IRISH CATTLE BREEDING FEDERATION

Swedish University of Agriculture

Department of Animal Breeding & Genetics

Using Digital Images of Carcasses in the Irish Genetic Evaluation

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BSAS – ARF joint meeting

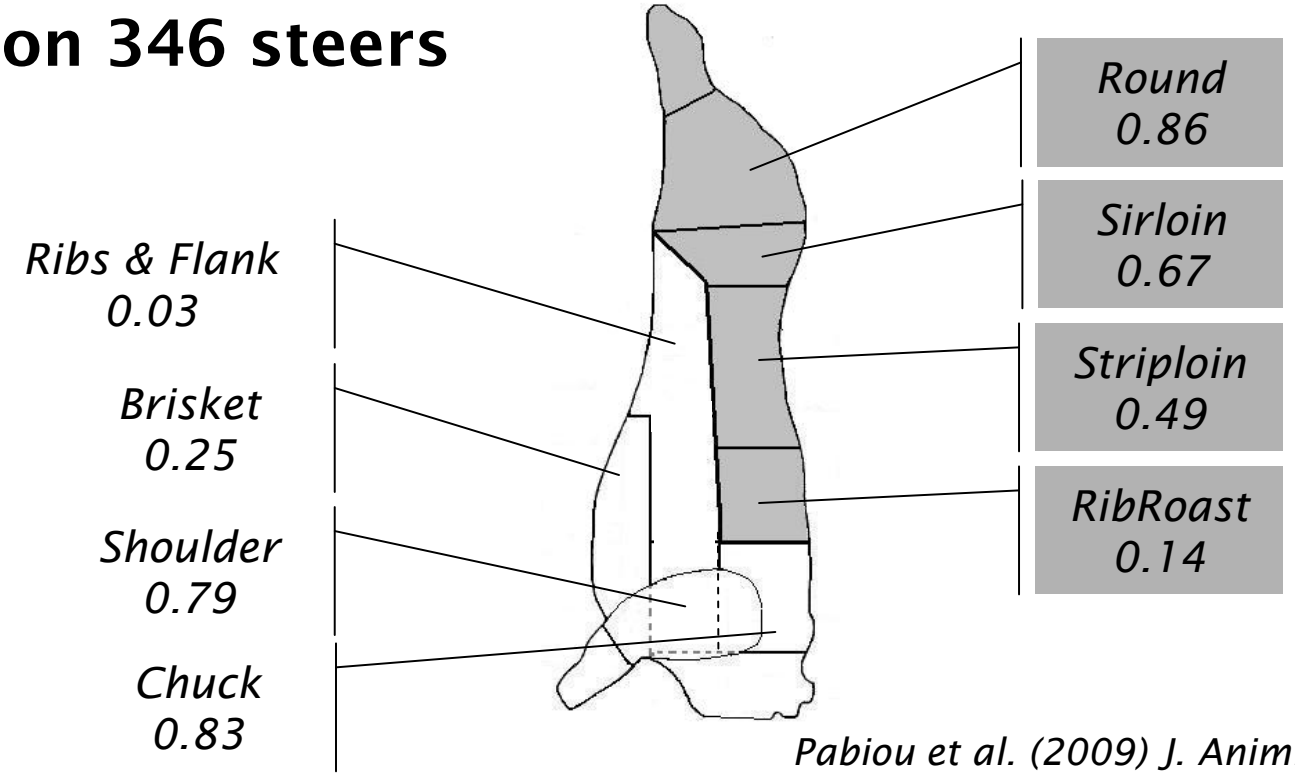
Thierry Pabiou (ICBF)

Belfast – 12 - 14 April 2010

NATIONAL DEVELOPMENT PLAN

Motivation

- **h^2 calculated on 346 steers**



Pabiou et al. (2009) J. Anim. Sci.

- Genetic variation in carcass cut yields
- Need access to a large group of data for genetic evaluation

Objective

- Evaluate the potential of carcass digital images to predict meat yield

- Facilitate the identification of germplasm of greater carcass value
- Improve carcass payment to Irish farmers

Mechanical Grading

VBS2000 (E+V, Germany)

- Approved since 2001 for EUROP carcass grading in Ireland *(conformation & fat)*
- 2D & 3D images / carcass
- Used in 26 factories across Ireland
- Images stored at ICBF since July 2005

▶ Mechanical grading used for +80% cattle slaughtered in Ireland

Digital Variables

- 428 variables / carcass
  - Contours
  - Linear measurements (length, width)
  - Area measurements
  - Volumes
  - Colours

▶ Colour variables were not used as predictors

Two Datasets of Carcass Cuts

- Experimental
  - 346 crossbred steers
  - 3 Overall weights
    - Total meat
    - Total fat
    - Total bone
  - 23 primal cut weights
- Commercial
  - 281 crossbred heifers
  - 1 Overall weights
    - Total meat
  - 16 primal cut weights

▸ Steer & heifers: >70% slaughtered animals in Ireland

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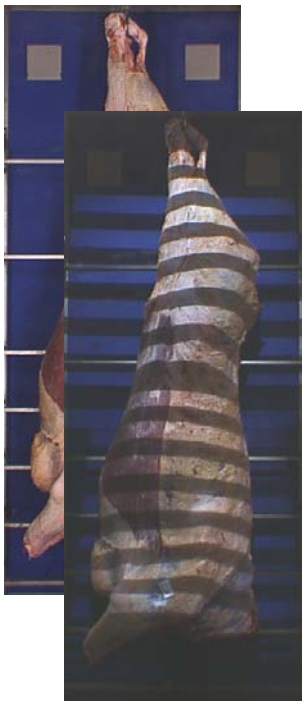
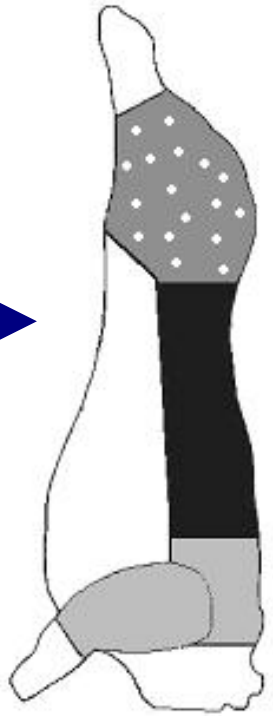
Multiple Regressions



Multiple Regression Analysis



- Lower value cuts
- Medium value cuts
- High value cuts
- Very high value cuts

- Prediction of 4 groups of cuts based on retail value

Calibration / Validation

For each trait

- **Calibration file** (67%) : to build up the regressions equations

- **Validation file** (33%) : to assess regression accuracy & fit

▸ Based on similar distribution of the trait (mean, SD)

3 Models Tested

1. *Meat Cut* = carcass weight

2. *Meat Cut* = carcass weight + EUROP classifications

3. *Meat Cut* = carcass weight + VIA variables

- Comparison based on R^2, RMSE, bias, and residual correlation

5 Methods Tested

1. Stepwise regression
2. Partial Least Square regression
3. Principal Component Analysis
4. Canonical Correlations Analysis
5. Least Angle Regression

- Best method : stepwise regression

Results Steers: R^2

Weight (kg)	Carc. weight	Carc. weight + EUROP class.	Carc. weight + VIA variables
Total meat	0.91	0.97	**0.98**
Total fat	0.33	0.74	**0.77**
Total bone	0.66	0.79	**0.81**
Lower value cuts	0.87	0.89	**0.92**
Medium value cuts	0.74	0.79	**0.86**
High value cuts	0.75	0.89	**0.93**
Very high value cuts	0.74	0.85	**0.84**

- Better R^2 using VIA + carcass weight

Results Steers: RMSE

Weight (kg)	Carc. weight	Carc. weight + EUROP class.	Carc. weight + VIA variables
Total meat	11.8	7.5	**5.9**
Total fat	10.7	6.7	**6.4**
Total bone	4.3	3.4	**3.2**
Lower value cuts	6.9	6.5	**5.6**
Medium value cuts	3.7	3.4	**2.7**
High value cuts	6.0	3.9	**3.3**
Very high value cuts	2.3	1.7	**1.8**

- Lower RMSE using VIA + carcass weight

Results Steers: Bias

Weight (kg)	Carc. weight	Carc. weight + EUROP class.	Carc. weight + VIA variables
Total meat	-1.14	-1.19	-0.18
Total fat	-0.36	-0.76	-0.58
Total bone	0.00	0.18	0.32
Lower value cuts	-0.59	-0.34	0.15
Medium value cuts	0.03	-0.01	0.13
High value cuts	0.76	**1.10****	**1.18****
Very high value cuts	-0.01	-0.09	-0.11

*** Significantly different from zero at P < 0.01*

- Limited bias across all models

Results Steers: Residual Corr.

Weight (kg)	Carc. weight	Carc. weight + EUROP class.	Carc. weight + VIA variables
Total meat	0.08	**-0.15***	0.06
Total fat	-0.03	-0.01	-0.13
Total bone	-0.03	-0.09	-0.12
Lower value cuts	-0.10	-0.07	-0.08
Medium value cuts	-0.02	-0.00	-0.10
High value cuts	-0.04	-0.01	0.05
Very high value cuts	-0.11	0.01	-0.01

** Significantly different from zero at P < 0.05*

- No systematic over/under predictions across all models

Heifer Dataset

- 281 heifers
- Best R^2 given by 'Carcass weight + VIA variables' model

Weight (kg)	Carc. weight + VIA variables R^2
Total meat	**0.84**
Lower value cuts	**0.65**
Medium value cuts	**0.70**
High value cuts	**0.85**
Very high value cuts	**0.72**

- RMSE, Bias, Residual Correlations: Best results with 'Carcass weight + VIA variables' model

Conclusion

- Best regression : VIA + carcass weight stepwise regression model

- Need to apply regression to all carcass images available

- Integrate results in the Irish genetic evaluation => generate EBVs