Expected Progeny Differences

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Physical features, such as structure and muscling, are important for animal selection and will be discussed further in another section of this manual. However, other important factors in beef cattle production, such as carcass, growth, maternal, and reproductive traits, cannot be adequately selected for simply by physical observation of a potential breeding animal in the sale ring. When seeing an animal once or even several times in one environment, it is difficult to determine what portion of the animal's performance is due to non-genetic factors (management, nutrition, weather, etc.) and what portion is actually due to the genetics of the animal which can, in turn, be passed on to its offspring. To aid producers in selecting animals based on genetic potential, genetic predictions for many traits are available. In beef cattle, these genetic predictions are referred to as Expected Progeny Differences.

What Are Expected Progeny Differences?

Expected Progeny Differences, more commonly referred to as EPD, are the genetic predictions that producers can use when making selection decisions. These values are readily available on registered animals from breed associations. For most breeds, particularly those with large numbers of annual registrations, genetic evaluations are performed twice a year, but smaller breeds may perform these evaluations less frequently. For instance, breeds with fewer annual registrations may run an evaluation only once a year or only after a specific number of new registrations have been received. For specific information about your breed's genetic evaluation schedule, contact your national breed association.

Following each evaluation, breed associations publish EPD for active sires. Traditionally, these have been available in print in the form of sire summary books, but with the advent of the Internet, most breeds have also begun publishing their EPD on their Web sites for producers to access. Even so, it is not always necessary to look each animal up either in a sire summary or on the Web in order to access its EPD. Many times, seedstock producers, bull studs , and anyone else wishing to market animals will often market those animals using the EPD.

How Do You Use EPD?

By themselves, EPD on one animal have no meaning. This is because EPD are not absolute values. They are deviations from some preset value (base) that is determined individually by each breed. When EPD are used to compare two or more animals, however, the EPD have a great deal of meaning because the difference between the animals' EPD predict the difference between the future calves of the animals for a given trait.

EPD can also be used to determine how a bull ranks in the breed compared to the breed average for a given trait. Breed average EPD are rarely zero. Zero is equal to the base, which is determined individually by each breed association. Many times, the base is set so that animals born in a specific year are forced to have an average EPD of zero. The breed average EPD for each trait can be found in the breed association's sire summary or on its Web sites.

Table 1. Example of a beef sire summary.

Bull Name	Registration Number	Birth Weight	Weaning Weight	Milk	Yearling Weight
Bull A	98761001	-3.1	+54	+28	+108
		(0.66)[a]	(0.66)	(0.26)	(0.57)
Bull B	98761002	+1.0	+21	+19	+54
		(0.75)	(0.74)	(0.50)	(0.67)
Bull C	98761003	-1.9	+46	+28	+92
		(0.94)	(0.94)	(0.80)	(0.85)
Breed Average		+2.0	+28	+15	+54

[a] Accuracy for the EPD.

In sire summaries, EPD are reported in a format similar to what is shown in Table 1. In this example, Bull A has a weaning weight EPD of +54 lb, Bull B has a weaning weight EPD of +21 lb, Bull C has a weaning weight EPD of +46 lb, and the breed average weaning weight EPD is +28 lb. These values show that the calves of Bull A, on average, can be expected to be 33 lb heavier at weaning than the calves of Bull B and 8 lb heavier at weaning than the calves of Bull C. Furthermore, you can expect those same calves to be 26 lb heavier than calves sired by breed-average bulls.

Bull A	54 lb	Bull A	54 lb	Bull A	54 lb
Bull B	21 lb	Bull C	46 lb	Breed Avg.	28 lb
Difference	33 lb	Difference	8 lb	Difference	26 lb

Using birth weight as an example, Bull A's calves are expected to be 4.1 lb lighter than Bull B's and 1.2 lb lighter than Bull C's. His calves can also be expected to be 5.1 lb lighter at birth than calves out of breed-average bulls.

Bull B	1.0 lb	Bull C	-1.9 lb	Breed Avg.	2.0 lb
Bull A	-3.1 lb	Bull A	-3.1 lb	Bull A	-3.1 lb
Difference	4.1 lb	Difference	1.2 lb	Difference	5.1 lb

Even though Bull A has the highest weaning weight EPD relative to the other two bulls, he also has the lightest birth weight EPD. This means that his calves could be expected to be the heaviest at weaning, but also the lightest at birth. Many times, this type of bull is referred to as being a curve bender or having a large spread because his calves are born small but grow quickly so they are still large at weaning.

Currently, most EPD that are available can only be used to compare animals within a certain breed. For example, an Angus bull with a weaning weight EPD reported by the American Angus Association cannot be compared with a Charolais bull with a weaning weight EPD reported by the American International Charolais Association. This is because the two different associations report animals based on different bases and use information calculated in different analyses. The breed associations also could potentially calculate data using different models and genetic parameters. Therefore, a weaning weight EPD of +2 lb does not mean the same thing for Angus bulls as it does for Charolais bulls.

Currently, the only way to compare two bulls of different breeds is to use the across-breed EPD adjustment values that are updated annually by Van Vleck and Cundiff (2005) and available at www.beefimprovement.org/proceedings.html.

What Are Accuracies?

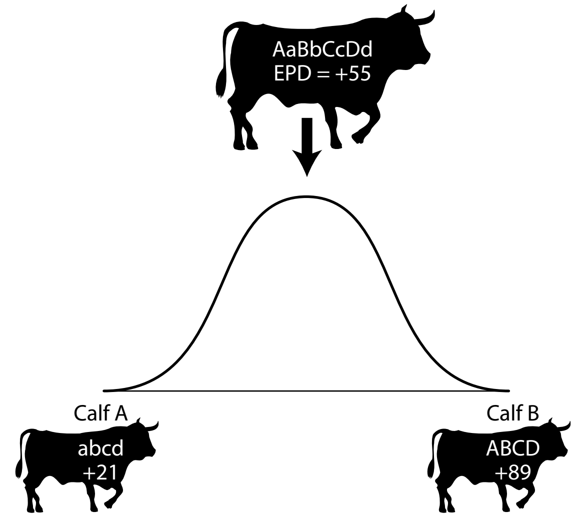
Expected Progeny Differences are predictions of the genetic merit of an animal. They are not exact known values of the true genetic merit or breeding value, so there is some risk involved in using EPD. Furthermore, no two EPD are created the same because animals have varying amounts of data that contribute to the calculation of their individual EPD. The more data included in the calculation, the more accurate the EPD will be and the less risk associated with using that value. Also, data are weighted differently if it is from parents, progeny, grandprogeny, and other relatives with descendants providing more information than ancestors. However, by just looking at the EPD, a producer cannot tell how much or what type of data were used to calculate the prediction. Therefore, with every EPD, there needs to be a measure of how confident a producer can be in the value. This measure is referred to as accuracy.

In theory, accuracy can range from 0 (no information) to 1 (exact true genetic value known). In reality, accuracies are typically reported in sire summaries in the 0.40 to 0.99 range for traits such as the growth traits. Breed associations will not report bulls in sire summaries that have accuracy values for specific growth traits (either weaning weight or yearling weight depending on the breed) less than a predetermined number, usually approximately 0.40 to 0.50. Some traits, such as reproduction and carcass traits, are reported with lower accuracies due primarily to limited data available. On the high end, no animals are reported with accuracies of 1.00 because it is never known with 100% certainty what an animal's true breeding value is.

In the example sire summary that was shown previously in Table 1, below each EPD, in parentheses, is the accuracy associated with that EPD. Based on these accuracies, it would appear that Bull A has the least amount of information included in the analysis compared to the other two bulls because his accuracies are the lowest. Similarly, it would appear that out of the three bulls reported, Bull C has the greatest amount of descendants (or progeny) with data reported, because he has the highest accuracies of the three bulls shown.

Accuracy does not measure how close the individual progeny will perform to the EPD value but how close the EPD prediction is to the true genetic value. By chance, a calf could receive all of its sire's undesirable genes or by chance a second calf could receive all of its sire's favorable genes (see Figure 1). The performance of these two calves can be greatly different, even if their sire has a high accuracy EPD. More often, calves will get a combination of desirable and undesirable alleles from their sire, and their average performance (across many calves) will be the same as the true genetic merit that the EPD predicts if the bull was a high accuracy sire. For instance, if the bull's weaning weight EPD is 45 lb above breed average and he is a high accuracy sire, you can expect that his calves will average close to 45 lb above breed average at weaning.

Figure 1. Four genes control some hypothetical trait. The sire is heterozygous for all of these genes. Calf A receives all of the sire's "bad" alleles for those genes, designated by lowercase letters, and Calf B receives all of the sire's "good" alleles, designated by capital letters, for those genes. The calves in between get a sampling of good and bad genes, and all calves also get alleles from their dams that will affect their performance. Over a random sampling of dams, calves should average the genetic merit of their sire.



Proven Sires vs. Young Sires

The difference between proven sires and young sires is simply a matter of accuracy due to data. As more data from a bull's progeny are included in the evaluation, his accuracy increases. Once the accuracy reaches a certain point, the bull is considered a "proven sire." Prior to that, the bull is included in the "young sire" category. This idea is constant, but the terminology may change from breed association to breed association.

How Are EPD Calculated?

Although some people think that EPD are a product of magic or someone shooting darts at a dartboard to determine the values, that really is not the case. Many calculations are performed by computers that ultimately result in an EPD.

In order to perform these calculations so that results are unbiased and predict only genetic differences, data need to be adjusted for any known non-genetic effects. This is done in two ways. The first is by preadjusting the data for environmental factors with known effects, such as age of dam and calf age. The second is through the formation of contemporary groups.

Adjustment Factors

Some non-genetic effects are assumed to have a consistent effect from year to year, ranch to ranch, and management style to management style. Because these effects are thought not to change, producers can adjust their own raw data in order to make selection decisions. *These adjustments should never be made to data sent to your breed association because breed associations adjust the data themselves.*

Age of Dam Adjustments

Age of dam adjustments for birth and weaning weight are necessary because heifers and young cows generally produce calves that are smaller than they produce later in life. This is because young females are still growing and are having to partition nutrients to not only lactation and gestation but also their own growth. Older cows can partition the same nutrients to lactation and gestation without having to provide any nutrients for growth, providing their calves with more nourishment. Similarly, older cows (11 years and older) are usually less efficient in partitioning nutrients and therefore also tend to produce smaller calves.

Standard additive age of dam (AOD) adjustment factors for birth weight are provided by the Beef Improvement Federation in its eighth edition of the *Guidelines for Uniform Beef Improvement Programs* (BIF, 2002), as shown in Table 2. Not all breeds use these recommended adjustments; instead, some have developed their own to fit their individual breed needs. Individual breed adjustments can be obtained by contacting your individual breed association.

Table 2. Beef improvement federation recommendations for age of dam adjustments for birth weight.

AOD (yr)	Bull Calves (lb)	Heifer Calves (lb)
2	8	8
3	5	5
4	2	2
5-10	0	0
11	3	3

For instance, calves out of heifers are smaller than calves out of older cows. Using the adjustments from Table 2, when making selection decisions on which calves to keep and which to cull, calves out of heifers would look more appealing as they would be, on average, 8 lb less than calves out of the same cows once they reach maturity. By adjusting the birth weights so that AOD does not have an effect, it can change the interpretation of the calf crop data considerably.

These standard adjustment values adjust weights to a mature cow base, adding weight to calves out of both younger and older females. With birth weight adjustments, sex is not a factor. Bull calves receive the same adjustment as heifer calves when their dams are the same age. This is not true for weaning weight adjustments. For weaning weight, heifer calf adjustments are typically less than adjustments for bull calves when their dams are the same age.

Recommendations for weaning weight AOD adjustments are also available from the Beef Improvement Federation (BIF, 2002) and are shown in Table 3. As with the birth weight adjustments, many breed associations provide their own adjustment factors for weaning weight, and you should consult your specific breed association for those values. If breed-specific values are not available for your breed, the Beef Improvement Federation adjustments should be used.

Table 3. Beef Improvement Federation recommendations for age of dam adjustments for weaning weight.

AOD (yr)	Bull Calves (lb)	Heifer Calves (lb)
2	60	54
3	40	36
4	20	18
5-10	0	0
11	20	18

Consider the following example:

	First Calf Heifer	6-Yr-Old Cow
Actual Bull Calf Birth Weight	72 lb	80 lb
Adjustment	+8 lb	+0 lb
Adjusted Birth Weight	80 lb	80 lb
Actual Bull Calf Weaning Weight	480 lb	525 lb
Adjustment	+60 lb	+0 lb
Adjusted Weaning Weight	540 lb	525 lb

In this case, the heifer produces a calf that could have been expected to be 8 lb heavier had the dam been older. Therefore, that calf is actually evaluated as an 80 lb calf when genetic evaluations are run, the same as the calf from the 6-year-old cow. Similarly, at weaning the calf gets 60 lb added to its true weaning weight because of the decreased milk production of its heifer mother, so the calf is actually genetically heavier than the calf from a 6-year-old cow.

Calf Age Adjustments

In an ideal world, every calf would be born on the same day so that they are the same age when they are weighed at weaning or yearling, but that is not the case. Calves are born over a range of days, and a calf crop is typically weighed for weaning and yearling weight on the same days, regardless of age. Because of this, breed associations adjust data to an equivalent calf age. To adjust weaning and yearling weights, see the equations below.

To adjust weaning weight, the following equation is used:

$$\text{Adjusted 205d weight} = \left[\frac{\text{(actual weaning wt.)} - \text{(actual birth wt.)}}{\text{weaning age in days}} \times 205\right] + \text{(actual birth wt.)} + \text{(age of dam adjustment)}$$

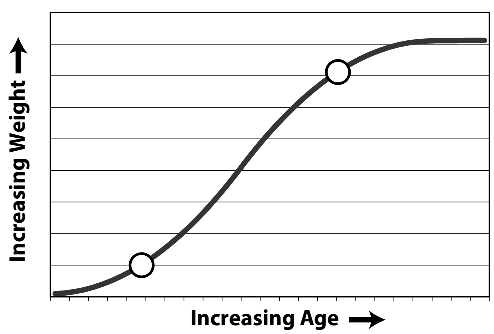
To adjust yearling weight, the following equation is used:

$$\text{Adjusted 365d wt.} = \left[\frac{\text{(actual yearling wt.)} - \text{(actual weaning wt.)}}{\text{days between weights}} \times 160\right] + \text{205d weaning wt.}$$

This allows all animals to be evaluated at a constant age and does not penalize calves born late in the calving season. It is important to remember that adjustments for AOD should be done at the end so that it is the actual weights that are being included in the equations and not the weights that are already adjusted for AOD.

For these adjustments to be the most accurate, calves need to be within a specific age range. For weaning weight, this range is typically 160 to 250 days. For yearling weight, this range is typically 320 to 410 days. Adjustments within these age ranges are done linearly, but because the growth curve of an animal is not linear, as shown in Figure 2, animals that are outside of these age ranges would not be adjusted correctly. Animals that are outside of these age ranges when weighed may not be included in genetic evaluations because it is harder to accurately adjust the data.

Figure 2. The growth curve of a typical calf. Weaning weight can easily be estimated by linear adjustment for the period of time in between the two dots. Linear adjustments would not be accurate for more extreme ages outside the dots.



Contemporary Groups

Contemporary groups are used to account for the non-genetic effects that are not as predictable as those accounted for by adjustments, but they can also alter the expression of traits. Effects such as weather, creep feed, diet, individual farm/ranch, and many other factors can affect animal performance. Unfortunately, the effects of these factors change frequently and are difficult to account for using set adjustments. Even so, the effect of these non-genetic items must be factored out so that EPD can be calculated that only account for genetic differences and not any of these other factors.

In order to do this, animals are grouped into contemporary groups. Animals within the same contemporary group are alike for all factors that go into the formation of these groups. These factors may differ slightly from association to association and do depend on the trait being analyzed. Table 4 shows the factors that typically go into the formation of contemporary groups for the most common traits (adapted from BIF, 2002).

Table 4. Typical factors used in the formation of contemporary groups.

Trait	Grouping Factors
Birth Weight	Breeder-Herd Code, Year, Season, Sex, Breed Composition, Birth Management Code, Service Type (Embryo Transfer Calves)
Calving Ease Direct	Same as Birth Weight
Calving Ease Maternal	Same as Birth Weight
Carcass Traits	Weaning or Yearling Weight Contemporary Group, Management/Pen/Feeding Unit, Days on Feed, Harvest Date, Grading Date, Carcass Sex, Date on Feed, Breed of Dam
Feed Efficiency	Weaning or Yearling Weight Contemporary Group, Feed Efficiency Management/Feeding Unit Code, Days on Feed (or Date on Feed), Date Scanned or Harvested, Sex, and Breed Composition
Heifer Pregnancy	Yearling Weight Contemporary Group, Heifer Pregnancy Management Code, Breeding Season Start and End Dates, Exposure, Breeding Pasture, and/or Sire Effect
Mature Cow Body Condition Score	Breeder-Herd Code, Year, Date Measured, Age at Measurement (Years), Breed Composition, and Birth Management Code
Mature Height	Same as Mature Cow Body Condition Score
Mature Weight	Same as Mature Cow Body Condition Score
Stayability	Breeder-Herd Code, Birth Year, Code of the Breeder-Herd in which the cow produced a calf, Breed Composition
Ultrasound Body Composition Traits	Weaning or Yearling Contemporary Group, Management/Feeding Unit Code, Date Scanned, Sex
Weaning Weight	Birth Weight Contemporary Group, Management/Pasture Code, Date Weighed, Weaning Sex, Breed Composition, Service Type (Embryo Transfer Calves)
Yearling Frame Score	Weaning Weight Contemporary Group, Management/Feeding Unit Code, Date Weighed, Yearling Sex
Yearling Weight	Same as Yearling Frame Score

Breeder-Herd Code is sometimes substituted with workgroup or process date by breed associations. Workgroup or process date groups the animals that are sent into the association at the same time. If a producer splits the calf crop and sends in half of the data at a time, then the calves included in the first group will be put into a different contemporary group than the calves in the second group, regardless of whether or not they would have been included in the same group if they had been sent in together.

Breed percentage groups animals into ranges of percentages of the breed performing the evaluation so that, for instance, purebred animals are not grouped together with animals that are only 50% of the given breed.

Sex is included separately in birth, weaning, and yearling contemporary groups not only to separate males and females but also to account for males that may not be castrated until later in life. If sex was only included in the birth weight contemporary group, which carries through to later groups, it would not be possible to separate these late-castrated animals from bulls.

Management codes are producer defined and are a place for producers to make the association aware of management differences. Animals that are managed separately (different diets, pastures, illness, etc.) need to be identified with different codes so that they are placed in different contemporary groups. The association does not know if individual producers manage their calves together or separate them into different groups, and these codes help the association group animals accordingly.

Dates that the animal is weighed are also important for contemporary grouping. For birth weight contemporary groups, birth date has to be within a predesignated range of dates, generally 90 days. The dates for the contemporary groups of other traits, however, are exact dates. So, in order to be considered in the same contemporary group for weaning weight or yearling weight, animals have to be weighed on the same day, but for birth weight, they have to be within 90 days of each other.

Additionally, in order to be in the same contemporary group later in life, animals must be in the same contemporary groups at earlier ages. So, to be in the same yearling contemporary group, animals must also be in the same birth and weaning contemporary groups.

Once contemporary groups are formed, the cumulative effects of all the non-genetic factors included in the contemporary groups can be estimated for each contemporary group. Estimation of this removes these influences on phenotype from the EPD calculation and leaves the EPD as a true genetic prediction with minimal bias. Contemporary group estimates are calculated simultaneously with the calculation of EPD.

Single Animal Contemporary Groups

In order to get accurate estimates of contemporary group effects, it is important not to have single animals in a contemporary group. Producers should try to manage animals as similarly as possible so that many animals are included in each contemporary group. Obviously, there are some situations in which it is impossible to eliminate single animal contemporary groups (i.e., 4-H show steer, sick animal, etc.), but these should be kept to a minimum. If a single animal is in a contemporary group, it is impossible to determine what portion of the performance can be attributed to the non-genetic factors and what portion of the performance is due to genetics. Because of this, the performance of calves from single animal contemporary groups is not included in the calculation of EPD by national cattle evaluation procedures. These animals could, however, receive an EPD from pedigree estimates, which will be discussed later in this chapter.

Single Sire Contemporary Groups

Just like single animal contemporary groups, single sire contemporary groups should be avoided. When a single bull sires all the calves within a contemporary group, it is more difficult to determine how much of the performance is due to the genetics of the sire and how much of the performance is due to the non-genetic factors that are common to that contemporary group.

How Are Accuracies Calculated?

Accuracies are a direct product of not only the amount but also the type of data that is included in the analysis. Many records from parents, grandparents, siblings, and other ancestors may be included in the evaluation, but this type of data does not add much to the accuracy of an animal. This is because these data indicate the type of genetics that the animal has the chance of inheriting but does not indicate what genes the animal has actually inherited. With only ancestor information, two full siblings will have exactly the same EPD and accuracy but could in actuality have very different genetics (as depicted in Figure 1).

The type of data that is most important and has the largest effect on accuracy is data from descendants of an animal. These records depict the type of genetics which that animal actually possesses because it helps estimate the genetics that it has passed on to its progeny.

As more descendants have records submitted to the breed association, the higher the accuracy of the bull's EPD. Progeny data will increase accuracy faster than will grandprogeny and further descendants because the bull influences half of the genetics in his progeny (the other half come from the cow), while he only has a quarter of the genetic influence in his grandprogeny and an eighth of the genetic influence in his great-grandprogeny, and so on.

Classification of EPD

Interim/Pedigree EPD

Expected Progeny Differences are an estimate of the cumulative effect of the genes that an animal has and can pass on to its offspring. Because of this, until an animal has a record of its own, or even better, progeny of its own, it is difficult to know what genes it possesses. Without this information, the only way to estimate what genes an animal possesses is by averaging the parents. This means that all progeny of the same two parents will have the same EPD value until they have progeny of their own or records of their own. These EPD that are simply averages of the parental EPD are pedigree estimates and are referred to as pedigree EPD.

In most sire summaries, pedigree EPD are easy to identify because, instead of a numerical value, their accuracy values are designated as either "I" or "P," again depending on the breed association supplying the value. Some breeds may publish actual accuracy values, but these will be extremely small in value.

An interim EPD is a pedigree EPD that also includes the animal's own record for that trait. In many cases, these EPD have accuracies of "I+" or "P+."

For example:

Sire
WW EPD = +35

Dam
WW EPD = +25

Bull Calf Progeny
WW EPD = +30
Acc. = I (or P)

The bull calf progeny has an EPD that is the average of its parents' EPD until it has a record of its own from a valid contemporary group. Once the calf has its own record, the pedigree EPD of +30 is adjusted to include the animal's own record as well. The accuracy is then designated at "I+" (or "P+," depending on the breed association). Again, this depends on the breed association;

some breeds do not identify accuracies with a "+", while others may report the actual low numerical value, so it may be difficult to know, in these cases, if the animal's own record has been included or not.

For those breeds that do not report the numerical accuracy with pedigree and interim EPD, once the animal has progeny data reported, the accuracy value reported will be the actual numerical value. As more data are added, the accuracy of the bull's EPD will increase in value.

Direct vs. Maternal EPD

Most EPD are expressed in a direct form—meaning it predicts a bull's future progeny performance. Others are maternal EPD and predict a bull's grandprogeny. For instance, calving ease is expressed in two different EPD, one direct and one maternal. Milk, which is known by many names, including maternal milk, milking ability, maternal, and maternal traits, is the oldest maternal EPD available to producers.

Direct EPD predict the performance of a bull's calves. Direct calving ease, for instance, is a prediction of calving ease when the bull's calves are born—a measure of dystocia experienced by the heifers to which he is bred. Other EPD that are not explicitly referred to as direct or maternal can usually be assumed to be direct EPD.

Maternal EPD, on the other hand, predict the performance of a bull's daughter's calves. Maternal calving ease is a prediction of the ease with which a bull's daughters will calve as first-calf heifers. Greater values indicate the bull's daughters will calve with greater ease. Similarly, milk and total maternal EPD help to predict the weaning weight of a bull's daughter's calves.

Indicator Traits vs. Economically Relevant Traits

The first national sire evaluation in beef was published in the early 1970s comparing 13 sires for a limited number of traits. As time has gone on, both the number of animals and the number of traits with EPD have increased.

More recently, a more defined focus for EPD has been encouraged. This new focus has been on Economically Relevant Traits, or ERT, as they are sometimes called. Economically Relevant Traits, as the name implies, are those traits that have a direct economic impact to the producer. Traits such as weaning weight and carcass weight are ERT because there is a direct monetary value associated with these traits.

Other traits, such as birth weight, do not have a direct economic value associated with them. For instance, an increase in 1 lb of weaning weight increases the producer's income, but a decrease in 1 lb of birth weight does not directly affect the income or expense of a producer. Instead, birth weight is used to indicate the probability of dystocia, or calving difficulty, which does have an economic impact. For this reason, birth weight is not an ERT but is what is called an indicator trait. Newer EPD, such as direct and maternal calving ease, are the ERT for which birth weight is the indicator. For more information on specific EPD, refer to the next chapter.

Different Types of Genetic Evaluations

Genetic evaluations are different depending on the trait being analyzed. Some traits are analyzed with other traits, while some are analyzed by themselves. Some traits are expressed on a continuous scale, while others are analyzed using threshold models. Traditionally, evaluations have considered one breed, but the future of evaluations includes evaluation of many breeds simultaneously.

Single-Trait Analysis

Some traits are analyzed by themselves in what is called a single-trait analysis. This means that these traits are not analyzed in conjunction with any other correlated trait. If a trait is analyzed as a single trait, data from other traits contribute no information.

Multiple-Trait Analysis

Many traits are analyzed with other traits in what is called a multiple-trait analysis. Just as it sounds, a multiple-trait analysis computes more than one trait at a time. Typically, growth traits are analyzed together, as are the carcass traits. Ideally, all traits would be analyzed together in order to take advantage of all possible correlations, but this would require tremendous amounts of computing power, which is not feasible.

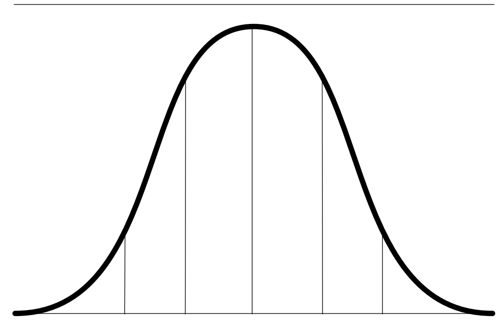
Threshold Analysis

Most traits that producers are interested in, such as the weight traits, are expressed on a continuous scale. For instance, weight can be any positive number. Traits that are continuous usually experience a normal distribution, meaning that when data are plotted, they form a bell-shaped curve.

Threshold traits also follow a normal distribution, but it is not as noticeable because there are distinct categories that ranges of values fall in, as shown in Figure 3. Calving difficulty, for instance, is scored on a scale of 1 to 4 but is actually occurring in a continuous but unobservable phenotype.

Despite the fact that threshold traits are categorically reported, when EPD are calculated, they are reported on a continuous scale. For calving difficulty (or calving ease), as an example, the EPD is typically reported as a percentage.

Figure 3. Threshold traits are observed in categories but have an underlying normal distribution.



Multi-Breed Analysis

Traditionally, genetic evaluations have been performed within a breed. This means that only bulls from the same breed could be directly compared. If a producer wanted to compare two bulls of different breeds for use in his or her herd, it was impossible to do so using traditional within-breed EPD.

Researchers at the USDA Meat Animal Research Center in Clay Center, Nebraska, have developed across-breed EPD adjustment factors. These additive adjustments can be used to adjust EPD from different breeds in order to compare bulls. These values are updated annually and are made available each year on the Beef Improvement Federation's Web site located at www.beefimprovement.org/proceedings.html.

The next generation of EPD will bring together animals from several breeds in a format that allows people to compare animals of several different breeds without having to additively adjust the EPD. Current research is being conducted to calculate EPD using multi-breed analyses. Results from these analyses would provide EPD for animals from all breeds included in the analyses on one common base so that animals can be directly compared.

Besides being able to compare different breeds of bulls, there are other advantages to a multi-breed evaluation. Bulls that have calves represented in several different breeds, such as Angus bulls that have sired Simmental or Charolais calves, for example, can have all of that information included in one analysis to increase the accuracy of his EPD. Also, crossbred bulls that may not typically be evaluated in a normal genetic evaluation can be included in multi-breed evaluations.

Although there are many benefits to a multi-breed evaluation, there are also some drawbacks. Results from a multi-breed analysis may not be suitable for choosing bulls for a crossbreeding scenario, as heterosis effects are taken out of the data prior to calculation of the EPD values. As an example, comparing Red Angus versus Gelbvieh bulls for use on Red Angus cows would not be a valid comparison, as the Gelbvieh bulls would also introduce heterosis that the Red Angus bulls would not provide.

Summary

Expected Progeny Differences are a selection tool available to producers who want to make genetic progress in their herd. With knowledge of EPD and accuracies and how to use these values, producers can improve the genetics of their herd. Details of specific EPD are provided in the next chapter.

Current genetic evaluations are limited to within-breed comparisons unless the across-breed EPD adjustment factors are used. Future genetic evaluations may result in multiple breeds being evaluated together so that producers can compare all animals on the same basis.

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