Real-Time Ultrasound: What Does Image Quality Mean to Genetic Evaluations?

M. L. Spangler[1] and D. W. Moser[2]
[1] University of Nebraska-Lincoln
[2] Kansas State University

Purpose of Ultrasound

- Correctly rank animals
- Depict differences between them
  - Conserve carcass variation

Review of Image Quality Scores

- Scores from 1-7
  - Acceptable (1 and 2)
  - Marginal (3-5)
  - Reject (6 and 7)

Landmarks-UREA

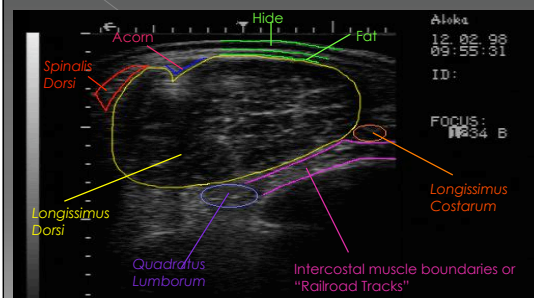# Image Quality-UREA

- Indicators of problems:
  - Image is taken on or across a rib
  - Full muscle is not visible
    - Poor contact or wrong position
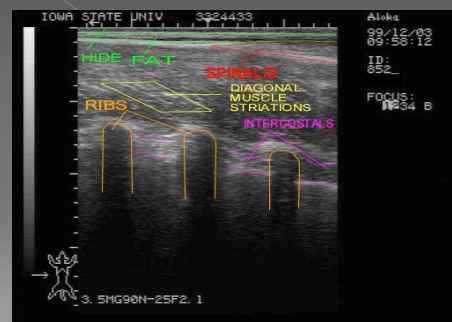

Landmarks-UPFAT

Image Quality-UPFAT

- Indicators of problems:
  - › Lumbar vertebra in the image
  - › Blurring
  - › Excessive presence of spinalis in the image
    - 1/3 of image = marginal
    - ½ of image = reject

Contemporary Grouping

- From an ultrasound perspective, what's included?
  - › Machine
  - › Field technician
  - › Lab technician
  - › Interpreting software
  - › NOT differences in image quality

Questions

- Do subjective image quality (IQ) scores impact the bias of prediction?
- Would this need be accounted for if multiple IQ scores are in a contemporary group?

Data

- Data from Ultrasound Guidelines Council field certifications
  - › Ames, IA from 2002-2006
  - › Over 5,000 interpretations
    - Ribeye area, 12th rib fat, percentage of intramuscular fat
  - › Image quality scores 1-5 only

Summary of carcass and ultrasound values

Trait	Mean	SD
UREA	12.85	1.73
CREA	12.88	1.68
UFAT	0.41	0.14
CFAT	0.44	0.15
UPFAT	3.82	1.12
CPFAT	3.99	1.54

Analysis

- GLM procedure of SAS
- Absolute value of bias (ABS)
  - › |Ultrasound measurement-carcass measurement|
- Explanatory variables included:
  - › Machine (MACH)
  - › Lab technician (INTERP)
  - › Animal (ANIM)
  - › YEAR
  - › Ether extract category (CAT)

Summary Statistics-UREA

Trait	IQ	Frequency	Mean ABS	SD
UREA	1	657	1.05	0.80
	2	1,982	1.03	0.78
	3	1,379	0.99	0.76
	4	865	0.97	0.75
	5	531	1.04	0.76

Summary Statistics-UFAT

Trait	IQ	Frequency	Mean ABS	SD
UFAT	1	657	0.076	0.061
	2	1,982	0.069	0.055
	3	1,379	0.074	0.057
	4	865	0.075	0.057
	5	531	0.80	0.061

Summary Statistics-UPFAT

Trait	IQ	Frequency	Mean ABS	SD
UIMF	1	1,036	1.14	0.96
	2	3,079	1.03	0.87
	3	784	0.99	0.84
	4	543	0.97	0.89
	5	306	0.92	0.75

Ether Extract Category (CAT)

CAT	Frequency	Range
1	105	0-1.50
2	727	1.51-2.50
3	1,813	2.51-3.50
4	1,110	3.51-4.50
5	1,192	4.51-5.50
6	293	5.51-6.50
7	369	6.51-7.50
8	139	> 7.51

Ether Extract Categories (CAT)
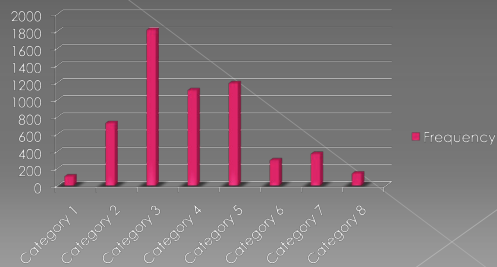
Results-UREA

- ABS= INTERP + YEAR(ANIM) + IQ
  - R^2 = 32.02%
  - IQ not significant (P=0.771)
- ABS = INTERP + YEAR(ANIM)
  - R^2=32.00%

Results-UFAT

- ABS=INTERP + YEAR(ANIM) + IQ
  - R^2 = 53.64%
  - IQ SIGNIFICANT (P=0.0018)
  - Other variables significant (P<0.0001)
- ABS= INTERP + YEAR(ANIM)
  - R^2 = 53.49%

Results-UPFAT

- ABS=INTERP + MACH + ANIM + CAT + IQ
  - R^2 = 53.73%
  - IQ not significant (P=0.3361)
  - MACH significant (P=0.0264)
  - Other significant (P<0.0001)
- ABS= INTERP + MACH + ANIM + CAT
  - R^2=52.43%

Results-UPFAT

- Why is CAT significant?
- Why is this interaction significant?
- ABS=MACH + CAT + ANIM + MACH*CAT
  - R^2=39.81%

Cautions

- This conclusion is dependant on the skill set of the interpreting technicians
  - Human interaction could be accounting for image quality differences
- "Systems" are not clearly defined in the data
  - Interaction between machine and CAT may be an artifact of this

Conclusions

- Image quality is not significant in the explanation of prediction bias
- Explanation of variables included:
  - ANIM-differences in hide thickness, ribbing, or hide pull
  - INTERP-Bias due to lab technician
  - MACH-Bias created by a "system"
  - CAT-Some animals outside of model development ranges

Implications

- Multiple IQ scores within a contemporary group should not create unaccounted for bias

Further THOUGHTS

- What is the role of image quality?
  - Training
  - Lab quality control

Where Do We Go?

- Do these conclusions change in the framework of auto interpretation?
- Do significant differences exist between software with regards to variation conserved?
  - This needs to be answered

Acknowledgements

- UGC Board
- Darrell Busby and crew
- Daryl Strohbehn