	0.06	0.06	-0.13	-0.07
Rear Udder Height	0.35	0.42	-0.12	0.10	0.03	-0.04
Rump Width	0.04	0.33	0.21	0.01	-0.05	0.05
Stature	0.10	0.49	0.16	-0.06	-0.01	0.04
Udder Depth	0.32	0.37	-0.15	0.30	0.19	0.05
Udder Support	0.28	0.34	-0.05	0.10	0.01	-0.02

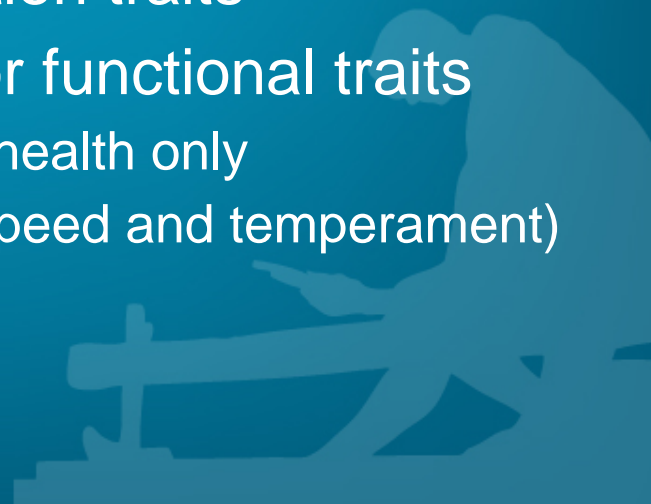
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Predicting 1st component from  
combined proofs  
(on phantom scale)



# Regressions of 1<sup>st</sup> component

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- ✓ On combined proofs on phantom scale provided by Helge in March 2011
  - ✓ By stepwise regressions on four groups of available traits
    - ✓ Combined proofs for production traits
    - ✓ Combined proofs for conformation traits
    - ✓ 2 groups of combined proofs for functional traits
      - ✓ female fertility (C2) & udder health only
      - ✓ + workability traits (milking speed and temperament)
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# Regressions of 1<sup>st</sup> component

	Estimate	SE	t Value	Pr >  t
<b>Production (N=458, R<sup>2</sup>=0.513)</b>				
Milk	<b>-0.441</b>	0.126	-3.51	0.0005
Fat	0.400	0.075	5.32	<.0001
Protein	1.338	0.118	11.3	<.0001
<b>Functionality I (N=458, R<sup>2</sup>=0.159)</b>				
Udder Health	0.728	0.090	8.08	<.0001
Female Fertility (C2)	0.181	0.063	2.86	0.0045
<b>Functionality II (N=272, R<sup>2</sup>=0.179)</b>				
Udder Health	0.854	0.126	6.76	<.0001
Female Fertility (C2)	0.209	0.082	2.56	0.0111
Milking Speed	0.356	0.129	2.75	0.0064

Temperament is missing !

# Regressions of 1<sup>st</sup> component

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	Estimate	SE	t Value	Pr >  t
<b>Morphology (N=418, R<sup>2</sup>=0.318)</b>				
Body Condition Score	0.149	0.047	3.14	0.002
Body Depth	-0.549	0.098	-5.60	<.0001
Fore Teat Placement	0.305	0.083	3.69	0.000
Locomotion	0.425	0.194	2.19	0.029
Overall Feet & Legs	0.342	0.134	2.55	0.011
Rear Leg Rear view	-0.497	0.187	-2.66	0.008
Rear Teat placement	-0.460	0.105	-4.38	<.0001
Rear Udder Height	0.226	0.101	2.23	0.027
Udder Support	0.360	0.105	3.42	0.001

Only 9 of 19 morphological traits have a significant effect!

# Regressions of 1<sup>st</sup> component

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- ✓ One value per group of traits
- ✓ Correlations between groups ranged from -0.21 to 0.28
  - ✓ Except correlation between both groups of functionality: 0.93
- ✓ Functionality II not greater than functionality I ?
- ✓ Multiple regression method to combine these 3 values in both cases of functionality

→ Estimation of an European TMI



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# Definition of European TMI




# Definition of European TMI

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	Estimate	SE	t Value	Pr >  t	Relative weights
<b>TMI 1 (N=418, R<sup>2</sup>=0.884)</b>					
production value	0.995	0.024	42.28	<.0001	37.4%
functional value I	0.991	0.043	23.12	<.0001	37.2%
morphology value	0.677	0.031	21.81	<.0001	25.4%
<b>TMI 2 (N=248, R<sup>2</sup>=0.881)</b>					
production value	0.973	0.031	31.18	<.0001	39.2%
functional value II	0.835	0.054	15.32	<.0001	33.7%
morphology value	0.673	0.044	15.46	<.0001	27.1%

# Conclusions

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- ✓ PCA easy method to assess common variation of European Global Indexes
    - ✓ Enough common bulls ?
    - ✓ Only Prin1 ?
  - ✓ Definition of European TMI
    - ✓ Results seem to make sense
    - ✓ Impact of the inclusion of calving traits?
    - ✓ How calculate reliability for European TMI?
  - ✓ Your impressions?
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# Thank you for your attention !

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