

Marbling Economics - Beyond the Basics

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How much emphasis should I place on marbling? How much can I change my CAB® acceptance rate? How many Prime carcasses can I produce? How much can I affect my bottom line with marbling? As Angus breeders, producing seedstock, and as commercial producers providing finished cattle for a high quality, premium beef product, we have all entertained at least one of these questions. The answers are not easy, but the information needed is available in the statistics presented in the Angus Sire Summary. It just takes a little bit of time and effort along with some basic statistical skills to get a handle on the economics of marbling.

The Basics

We have all seen John Crouch's Henry VIII and Richard II example. Henry is an Angus bull with a marbling EPD of +0.0 whose calves have an average marbling score of 4.80 (Slight 80) and have an average quality grade of Select. Richard on the other hand has a Marbling EPD of +0.30 and produces calves with an average marbling score of 5.1 (Small 10) and an average quality grade of Low Choice. Assuming a \$4/cwt spread between Select and Choice, a 700 lb. carcass and no differences in yield grades, *on the average*, Richard's calves are worth \$28 more per carcass than Henry's. For these economics to work, we have to assume that all of Henry's calves grade Select and all of Richard's calves grade Low Choice. Not exactly real world, but easy to understand.

After reviewing the data, we decide to increase marbling even more in order to produce CAB® qualified cattle. We go the sire summary and find William, the highest marbling bull in the breed. He has a Marbling EPD of 0.88. We use him on the same set of cows and produce steers with an average marbling score of 5.68 (Small 68) and an average quality grade of Low Choice. *On the average*, steers sired by William and Richard both grade Low Choice. Does this mean that William's steers aren't worth any more than Richard's? Well...Not Exactly. This is where it starts getting complicated.

We know that when we produce an extra pound of weaning weight, we get paid for it. However, we don't get paid for additional marbling until we cross specific thresholds, Select to Low Choice, Low Choice to Average Choice (CAB®) and High Choice to Prime. In addition, the value is different at each threshold. To get beyond the basics, we have to look at the whole population, not just the averages.

Table 1 Simplified (unrealistic) marbling economics.

Bull	Bull's Marbling EPD	Steer's Marbling Score	Steers Average Quality Grade	Average Premium/Discount
Henry VIII	0.0	4.8 (Slight 80)	Select	-\$28.00
Richard II	.3	5.1 (Small 10)	Low Choice	\$0.00
William	.88	5.68 (Small 68)	Low Choice	\$0.00

Population Basics

In biological populations, including Angus cattle, most traits (marbling) tend to follow the infamous normal distribution, bell shaped curve (Figure 1). Most of the individuals in the population will be close to average, and the farther you move from average, the fewer animals there are. There are two numbers that describe the shape of the bell curve, average and standard deviation. We are all familiar with the averages as we used them in our basic example earlier. Most of us have at least heard the term "standard deviation" but it's not something we use every day.

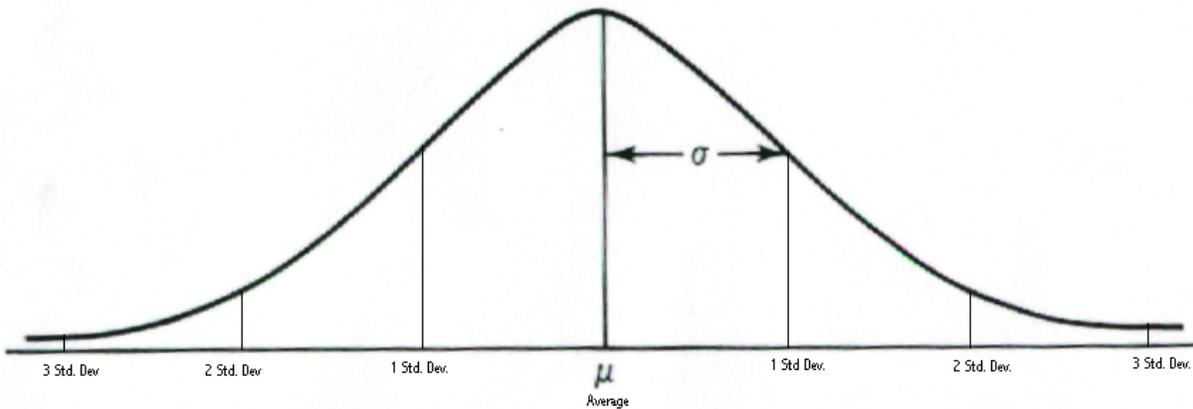


Figure 1 – Normal distribution, bell shaped curve

The Standard Deviation describes the range in which the population is distributed relative to the average. Approximately two-thirds of the population will have values within one standard deviation of the average and approximately 95% of the population will have values within two standard deviations of the average. Individuals that have values three or more standard deviations from the average are referred to as outliers.

For an example, let's go to the sire summary and look at the population of steers under 480 days when slaughtered. We see that the average adjusted marbling score is 5.92 +/- .96. The .96 is the standard deviation of marbling scores in this population. This means that two-thirds of the steers have marbling scores between 4.96 (5.92-.96) and 6.88 (5.92+.96). If we want to consider two standard deviations, then 95% of the steers have marbling scores ranging from 4.00 to 7.84.

We can represent this visually on a normal distribution bell shaped curve as shown in Figure 2.

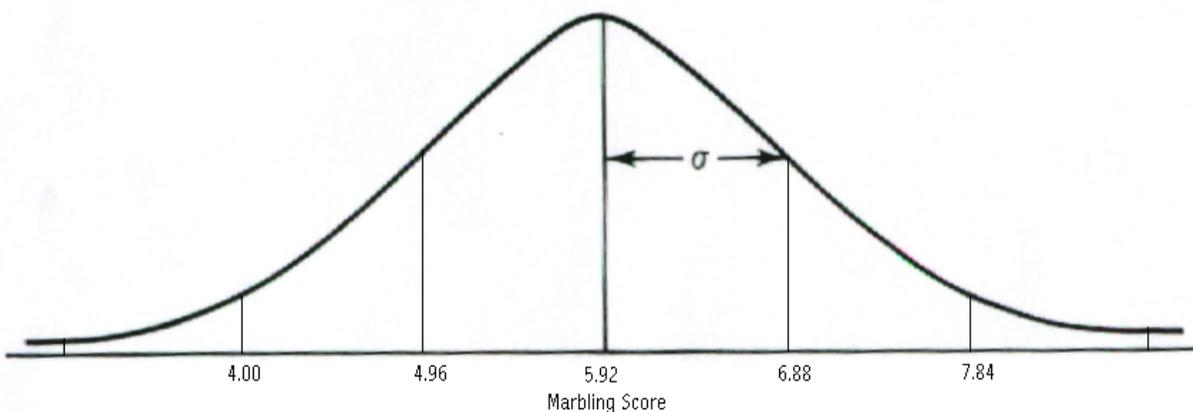


Figure 2

Now that we know the mean and standard deviation of this population, we can apply a few basic formulas from STAT 101 and calculate the percentage of steers expected to fall within the thresholds of interest. When we do this, we find that we expect 2.3% Standard, 14.6% Select, 36.4% Low Choice, 33.6% Average Choice, 11.5% High Choice and 1.5% Prime. This is represented visually in Figure 3. Now we are starting to get something we can work with.



Figure 3

Putting The Numbers to Work

Now it's time for assumptions. Of course, the more you know about the population, the better your assumptions are going to be. Let's assume that this population of 25,122 steers was sired by bulls that had an average Marbling EPD of +0.05, breed average. Let's also assume that Standard carcasses are discounted \$16/cwt(100 lb), Select carcasses are discounted \$8/cwt, upper two-thirds Choice get a \$3/cwt premium and Prime receives a \$6/cwt premium. Carcass weights are going to remain at 700 lb. and Yield Grades are not going to change.

What if we use Richard III with a Marbling EPD of +0.3 on this population. We would expect the average marbling score of his steers to be .25 (.3-.05) higher than the average or 6.17 (5.92 + .25), Average Choice. This results in 1.2% Standard, 10.0% Select, 31.8% Low Choice, 37.7% Average Choice, 16.5% High Choice and 2.8 % Prime. CAB® acceptance is 57%. These carcasses would be worth \$6.14 more than those produced by breed average sires.

Now let's bring in William with a Marbling EPD of .88, the best marbling bull the breed has to offer. The average marbling score of his steers should increase by .83 (.88-.05) to 6.75, Average Choice. After crunching through the numbers, we find that the break down of the steers sired by William should be as follows: .2% Standard, 3.2% Select, 18.3% Low Choice, 38.5 % Average Choice, 30.1% High Choice and 9.6% Prime. This results in 78.2% CAB®. These carcasses received a premium of \$16.42/head and were worth \$10.81 more than carcasses sired by Richard.

Table 2 A more realistic representation of marbling economics

Bull	Bull's Marbling EPD	Avg. Marbling Score of Offspring	% Prime	% High Choice	% Average Choice	% Low Choice	% Select	Average Premium or Discount
Henry	0.0	5.87	1.3%	10.6%	32.7%	37.1%	15.7%	-\$2.07/hd
Richard	0.3	6.17	2.8%	16.5%	37.7%	31.8%	10.0%	\$5.61/hd
William	0.88	6.75	9.6%	30.1%	38.5%	18.3%	3.2%	\$16.42/hd

Stacking Generations

In the previous examples, we assumed that the cow herd didn't change, just the sires. Realizing that the genetics of a cow herd change over time to reflect sire selection, let's run some numbers looking at the changes in subsequent generations. We will use the same steer data as a base and assume that the cows are breed average for marbling with a Marbling EPD of +0.05. Let's select 4 unrelated bulls with an average Marbling EPD of .80 and assume that they will be used equally in each generation.

Our base herd consisting of average cows and average bulls produce offspring with a +0.05 average Marbling EPD and carcasses with an average marbling score of 5.92. The distribution of the carcasses is as follows: 2.3% Standard, 14.6% Select, 36.4% Low Choice, 33.6% Average Choice, 11.5% High Choice and 1.5% Prime. The CAB® acceptance rate is 46.6%.

The first generation of calves sired by the selected bulls (+0.80) out of base cows (+0.05) would have a Marbling EPD of +0.42 and have carcasses with an average marbling score of 6.66 with the following distribution: .3% Standard, 3.9 % Select, 20.4% Low Choice, 39.3% Average Choice, 28.0% High Choice and 8.1% Prime. The CAB® acceptance rate is 75.4 %.

The second generation of calves sired by selected bulls (+0.80) out of first generation cows (+0.42) would have a marbling EPD of +0.61 and have carcasses with an average Marbling score of 7.04 with a distribution of: .1% Standard, 1.6 % Select, 12.3% Low Choice, 34.4% Average Choice, 35.8% High Choice and 15.9% Prime. The CAB® acceptance rate is 86.1 %.

The third generation of calves sired by +0.80 bulls out of +0.61 cows (second generation) would have a Marbling EPD of +0.70 and have carcasses with an average marbling score of 7.22 with the following distribution: 0% Standard, 1.0 % Select, 9.2% Low Choice, 30.7% Average Choice, 38.2% High Choice and 20.8% Prime. The CAB® acceptance rate is 89.7 %.

If we continued this program with the same sires, the population would eventually stabilize with an average Marbling EPD of +0.80 for sires, cows and offspring. The carcasses would have an average marbling score of 7.42 with the following distribution: 0% Standard, .6 % Select, 6.4% Low Choice, 26.1% Average Choice, 39.6% High Choice and 27.3% Prime. The expected CAB® acceptance rate is 93%.

Table 3 reflects a summary of the changes discussed.

In this example, we maintained the same group of sires to keep the numbers easy to follow. Further advances in marbling could be realized through sire evaluation and selection.

Table 3 Changes From Maximum Selection for Marbling EPD

	Base Herd	1 st Generation	2 nd Generation	3 rd Generation	~ Generation
Sire's EPD	+0.05	+0.80	+0.80	+0.80	+0.80
Dam's EPD	+0.05	+0.05	+0.42	+0.61	+0.80
Steer's EPD	+0.05	+0.42	+0.61	+0.70	+0.80
Avg. Marb. Score	5.92	6.66	7.04	7.22	7.42
% Prime	1.5%	8.1%	15.9%	20.8%	27.3%
% High					

Choice	11.5%	28.0%	35.8%	38.2%	39.6%
% Average Choice	33.6%	39.3%	34.4%	30.7%	26.1%
% Low Choice	36.4%	20.4%	12.3%	9.2%	6.4%
% Select	14.6%	3.9%	1.6%	1.0%	.6%
% Standard	2.3%	.3%	.1%	0%	0%
% CAB® & Prime	46.6%	75.4%	86.1%	89.7%	93.0%
Premium/ Carcass	-\$0.94	\$15.02	\$20.41	\$22.64	\$24.93

I hope you're beginning to appreciate that once you know or assume the basic statistics for a population, the impact of changing marbling can be calculated fairly quickly and easily. You need to know or assume the average marbling score, the standard deviation of the marbling scores and the average Marbling EPD of the population. With this information, you can create _what if situations_ to evaluate the impact of potential changes. Table 4 shows the results of various EPD levels on the base population that we have been working with in this discussion. It shows the average marbling score and EPD and the results of moving the population up or down from that base. Use it as a guide to evaluate the importance of marbling in your operation. As you start collecting information, you will most likely have to adjust the chart based on your data.

Table 4 - Carcass Grade Distributions at various Marbling EPD Levels

Steers Marbling EPD	Average Marbling Score	% Prime	% High Choice	% Avg. Choice	% Low Choice	% Select	% Standard
-0.2	5.42	0.4%	4.6%	22.3%	39.6%	26.1%	7.0%
-0.1	5.62	0.7%	6.9%	27.1%	39.5%	21.3%	4.6%
0.05*	5.92* +/-0.96*	1.5%	11.5%	33.6%	36.4%	14.6%	2.3%
0.1	6.02	2.0%	13.4%	35.5%	34.8%	12.6%	1.8%
0.2	6.22	3.2%	17.6%	38.2%	30.7%	9.2%	1.0%
0.3	6.42	5.0%	22.3%	39.6%	26.1%	6.4%	0.6%
0.4	6.62	7.5%	27.1%	39.5%	21.3%	4.3%	0.3%
0.5	6.82	11.0%	31.6%	37.8%	16.8%	2.7%	0.2%
0.6	7.02	15.4%	35.5%	34.8%	12.6%	1.7%	0.1%
0.7	7.22	20.8%	38.2%	30.7%	9.2%	1.0%	0.0%
0.8	7.42	27.3%	39.6%	26.1%	6.4%	0.6%	0.0%
0.9	7.62	34.6%	39.5%	21.3%	4.3%	0.3%	0.0%
1.0	7.82	42.6%	37.8%	16.8%	2.7%	0.2%	0.0%

* base population assumptions used to calculate distributions for other Marbling EPDs

Roseda Steers

In 2000, we slaughtered a group of purebred Angus steers bred at Roseda Farm with known EPDs.

When you compare the performance of these steers with the expected performance based on Table 4, you will see that it is pretty close and not statistically different. Table 5 summarizes this.

Table 5 – Comparison of Roseda Steers with expectations from table 4

	Marbling EPD	% Prime	% Upper 2/3 Choice	% Low Choice	% Select
Roseda Steers	.33	7.0%	57.0%	29.0%	7.0%
Expected (table 4)	.3	5.0%	61.9%	26.1%	6.4%

Questions or comments?

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