EPD/Profit Indexes

Economic Selection Indexes: A Tool for Successful Sire Selection

In 2005 the American Hereford Association (AHA) introduced four profit indexes. These indexes allow Hereford members and their commercial costumers to select sires that maximize profit under different production situations. The indexes are formulated on general representations of beef production systems used in the U.S. and consider a group of economically relevant traits that characterize those systems. Relative economic values for this group of traits are paired with expected progeny differences (EPDs) to produce a dollar ($) index value. The difference in the $ value of the index predicts the difference in profit potential.

Selection index technology is nothing new. The original scientific paper describing the technique was published in 1943. For decades, swine and dairy breeders have used values such as sow productivity index and type-production index to select animals that excel in several traits. Beef breed associations in Australia have used index selection for several years, and a number of other U.S. beef breed associations publish various index values as part of their genetic evaluation programs. While other breeds have only terminal sire indexes, Hereford has developed three maternal indexes in addition to a terminal index.

The four Hereford indexes are:

Baldy Maternal Index (BMI$) – This is an index to maximize profit for commercial cow-calf producers who use Hereford bulls in rotational crossbreeding programs on Angus-based cows. Retained ownership of calves through the feedlot phase of production is maintained and the cattle are to be marketed on a CHB pricing grid.

Brahman Influence Index (BII$) – This index utilizes Hereford bulls in a rotational crossbreeding system with Brahman. This index emphasizes fertility and age at puberty and less on growth. Because Brahman cattle are not used in the CHB program, a commodity pricing grid is used.

Certified Hereford Beef Index (CHB$) – This is a terminal sire index, where Hereford bulls are used on British-cross cows and all offspring are sold as fed cattle on a CHB pricing grid. There is no emphasis on milk or fertility since all cattle will be terminal. This index promotes growth and carcass.

Calving Ease Index (CEZ$) – This index is used to select bulls that will be used in a heifer program. This index has increased emphasis on direct and maternal calving ease.

Real-world scenario

Economic selection indexes allow cattle producers to select animals with the most favorable combination of EPDs to maximize profit in a given situation. As an example, EPDs for four fictitious Hereford bulls are listed in Table 1. Of these four sires, which would be expected to generate the most profit in a rotational crossbreeding program, when mated to Angus-cross cows and heifers?

Each of the four bulls excels in at least one economically important trait. Bull A is the most favorable for scrotal circumference, an indicator of early puberty and increased lifetime female fertility. Bull B has the most favorable combination of calving ease and growth, but is less desirable than breed average for both fat and ribeye area. The bull with the highest milk and intramuscular fat (IMF) EPDs is C, but he is the least desirable for calving ease. In contrast Bull D is the calving-ease sire of the group, but is only average for growth, and in the bottom 5% of active sires for IMF.

The answer to this question is found by comparing the index values in Table 2. Bull B would be expected to sire the most profitable calves for this scenario, slightly better than A, and significantly better than D or C. His BMI$ value is the highest of the four bulls. His calves should generate $2.14 more profit per head, compared with A ($25.35 – 23.12 = $2.23), and $19.86 more profit per head than C. If B and C each produce 25 calves per year for four years, a producer should realize $1,986 more profit using B compared to C, including the cow herd contributions of daughters of B compared with daughters of C (25 calves × 4 years × $19.86 per head = $1,986).

Note that each of the four bulls is best for one of the indexes. While B is an excellent choice for the scenario just discussed, he would be only second best as a terminal sire (CHB$) or a sire of heifer bulls (CEZ$). When crossed with Brahman-influenced

Table 1. EPDs for four Hereford bulls.

Bull	CED	BW	WW	YW	MM	M&G	CEM	SC	FAT	REA	IMF
A	-3.0	5.0	35	65	25	40	-3.0	2.0	-0.01	0.30	-0.05
B	4.0	1.0	55	70	10	35	2.0	1.5	0.02	-0.20	-0.10
C	-4.0	4.5	45	75	30	50	-3.0	0.0	-0.03	-.30	0.10
D	10.0	1.5	30	60	20	35	7.0	0.8	-0.02	-0.20	-0.25

Table 2. Index values for the four Hereford bulls in Table 1.

BULL	BMI$	BII$	CEZ$	CHB$
A	23.12	26.76	14.06	14.25
B	25.35	23.86	20.77	18.49
C	5.49	4.45	7.67	22.50
D	17.16	13.54	25.86	10.37

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females, A would be a somewhat better choice (BII$), largely the result of his high scrotal circumference EPD. Bull C's favorable carcass genetics make him the most profitable terminal sire, while D is the best choice as a sire of heifer bulls, given his genetic values for calving ease.

Selection vs. ICLs

Selection on index values is more effective than using independent culling levels (ICLs) in a computer sire sort. Often breeders set minimum and maximum values for several EPDs, then select among those sires that meet all those criteria. As an illustration, consider a Hereford seedstock breeder whose bull customers typically cross Hereford bulls on Angus-based cows. The Hereford breeder might decide to seek artificial insemination (AI) sires that are in the top 25% of active sires for calving ease, weaning weight, milk, scrotal circumference and intramuscular fat. A sort on the AHA Web site might provide a list of bulls like that found in Table 3.

But are those the most profitable bulls for this scenario? Not necessarily. In particular, sire sorts eliminate any animal that fails to meet even one of the given criteria, even by a very small amount. What if the producer had lowered their criteria slightly? They might have found more bulls, some of which were significantly better overall. In Table 4, the same three bulls are listed, plus one who fails to meet the original criteria for one trait by a small amount.

In Table 4 sire H is the most profitable for the situation, even though he failed to meet the initial criteria set by the producer. His direct calving ease EPD was lower than desired, but only by a small amount. That deficiency is offset by a superior combination of weaning weight, scrotal circumference and IMF EPDs giving him the highest BMI$ value. Rather than setting minimums, index selection allows favorable EPDs for one trait to compensate for less favorable EPDs in another. Indexes identify animals with the overall most profitable genetic profile.

However, like any tool, selection indexes must be used carefully to avoid undesired results. While independent culling levels tend to select animals that are close to average for a large number of traits, indexes may identify animals that are rather extreme in their genetic values. Because indexes do allow one trait to compensate for another, they can select animals that are extremely favorable for a single trait, and somewhat undesirable for several others. Producers should scrutinize the individual EPDs of top index sires to be sure all EPD values are within an acceptable range. This is especially important for selecting calving ease sires for commercial herds. While the CEZ$ value does heavily emphasize direct and maternal calving ease, commercial producers selecting heifer bulls should continue to set minimum levels for those EPDs. The CEZ$ index identifies the most profitable animals for producing heifer bulls over several generations, but a sire can have a favorable CEZ$ value if its other traits are desirable enough to offset a marginal calving ease EPD.

As breeders begin to study index values for their animals, it will become apparent that milk EPD has little effect on any of the index values. In fact milk EPD is ignored in CHB$; that index identifies the best terminal sires, so milk is irrelevant. For the others, the economic value of increased milk, while small, is negative. No doubt some breeders will find this puzzling, as most beef breeds have selected for increased milk EPD over the last decade. However, economic research shows that once a cow provides adequate milk for her calf to meet its needs for health, maintenance and growth, additional milk is an economic liability, not an asset. Heavier milking cows have higher feed requirements, even when dry. If producers reduce the feed requirements per cow, they can increase herd size without acquiring additional land or purchased feed, and increase profit to the overall enterprise. However, if commercial bull customers insist their bulls have a minimum milk EPD, seedstock producers may want to continue to set a minimum milk value for AI sires, then select the top index sires with a milk EPD of that level or higher.

Table 3. Independent culling levels for five traits, and EPDs for three bulls meeting those levels.

BULL	CED	BW	WW	YW	MM	M&G	CEM	SC	FAT	REA	IMF	BMI$	BII$	CEZ$	CHB$
ICLS	2.1		43		18			0.9			0.04				
E	2.5	1.0	55	90	20	48	4.3	1.0	0.00	-0.01	0.10	20.16	16.01	18.21	26.05
F	5.0	2.0	50	85	25	50	7.0	1.2	0.01	-0.10	-0.10	19.55	14.91	21.34	19.51
G	4.0	3.0	45	80	20	43	-2.0	1.0	0.00	0.00	0.25	20.35	18.58	17.95	25.55

Table 4. Independent culling levels for five traits, and EPDs for three bulls meeting those levels, and one that does not.

BULL	CED	BW	WW	YW	MM	M&G	CEM	SC	FAT	REA	IMF	BMI$	BII$	CEZ$	CHB$
ICLS	2.1		43		18			0.9			0.04				
E	2.5	1.0	55	90	20	48	4.3	1.0	0.00	-0.01	0.10	20.16	16.01	18.21	26.05
F	5.0	2.0	50	85	25	50	7.0	1.2	0.01	-0.10	-0.10	19.55	14.91	21.34	19.51
G	4.0	3.0	45	80	20	43	-2.0	1.0	0.00	0.00	0.25	20.35	18.58	17.95	25.55
H	1.6	4.0	62	88	19	43	2.0	1.0	0.00	0.00	0.20	21.64	17.90	16.86	30.07

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