Feed Intake- Beyond the Guidelines Data Standards and Multi-Trait Selection

Susan Willmon,
Dir. of Breed Improvement,
American Gelbvieh Association

Patrick Doyle, Associate Professor,
Animal Science, Cal State University, Chico

Feed Intake Data – What have we learned?

- From intakes to residual feed intake (RFI):
  - Need DMI, ADG and BW
  - RFI= DMI – Predicted DMI
    - ADG ← growth
    - MMWT ↑ Body wt maintenance

Feed Intake Data – What have we learned?

- Data editing
  - What constitutes a record that should be tossed?
  - What do Guidelines say?

Feed Intake Data – What have we learned?

- Guidelines say:
  - "delete records…no ad libitum access to feed and or water."
    - "restricted feeding periods"

Feed Intake Data – What have we learned?

- Guidelines say:
  - "…intake data judged to be unusable should be set to missing, or at least corresponding dates indicated so the data can be removed prior to further analysis."

Feed Intake Data – What have we learned?

- Observations from the trenches:
  - Preliminary editing
    - Data audits – data provider
    - Data audits – middle man
  - Considerations
    - Dry Matter Intake conversion
    - Expected DMI/d – varies from individual to individual

Feed Intake Data – What have we learned?

- Moving from intakes to ADG and MMWT:
  - Weighing cattle…simple enough, right?
    - Two weights on/off
    - Serial weights

Feed Intake Data – What have we learned?

- Two weights on/off:

$$ADG = \frac{(End\ Wt - Start\ Wt)}{Days\ on\ Test}$$

$$MMWT = (Avg.\ Test\ Wt)^{.75}$$

-OR-

$$=[SW + .5(Days)*ADG]^{.75}$$

Feed Intake Data – What have we learned?

- Serial Wts:

$$Regression\ Wt\ on\ Day\ of\ Test\ (R_{WT,Day})$$

$$\hat{y}_i = \beta_1 * day_i + \beta_0 + e_i$$

  - Within animal regression
    - Estimate of ADG = $\beta_{1\text{-}ind}$
    - Estimate SW = $\beta_{0\text{-}ind}$
    - $MMWT = [SW + ADG*(Days/2)]^{.75}$

Feed Intake Data – What have we learned?

- Observations from the trenches:
  - Serial vs. two on/off
    - Correlations
  - Contemporary group
    - Definition
    - Numbers

Feed Intake Data – Final Thoughts

- More standardization?
  - Acceptable vs. Unacceptable noise
  - More specifically defined calculations and acceptable data parameters

National Cattle Evaluation

- Making Progress
- Prototypes exist
  - Multiple Trait Evaluation
  - Feed Intake

Potential Sire Summary of the Future

- Birth direct
- Birth maternal
- Weaning direct
- Weaning maternal
- Total Maternal
- Yearling direct
- 600
- Calv
- Calv
- Car
- Rib
- Ru
- Rib
- Ma
- Qu
- Ul
- area
- Ultrasound Rib fat
- Ultrasound marbling
- Yield
- Condition score
- Frame score
- Muscle score
- Udder score
- Docility
- Tick score
- Parasite egg count
- Mature weight
- Gut weight
- Type score
- Uterine score
- Tooth score
- Precocity score
- Fat percentage

National Cattle Evaluation to Multi-trait Selection

- ❑ Don't just need another EPD – need AGGREGATE Measures
- ❑ Next Step –
  - ❑ Multi-trait Selection
    - ❑ Economic selection index (Hazel & Lush, 1942; Hazel,1943)

National Cattle Evaluation to Multi-trait Selection

- Index Calculation
  - Uses DMI, ADG and YW
  - Why is index important?

RegNum	Pre	Name	Int prog	DMI epd	ADG epd	RFI epd	YW epd	FE- idx
		FIRST CLASS	19	0.02	0.16	-0.11	150.7	$254.00
		PARADISE LOST	13	-0.04	-0.01	-0.11	118.0	$121.22
		ECONOMY	13	0.12	0.04	-0.11	115.5	$130.37
		LEG ROOM	23	-0.19	0.04	-0.11	113.3	$163.66

National Cattle Evaluation to Multi-trait Selection

- ❑ Define the breeding objective
  - ❑ What we value – Net returns, efficiency, etc. per cow, per calf… cow-calf, feedlot, system.

Breeding Objective
$H = v_1E_1 + v_2E_2 + \ldots + v_nE_n$

V_n=economic value
E_n = economic relevant trait

National Cattle Evaluation to Multi-trait Selection

- ❑ Objective to Selection Criterion (index traits)
  - ❑ What we value (ERTs) vs. what we have (EPDs)
  - ❑ Customized vs. industry application

Index
$I = b_1X_1 + b_2X_2 + \ldots + b_mX_m$

B_m=index weight
X_m = EPD

National Cattle Evaluation to Multi-trait Selection

- ❑ Phenotypic selection indexes
  - ➢ $b = P^{-1}Gv$

Economic values

Economic wts

Phenotypic (co)variance >selection criteria

Genetic covariance >selection criteria and objective traits

Value of genetically improving trait

Index including phenotypic RFI – Choice for NOW?

National Cattle Evaluation to Multi-trait Selection

- Case Study (Crews et al., 2006)
  - Define Objective –
    - Feedlot Profit Index
    - Steer intake, ADG, sale weight
    - **$H=v_1*SI + v_2*ADG + v_3*Wt$**
  - Index Criterion
    - Bull intake, ADG, yearling weight
    - **$I=b_1*BI+b_2*BADG+ b_3*YWT$**

National Cattle Evaluation to Multi-trait Selection

- Economic selection index (EPDs)
  - $b = v'G_{21}G_{11}^{-1}$
    - Economic values
    - Genetic covariance >selection criteria
    - Economic wts
    - Covariance between selection criterion and breeding objective traits

With genetic evaluations in place, we can develop (and have) multi-trait selection tools to describe aggregate genetic merit.

National Cattle Evaluation to Multi-trait Selection

- Economic Values:
  - Ad hoc
  - Regression
  - Partial derivative – Profit Function
  - Bio-economic Modeling

(MacNeil, 1997; Bourdon, 1998)

Case Study: Feedlot Profit Index

$b = a'G_{21}G_{11}^{-1}$

- G_{11} – (Co)variance structure among traits in the index
  - Best Case
  - Somewhere in middle
  - Worst Case

Case Study: Feedlot Profit Index

$b = a'G_{21}G_{11}^{-1}$

- G_{21} – Covariance matrix of traits in index and traits in the objective.
  - Best case
  - Somewhere in middle
  - Worst case

Case Study: Feedlot Profit Index

$b = a'G_{21}G_{11}^{-1}$

- From phenotypic selection index to an index with EPD:

$$I = -10(EPD_{DMI}) + 140(EPD_{ADG*}) + .52(EPD_{YWT})$$

- *ADG vs. PWG

Multi-trait Selection: Final Thoughts

- Economic data collection
  - Individual closeout data
  - Profit equations (system)
- Value calculation
  - Future impact, not today

Multi-trait Selection: Final Thoughts

- Index selection criteria – indicators, ERTs ---Choices!
- Relationship matrices
  - Literature meta-analysis
  - Data collection
  - Multi-trait NCE

Multi-trait Selection: Final Thoughts

- Is 'close' enough? (MacNeil, 1997)
  - **Small errors in eco weights** (VandePitte and Hazel, 1977; Smith, 1983)
  - **Small errors in genetic parameters** (Harris, 1963)

<Keep in mind >
Tools for now – Will evolve & change

To Do List:

- ✓ Guidelines – Considerations
  - Is there a need for more standardization of data protocols?
  - Quality Control Parameters –
  - Serial weight methodology to determine test ADG and Start Wt
  - Calculation of MMWT
- ✓ Multi-trait Selection
  - Economic data
  - Genetic (co) variance structures
  - Genetic covariance – Bull and steer performance

Feed Intake- Beyond the Guidelines Data Standards and Multi-Trait Selection

[Thank you]

QUESTIONS?