Beef Logic

by R.A. "Bob" Long

What's a standard deviation?

A recent phone conversation with an Angus breeder brought this statement: "Bob, I'm confused. Geneticists keep referring to *standard deviation*.

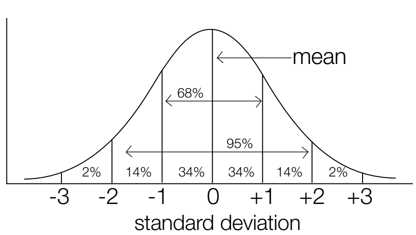
"I looked this up in the dictionary and found 'a measure of the dispersion of the frequency distribution that is the square root of the arithmetic mean of the squares of the deviation of each of the class frequencies from the arithmetic mean of the frequency distribution.'

"Now, what in the world does that have to do with breeding Angus cattle?"

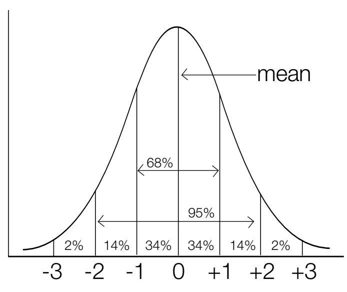
I replied, "George, I confess that your definition confuses me, too, but let's talk about standard deviations."

Put away the dictionary

Population geneticists like to measure things. They also are always looking for different ways to describe what has been measured. Measurements of a specific trait in a living population (herd or breed) tend to be distributed in a symmetrical bell-shaped curve, which geneticists refer to as a "normal curve" or "normal distribution" of data. Such curves always are bell-shaped, but whether the bell is short and wide or tall and thin depends on the variation of the data (see the figures).



Great variation (not uniform)



Little variation (uniform)

Geneticists love numbers, so they want to describe numerically the variation in a breed or herd. To accomplish this, the mean (average value) for a certain trait is established for the entire group. Next, the difference between each individual's value (X) and the mean value ($\bar{X}$) is calculated to provide a deviation score (x), which is then squared (x^2). The average of the squared deviation scores is termed the "variance," the square root of which is the "standard deviation" (SD) from the mean.

In the figures, notice that one standard deviation to either side of the average includes 68% (34% on each side of the mean) of all the individuals in the group. Two standard deviations from the mean include an additional 28% (14% on each end) for a total of 95% of the population. Finally, three standard deviations take care of the remaining 4% (2% at each extreme).

If you are looking for extremes, you select animals with trait values that fall in the third standard deviation, or in the top or bottom 2% of a population, depending upon which direction you wish to go.

Maintain perspective

It all boils down to two points. First, the smaller the standard deviation, the more uniform the group and the slower progress can be made. Second, for the most rapid change, selection should be as far from the average as possible. Whether that's greater or less than the average depends upon the goal. Herein lies a problem.

Remember, each distribution curve represents only one trait. There are a great number of heritable traits that contribute to overall performance and productivity, and a goal or ideal should include them all. Further complicating the situation is the fact that some traits tend to conflict with others. Therefore, the problem is where on the curve to make a selection.

Whenever numbers are used to describe an item, a common human weakness is to seek the extreme. For example, cattle breeders tend to select herd sires with EPDs for the lowest birth weight, the heaviest weaning and yearling weights, and the highest milk with little concern for other traits. Unfortunately, not one of these criteria nor any combination of them guarantees efficient production of high-quality beef.

Low birth weights are in conflict with growth rate and muscling, and low-birth-weight heifer calves do not necessarily make easy-calving cows. Weaning and yearling weights are of no value in measuring beef production without measuring the composition of that weight. Finally, why would you want cows with a genetic potential for milk production that's so high it can't be supported by range conditions, and that then fail to rebreed to boot?

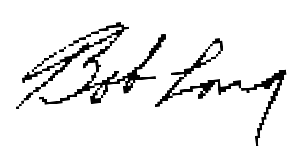
The crux of the matter

Selecting a herd sire is a complex procedure. It should involve the use of complete and accurate performance records for every heritable trait that contributes to the efficient production of high-quality beef. The right bull should come from a herd with a recordkeeping system that maintains such information, that is fed and managed under commercial conditions, and where the cows calve unassisted every 12 months.

From such a herd, select a bull as far from average as possible in every trait without deficiency in any single area. Look for "the most of the best," which is just a way of saying "balanced EPDs." Then use the bull extensively, and select replacements from his offspring by the same method.

Admittedly, this procedure limits the bulls available, but it is worth the search. The herd will change more slowly, but the change will be constant and positive.

And remember to be cautious of the third standard deviation!



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