

ASK NOT WHAT YOUR NCE CAN DO FOR
YOU, ASK WHAT YOU CAN DO FOR
YOUR NCE

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Best Linear Unbiased Prediction (BLUP) Animal Model

$$\begin{bmatrix} X'X & X'Z \\ Z'X & Z'Z + K^{-1}\alpha \end{bmatrix} \begin{bmatrix} \hat{b} \\ \hat{a} \end{bmatrix} = \begin{bmatrix} X'y \\ Z'y \end{bmatrix}$$

-
- This is the framework in which we have worked for decades.
 - Every component is related to the data you turn in.
 - X is how well you define CG, age, sex, etc.
 - Z is how well you identify animals
 - K is how well you record pedigree
 - y is how well you record data
 - Alpha is related to the quality, and amount, of data you turn in

Overall Thesis

- Cooperative genetic evaluations, as in the case of beef cattle, require partnerships based on mutual need and mutual benefit.
- Given the consolidation of germplasm ownership and ownership of genetic selection decisions is unlikely in the near term, a greater degree of participation by individual seedstock producers is required.
- Currently the rate of genetic change is limited due to:
 - Decreased intensity
 - Increased generation interval
 - Lack of critical phenotypes
 - Incomplete genotyping
 - Lack of understanding of fundamental genetic principles
 - Industry segmentation

Themes

- Understand the roles and responsibilities of each layer of the industry
- Clearly define goals
- Enable genetic-based decision making for the commercial industry
- Continued informed phenotyping
- Informed genotyping

Clearly define goals

- For seedstock producers, this requires identifying target clientele that likely are homogeneous in their breeding goals.
 - Overall goal should be to increase commercial level profit
- For commercial producers this requires identifying key drivers of profit conditioned on marketing goals and environmental (that turn into economic) constraints.

Seedstock responsibility

$$\Delta_{BV} / t = \frac{r_{BV,EBV} i \sigma_{BV}}{L}$$

- Make decisions simple, and sell problem free animals.
- Potential “leaks” of genetic improvement include:
 - Reduced accuracy due to lack of phenotypes and genotypes
 - Reduced intensity due to culling of genetically superior animals for perceived flaws
 - Using older sires and not culling older dams
 - Genotyping animals with records (particularly females)

Commercial cow/calf responsibilities

- Choose sires based on genetic potential to increase net profit.
 - Consider ROI of bull purchase
- Larger herds should contemplate recording data with a breed association.
 - Collect data that is not realized in seedstock settings
 - Enables more accurate EPD to be used to perform sire selection

Fed cattle sector responsibilities

- “Pay value for value”.
- Understand the value of, and participate in, genetic evaluation.

Use selection indices

- As the list of EPD grows, multiple-trait selection becomes more complex.
- Commercial producers should use indices that best fit their breeding objective.
- Note that “ERT” are only realized at the commercial (cow-herd, feedlot, packer, retailer) level.
- All phenotypes measured in seedstock (nucleus) level are indicators.
 - Value is based on genetic correlation

Selection index in a nutshell

- Tool to enable informed multiple-trait selection
- Based on:
 - Breeding objectives
 - Economic parameters
 - Relationships among traits
 - Population (herd) means
- Designed to improve commercial level profitability
- New (~ 10 years) to the beef industry but “old hat” to other industries



Increasing list
of EPD

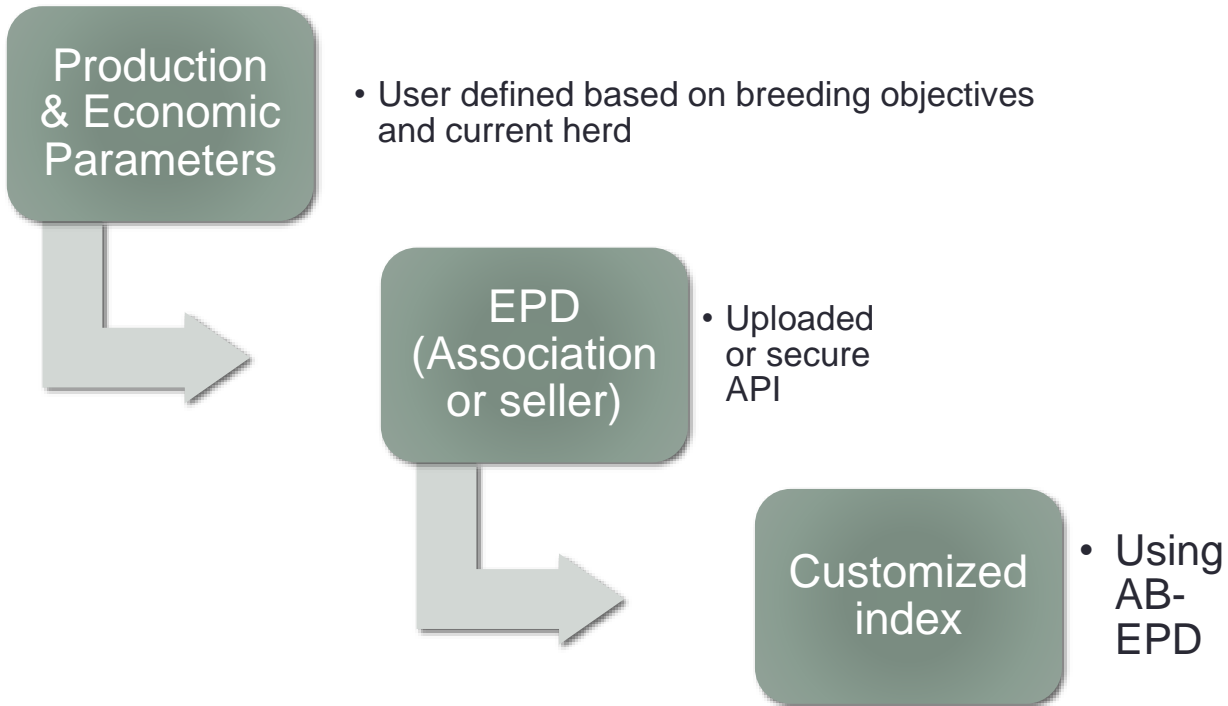
Requires
turning tools
into impactful
decisions

Make sire selection simple for commercial clientele

- Commercial producers must match genetics to their production environment, and the majority of their time will be spent managing the environment.
- Consideration of genetics will occur, at most, once per year.
- It is unreasonable to ask them to stay abreast of all the evolutions related to genetic evaluations.

Goal

- To develop a web-based decision support tool that combines all partial solutions towards providing sire selection recommendations based on relative economic value to a firm (producer).



A picture is worth a thousand words



But it only takes 2

- API
- TI

Other Species

- Same tools
- MUCH faster adoption
- Selection on indexes only

Seedstock Selection Focused on Downstream Value

- Do we currently measure all traits that are economically relevant to the commercial industry?
- We need dense recording of additional phenotypes considering commercial phenotypes as the ERT (seedstock records are indicators).
 - Fertility
 - Carcass
 - Disease
 - Packing plant value
 - Consumer acceptance

Commercial Data is Important

- Genomic selection will only be fully realized when we collect traits for which genomics could be most helpful.
- I might contend that the improvement in GS methods to date are only stepping stones to enable the capture of more phenotypes farther down the breeding pyramid.

Options for commercial phenotypes

- Structured sire tests
 - Expensive and limited numbers of offspring
 - Allows structure to the data
- Elite young sires should be mated to as many (or more) commercial cows than seedstock cows and resulting offspring should have completed phenotypes and pedigree/genotypes recorded with the breed organization.
- Collecting phenotypes on commercial animals from commercial bulls provides limited benefits.
 - Potential for tremendous genetic lag
 - If they are captured as part of ranch SOP, then there is value

Contemporary groups

- Multi-breed contemporary groups are important to inform breed differences.
- Do not force CG to be what “we” desire.

Genotype all animals (even the dead ones)

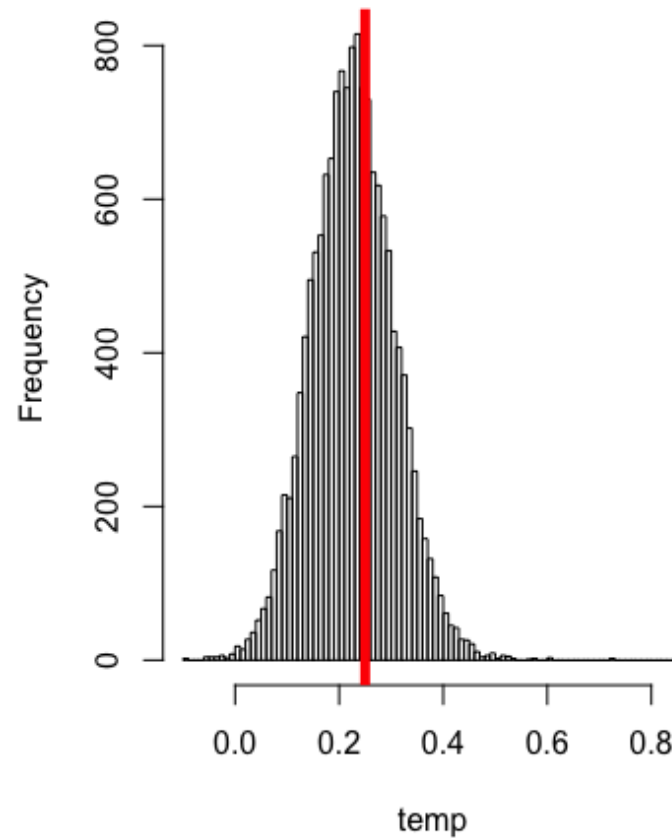
- Use to make selection decisions
 - Not marketing
- Enable genomic selection for sex-limited traits
- Currently, the best advice is to genotype all animals. The lack of structure of the beef industry makes strategic genotyping challenging.
 - The research area of strategic genotyping (and determining density) and phenotyping exists, but needs more attention

Relationships

- Pedigree information was the primary method to incorporate relationship information into genetic prediction and is still the backbone.
 - Usually deep
 - Prone to errors (with and without malice of forethought)
 - ~10%
- Genomic data now enables deviations from expected degrees of relationships
 - Cleans up pedigree errors (good for selection, bad for politics)

Understand relationships among animals

Grandparent Relationships



Purchase bulls with GE-EPD

- Genetic change is driven by sire selection in commercial herds
 - ~80% is due to the bulls used the last 4 years in self replacing herds,
 - Increased accuracy enables more informed bull selection decisions.
 - Think possible change.

Use genotypes to the fullest

- Genotypes can be used more for than the prediction of additive genetic merit (improvement of EPD).
 - Parentage
 - Tracking inbreeding
 - Identification and management of lethal and sub-lethal haplotypes
 - Breed identification
 - Estimating retained heterozygosity

Crossed the finish line?

- Releasing a single-step evaluation should allow the opportunity to turn organizational focus to other areas of NCE
 - Obviously additional improvement to be made overtime relative to single-step
- Economic indices clearly misunderstood
- Effort now needs to be focused on
 - Phenotypes
 - Enabling (accurate) selection decisions

Understanding of Genomic Selection

- The single thing that has stood out to me the most in the genomic selection era is that the majority of beef seedstock producers never understood EPD and accuracy to begin with. At some point this will manifest itself and I fear we run the risk of messing up the end game.

Organizational Focus

- IF beef is considered as the end product, then organizations should focus on tools that aid producers in producing beef that is accepted (and demanded) by consumers.
 - This is a dramatic culture shift.
 - This means an exclusive focus on genetic selection tools and the marketing of said tools that must accompany them.
 - All other activities are then secondary and should likely be parsed to a separate entity.

Future

- Strategic phenotypes at the nucleus level.
- Majority of phenotypes collected outside of seedstock herd.
- Breeding values predicted for commercial animals, including fed cattle.
- Breeding values, plus heterotic effect, used to market and manage cattle.
- Clear delineation of genetic decision makers and cattle producers.

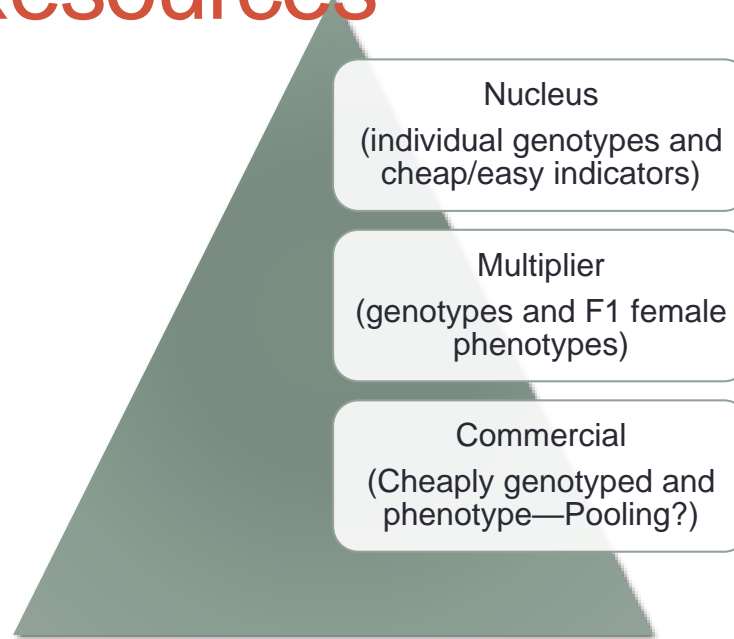
Changes to genetic evaluations

- Be an active participant
- Be a steward of data
- Be an advocate for change
- Become a student of genetics
- Understand that your profit is tied to your customer's profit.
- Continue to challenge “us” and help identify emerging needs.

You must be the “educators”



Strategic Use of Resources



Helpful Resources

- <http://beef.unl.edu>
- www.eBEEF.org

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