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Using National Sire Summaries to Improve Selection Skills

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Genetic improvement of breeding stock has been the goal of cattle producers for centuries. The desire to select superior animals as seed stock has led to several traditions in the beef industry.

Much of the heritage of Old West cattle history in the U.S. revolves around the change from the native cattle to the "meatier" domestic cattle resulting from importation of cattle from Britain. The show-ring was established as the selection place for superior breeding animals.

As the value of different production traits was recognized, producers attempted to quantify those traits—that is, measure them by a weigh scale.

The worth of individual animals was compared using within-herd ratios. Thus, an animal's relative worth was measured as a percentage difference from the herd average. With the coming of the computer in the 1960's and 1970's, breed associations began to report and use estimated breeding values (EBV's) as a numeric representation of an animal's genetic worth.

EBV is a systematic way to combine the information of heritability with the performance of relatives and progeny to define an animal's breeding value. This procedure provided more accurate selection than phenotypic selection (visual appearance).

While individual performance records increased the accuracy of selection within a herd, they did little to assist the breeder trying to select bulls from the total population. Within-herd comparisons are useful for selecting replacement females, but breeders who want to make maximum genetic progress need to be able to compare and select superior bulls from the entire population.

(We'll need to use a number of technical performance terms in this publication. You'll find definitions on page 5.)

Expected progeny difference (EPD)

Advances in computer technology led to the ranking of nonparent bulls and heifers in the total population. The "Reduced Animal Model" procedure, which produces expected progeny difference (EPD) and estimates accuracies (ACC), requires a large computing base.

Estimates use all available progeny and performance records of close relatives. EPD's can be calculated for bulls and cows with progeny and all nonparent bulls and females with legitimate records.

Nonparent bull and female EPD calculations combine the individual performance and all collateral relative performance. Primary ancestral information going into young nonparent EPD calculations comes from the animal's sire and dam.

Procedures for these calculations are very complex and difficult to understand. Don't be concerned about the formulas or calculations; just begin to use the information in making replacement selections. The dairy industry has used this approach successfully for years in its breeding programs.

Most beef breed associations are now using National Sire Evaluation Data to provide EPD's based on comparison of the progeny performance of bulls by using reference sires (see page 7 for a list of these associations). This breeding plan allows for comparative results in different herds and environments.

One of the limitations of this approach is the measurable traits involved in the reports. Most sire summary reports will include birth weight, weaning weight, yearling weight, and maternal ability (milking ability) estimates for the bulls. Some

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group reports will add calving ease scores, carcass traits, or combinations of these traits.

Not all producers will select for one or more of these traits directly.

Growth traits are *positively* genetically correlated to each other, so selecting an *increase* of any one trait will increase the other weights also. For example, an increase in weaning weight is usually associated with an increase in birth weight.

However, calving ease *decreases* as birth weight increases (*negative* correlation). Thus, if you select for weaning weight alone, you select indirectly for increased calving problems.

It's not the intent of this publication to define selection criteria but to show the usefulness of EPD's when you select sires (and daughters) for herd replacements. By studying EPD's of different sires, you might avoid some of the pitfalls inherent in the situations we've just described.

EPD's reflect the expected results from using different sires and are based on the average of the population. Each breed association must make the calculations with a reference population as a base and a designated year each time it makes the estimate. The reference population year may change from time to time.

So the EPD values may change from year to year, and the average may not be zero. A review of the printed sire summary describes these changes and averages. Thus, your major use of EPD's may be to compare two or more individuals for relative merit—not to use them as absolute values of genetic worth.

Try this example. Two bulls each appear to be functionally sound. The PD's are +35 and +15, respectively. The first bull is expected to produce calves 20 lb heavier than the second bull. The progeny would be 35 lb or 15 lb, respectively, heavier at weaning than the average in the reference breed.

If on the other hand, they're mated to cows above average in performance, the size of this increased weight would be smaller. However, the 20 lb difference in progeny performance between the two bulls should be constant.

You can evaluate bulls and define their usefulness according to EPD groupings. The top 5% of bulls in a breed are the elite group—use these in purebred herds to maximize growth in the foundation stock of the industry. This group of bulls has the highest chance of being the superior sires of the future.

The next group of bulls (50 to 60% of total bulls) include those that will increase growth in the commercial cattle population. Those grouped below these levels of EPD wouldn't be useful as sires to increase weights.

There's a conflict about a number of the economically important traits in beef cattle. Different segments of the industry have different priorities of important traits, which can be confusing to a cow-calf producer at the beginning of the production chain.

As a producer, you need to identify those traits most important to *your* management and marketing program. The total production ideal probably doesn't exist. Once you've clearly stated your production goals, you can develop an effective selection strategy involving EPD's.

You'll need to balance traits when you use EPD's. Your production goal might be to improve weaning weights without large changes in either yearling weight (replacement female mature size) or birth weight (to reduce calving difficulty).

Because the genetic correlation between the three traits is positive, the expected increase in weaning weight is lower than if you selected only for this one trait. There are bulls that fit this criteria. This is why different breeders will select different sires to meet their breeding objectives.

Maternal EPD's

Maternal EPD predicts the weaning weight performance of a sire's grand-progeny, which is an indication of the value of his daughters as replacements in the cow herd. Weaning weight is the result of the genetics for growth and the ability of the dam to produce milk.

An individual receives half the genetics to grow from each of its parents. Thus, the estimate for a grand-progeny to grow is half the grandsire's EPD for weaning weight. The estimate of Maternal EPD is the sum of half the EPD weaning weight plus the EPD for milk. If you can estimate two values, you can easily calculate the third.

Maternal milk EPD describes how daughters of a bull are expected to produce milk compared to other cows in the reference population. You can calculate an estimated value for an unproven bull by using production data on daughters of his sire and paternal and maternal grandsires plus his dam's progeny.

Once a bull's own daughters come into production, calculate the value by using the records of his own daughters in addition to those of his sire and paternal and maternal grandsires.

Table 1—A brief sire summary[a]

	Birth		Weaning		Yearling		Carcass cutability		Marbling score		Lean yield		Maternal	
Sire	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC
A	+1.5	.80	+33.5	.86	+52.1	.80	+.214	.63	+.061	.63	+3.2	.70	+23.2	.88
B	+5.6	.75	+39.1	.85	+65.2	.78							+12.8	.85
C	+8.5	.71	+45.2	.82	+80.6	.75	+.352	.65	−.631	.65	+8.5	.72	−5.0	.91
D	−0.5	.73	+24.3	.78	+42.0	.75							+28.0	.90

[a]ACC = Accuracy of the estimated EPD (indicates the reliability of the EPD).

An example of sire selection

This example, including tables 1 and 2, is based on the *1985 Polled Hereford Sire Summary,* published by the American Polled Hereford Association.

The selection procedure you use depends on whether your goal is to obtain maximum gain in a single trait or to improve two or more traits simultaneously. The more traits you select for, the less improvement you can expect in any one trait.

However, when you consider net profit, it may be costly to maximize a single trait without concern for other traits. The sire summary (table 1) and selection examples (table 2) illustrate how you can use the sire summary for production different goals.

Breeder No. 1 (table 2) has decided to maximize growth regardless of birth weight or maternal performance, so she chose Sire C.

Breeder No. 2 wishes to improve growth while maintaining an adequate level of maternal performance. His choice is Sire B.

Breeder No. 3 wants to improve growth and maternal performance while minimizing increases in birth weight. Sire A is her choice.

Table 2.—Some selection examples

Breeder No.	Selection goals	Birth EPD	Weaning	Yearling	Maternal EPD	Bull selected
1.	Maximize growth	none	maximize	maximize	none	C
2.	Improve growth and maintain adequate maternal performance.	none	+35.0	+60.0	+10.0	B
3.	Improve growth, improve maternal performance, minimize increase in birth weight.	+3.0	+30.0	+50.0	+20.0	A
4.	Improve maternal performance, reduce birth weight, maintain acceptable growth.	0.0	+20.0	+35.0	+25.0	D

Breeder No. 4, who wants to improve maternal performance, maintain acceptable growth and reduce birth weights, selected Sire D.

Many combinations of selection criteria are possible, including carcass data (which we left out of the above example for the sake of simplicity). Unless your selection criteria are very strict, several bulls in the sire summary will meet your standards.

Accuracy of EPD estimates

Whenever an estimate like EPD is calculated, there's not only some degree of probability that the estimate is correct but also an offsetting chance that it's not. Each association reports an accuracy figure (ACC) for each individual estimate, which is an expression of reliability of the EPD.

Values for accuracy can range from 0.0 to +1.0, where higher values indicate greater reliability. The accuracy values for EPD's can be categorized as estimates with:

- low reliability (less than .64)
- medium reliability (.65 to .75)
- high reliability (.76 or more)

Accuracy values for EPD's on bulls without progeny won't be as high as values for bulls with progeny. As the number of progeny records increase, so will the reliability of the estimate of accuracy increase. A young bull's EPD accuracy is about .35 and can change as progeny records are added.

When adequate progeny records are available, the accuracy will quickly exceed .76, which indicates that the EPD's are reliable and little change should be expected in the estimate.

Standard error. A brief description of the statistical term *standard error* might help us understand what's happening. Standard error indicates the size of the expected changes in particular estimates. Remember: The estimates are specific to a breed. We can illustrate this by using data from the American Hereford Association *Sire Summary* for 1986 (table 3).

If a group of young bulls, all +30 lb for weaning weight, are selected for use, 68% of the actual breeding values of these bulls will be within a range of +15 to +45 lb EPD (within one standard error of the predicted value). Almost all (98%) would be within a +2 standard error units (0 to 60 lb) when progeny is proven. Predicted EPD's on young bulls can change over time as progeny records are added.

Table 3.—American Hereford standard error of genetic traits at two accuracy levels (lbs)

	Standard error	
Trait	.35 ACC	.90 ACC
Birth weight	± 3.0	±0.4
Weaning weight	±15.0	±2.5
Yearling weight	±23.0	±3.5
Milk	±15.0	±2.2

However, on older bulls the standard error ranges are much narrower. The true progeny difference for a proven bull with an ACC of .90 and a weaning weight EPD of +30 is within the range of +25 to +35 lb. A breeder who understands that estimates can change over time can group the bulls and select on price if genetics are similar.

While the estimated EPD accuracy values for nonparent bulls appears to be low, their estimates are still more usable than within herd ratios or breeding values.

Summary

Producers now have the information to make a more accurate selection of breeding cattle than they have ever been able to make. The opportunity for breed improvement is directly on the breeders.

Breeders who mate the right bulls with the right cows will be the breeders with successful programs and will be those who move the breed forward. The only way a breed can move ahead is by getting a high percent of the cows within that breed bred to superior bulls. The top bulls in the breed should be used on a wide scale to insure genetic improvement.

EPD's are also an important tool for commercial cattle producers. The criteria for selecting herds that you use as sources of bulls indicate the genetics you're buying.

If a commercial breeder is concerned about birth weight, and the seed stock producer is concerned with maximum weaning weight response, that herd may not be a good source of genetics for this commercial breeder. So a commercial breeder can select herds as well as individual bulls for genetic material.

The use of these tools (EPD's) in selection can help the purebred breeder reach production goals more rapidly. In addition, the commercial producer can select seed stock based on fact—not just guesswork, as the "eye" sees it. Each producer can gain insight into the genetics of selected breeding stock by using these selection aids.

Definitions of performance terms

Accuracy (of selection). Correlation between an animal's unknown actual breeding value and a calculated estimated breeding value.

Beef Improvement Federation (BIF). A federation of organizations, businesses, and individuals interested or involved in performance evaluation of beef cattle. Purposes are:

- promoting uniform procedures,
- developing programs,
- promoting cooperation among interested entities,
- educating its members and the ultimate consumers about performance evaluation methods, and
- building confidence of the beef industry in the principles and potentials of performance testing.

Breeding value. Value of an animal as a parent. The working definition is twice the difference between a very large number of progeny and the population average when individuals are mated at random within the population and all progeny are managed alike. The difference is doubled because only a sample half (one gene of each pair) is transmitted from a parent to each progeny. Breeding value exists for each trait and depends on the population in which the animal is evaluated. For a given trait, an individual can be an above-average producer in one herd and a below-average producer in another herd.

Collateral relatives. Relatives of an individual that are not its ancestors or descendants. Brothers and sisters are an example of collateral relatives.

Contemporary group. A group of cattle that are of the same breed and sex and have been raised in the same management group (same location on the same feed and pasture). Contemporary groups should include as many cattle as can be accurately compared.

Correlation. A measure of the way two traits vary together. A correlation of +1.00 means that as one trait increases, the other also increases—a perfect *positive* relationship. A correlation of −1.00 means that as one trait increases, the other decreases—a perfect negative (inverse) relationship. Correlation coefficients may vary between +1.00 and −1.00.

Culling. The process of eliminating less productive or less desirable cattle from a herd.

Dystocia (calving difficulty). Abnormal or difficult labor causing difficulty in delivering the fetus and/or placenta.

Effective progeny number (EPN). An indication of the amount of information available for estimation of expected progeny differences in sire evaluation. It's a function of number of progeny but is adjusted for their distribution among herds and contemporary groups and for the number of contemporaries by other sires. EPN is less than the actual number because the distribution of progeny is never ideal.

Estimated breeding value (EBV). An estimate of an individual's true breeding value for a trait based on the performance of the individual and close relatives for the trait. EBV is a systematic way of combining available performance information on the individual, brothers and sisters of the individual, and the progeny of the individual.

Expected progeny difference (EPD). The difference in performance to be expected from future progeny of a sire, compared with that expected from future progeny of the average bull in the same test. EPD is an estimate based on progeny testing and is equal to half the estimate of breeding value obtainable from the progeny test records.

Frame score. A score based on subjective evaluation of height or actual measurement of hip height. This score is related to slaughter weights at which cattle will grade choice or have comparable amounts of fat cover over the loin eye at the 12th to 13th rib.

Generation interval. Average age of parents when the offspring destined to replace them are born. A generation represents the average rate of turnover of a herd.

Genetic correlations. Correlations between two traits that arise because some of the same genes affect both traits. When two traits (for example, weaning and yearling weight) are highly correlated to one another, successful selection for one trait will result in an increase in the other. When two traits (say, birth weight and calving ease) are negatively and highly correlated to one another, successful selection for one trait will result in a decrease in the other.

Maternal value for bulls. Maternal data (EPD's) is an estimate of a sire's ability to transmit maternal traits as expressed in weaning weight of his daughters' calves. The milk EPD is pounds of weaning weight expected from a bull's daughters' ability to produce milk. However, these daughters pass along some additional growth genes to their offspring other than milking ability. The maternal EPD is the total amount of weaning weight expected from a bull's daughters from both milk production and growth potential.

National sire evaluation. Programs of sire evaluation conducted by breed associations to compare sires on a progeny test basis. Carefully conducted national reference sire evaluation programs give unbiased estimates of expected progeny differences. Sire evaluation based on field data rely on large numbers of progeny per sire to compensate for possible favoritism or bias for sires within herds.

Number of contemporaries. The number of animals of similar breed, sex, and age, against which an animal was compared in performance tests. The greater the number of contemporaries, the greater the accuracy of comparisons.

Parturition. The act of giving birth; calving.

Performance data. The record of the individual animal for reproduction, production, and carcass merit. Traits included would be birth, weaning and yearling weights, calving ease, calving interval, milk production, etc.

Possible change. The variation (either plus or minus) that's possible for each expected progeny difference (EPD). This measurement of error in prediction or estimation of EPD decreases as the number of offspring per sire increases.

Puberty. The age at which the reproductive organs become functionally operative and secondary sex characteristics begin to develop.

Rate of genetic improvement. Rate of improvement per unit of time (year). The rate of improvement depends on:

- heritability of traits considered,
- selection differentials,
- genetic correlations among traits considered,
- generation interval in the herd, and
- the number of traits for which selections are made.

Reference sire. A bull designated to be used as a benchmark in progeny testing other bulls (young sires). Progeny by reference sire in several herds enable comparisons to be made between bulls not producing progeny in a common herd(s).

Seed stock breeders. Producers of breeding stock for purebred and commercial breeders. Progressive seed stock breeders have comprehensive programs designed to produce an optimum or desirable combination of economical traits.

Selection. Causing or allowing certain individuals in a population to produce offspring in the next generation.

Sibs. Brothers and sisters of an individual.

Sire summary. Published results of National Sire Evaluation programs.

National beef cattle associations that publish sire summaries

Angus
American Angus Assn.
Richard Spader, Exec. V. Pres.
3201 Frederick Blvd.
St. Joseph, MO 64501

Brahman
American Brahman Breeders Assn.
Wendell Schronk, Exec. V. Pres.
1313 LaConcha Lane
Houston, TX 77054

Brangus
Intl. Brangus Breeders Assn.
Jerry Morrow, Exec. V. Pres.
5750 Epsilon Dr., Box 69620
San Antonio, TX 78249-6020

Charolais
American Intl. Charolais Assn.
Joe Garrett, Exec. V. Pres.
11700 NW Plaza Circle, Box 20247
Kansas City, MO 64195

Chianina
American Chianina Assn.
Robert Vantreose, Exec. Off.
PO Box 890
Platte City, MO 64079

Gelbvieh
American Gelbvieh Assn.
Executive Director
5001 National Western Dr.
Denver, CO 80216

Hereford
American Hereford Assn.
H.H. Dickenson, Exec. V. Pres.
715 Hereford Dr.
Kansas City, MO 64105

Limousin
North American Limousin Fdn.
Greg. Martin, Exec. V. Pres.
100 Livestock Exchange Bldg.
Denver, CO 80216

Maine-Anjou
American Maine-Anjou Assn.
Steve Bernhard, Exec. Sec.
567 Livestock Exchange Bldg.
Kansas City, MO 64102

Polled Hereford
American Polled Hereford Assn.
T.D. Rich, Pres.
94700 E 63rd St.
Kansas City, MO 64130

Red Angus
Red Angus Assn. of America
Betty Grimshaw, Exec. Dir.
4201 I-35 North
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Salers
American Salers Assn.
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5600 S Quebec St., Suite 220A
Englewood, CO 80111

Shorthorn
American Shorthorn Assn.
Roger Hunsley, Ex. Sec.
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Simmental
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1 Simmental Way
Bozeman, MT 59715

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