

2018 AJSA REGIONAL AND NATIONAL CLASSICS GENETIC EVALUATION QUIZ STUDY PACKET

What is a genetic evaluation?

Information that compares the predicted average calf performance in breeding animals. Common products of a genetic evaluation include expected progeny differences (EPDs) and economic selection indexes. The American Simmental Association collaborates with 11 other US and international breed associations (International Genetic Solutions) to conduct a multi-breed genetic evaluation with a combined database of over 17 million animals.

What does EPD stand for and what is an EPD?

- Expected progeny difference. EPDs are estimates of how a bull or cow's future progeny will perform, *on average*, for a given trait compared to another animal's future progeny.
- **Expected:** what we think will happen based on the information available. Performance records for the individual animal, sire and dam, other relatives, and progeny are all used to calculate EPDs. The more information reported for an animal, the more confidence we have that our prediction is accurate.
- **Progeny:** we use these values to predict how an animal's calves will perform compared to another animal's calves in whatever trait we are considering.
- **Difference:** it is important to compare the differences between animals or between an animal and the breed average EPD for a trait.
- EPDs have little stand-alone meaning. Using them correctly requires making comparisons between animals or between an animal and the breed average EPD for a trait.
- EPDs are given in the unit of the trait. For example, birth weight EPDs are given in pounds. Ribeye area (REA) EPDs are given in square inches.
- The difference between the EPDs of two animals for a given trait would tell you the average expected difference between their calves. For example, let's say Bull A has a weaning weight EPD of 60 and Bull B has a weaning weight EPD of 50. We would expect Bull A's calves to weigh 10 pounds more ($60 - 50 = 10$) on average at weaning than Bull B's calves.
- Additional reading on this topic in this study packet:
 - ["The Random Shuffle of Genes: Putting the E in EPD" by Jared Decker](#)
 - ["EPD Basics and Definitions" by Matthew Spangler](#)

What EPDs does the American Simmental Association report?

- Calving Ease (CE): Percent of unassisted births when used on heifers.
- Birth Weight (Brth): Pounds of birth weight.
- Weaning Weight (Wean): Pounds of weaning weight.
- Yearling Weight (Year): Pounds of yearling weight.
- Average Daily Gain (ADG): Pounds of daily gain during the post-weaning feeding period.
- Maternal Calving Ease (MCE): Percent of unassisted births in first-calf heifer daughters.
- Milk: Pounds of weaning weight due to milk.
- Maternal Weaning Weight (MWW): Pounds of weaning weight due to milk and growth.
- Stayability (Stay): Percent of daughters remaining in the cowherd at 6 years of age.
- Docility (Doc): Percent of offspring expected to score favorably (docile or restless rather than nervous to very aggressive) on a docility scoring system. Higher values indicate that offspring should possess genetics for calmer behavior.

- Carcass Weight (CW): Pounds of hot carcass weight.
- Yield Grade (YG): Yield grade score.
- Marbling (Marb): Marbling score.
- Back Fat (BF): Inches of back fat.
- Ribeye Area (REA): Square inches of ribeye area.
- Shear Force (Shr): Pounds of force required to shear (cut) a steak, a measure of tenderness.

What is an economic selection index and what indexes does the American Simmental Association report?

- Selection indexes are commonly called “\$ Indexes” and blend EPDs and economics to estimate an animal’s overall impact on an operation’s bottom line. ASA reports two \$ indexes, API and TI. Both indexes calculate the estimated differences between bulls in net dollars returned per cow exposed.
 - **All-Purpose Index (API):** Evaluates sires for use on the entire cow herd (Angus heifers and mature cows) with replacement heifers selected from heifer calves and the balance of offspring sent to a feedlot and sold on grade and yield.
 - **Terminal Index (TI):** Evaluates sires for use on mature Angus cows with all offspring sent to a feedlot and sold on grade and yield.
- Additional reading on this topic in this study packet:
 - [“Beef Cattle Economic Selection Indices” by Bob Weaber](#)

What other values are important on a list of an animal’s EPDs?

- **Accuracy:** A measure of how true the EPD is to the animal’s actual (but unknown) genetic value. Accuracy values range from 0 to 1 with 0 meaning the EPD is not close to the animal’s true breeding value and 1 meaning the EPD is exactly the animal’s true breeding value. Accuracy is based on the amount and type of data used to generate the EPDs.
 - With more information on an animal, and more information from progeny as opposed to distant relatives, accuracy will increase.
 - Accuracy also increases if DNA information is incorporated into EPDs (genomically-enhanced EPD). Adding genomic information to an EPD can increase accuracy before any progeny of an animal are even conceived. See the article [“How DNA Testing Will Affect the Accuracy of EPD Information” by Bob Weaber and Matthew Spangler](#) in this study packet.
 - Accuracy gives us an idea about the possible change we may see in an animal’s EPDs. See the article [“Interpreting EPD Accuracy & Possible Change” by Scott Greiner](#) in this study packet.
- **Percentile Rank:** Compares EPDs for specific trait among animals within a breed. Values range from 1 to 99 and the smaller the number the better. For example, a bull with a percentile ranking of 5 for calving ease means that he is the top 5% of all the sires in that breed for calving ease.

Example: Using EPDs and Economic Selection Indexes to Compare Two Bulls

Bull X

	CE	Brth	Wean	Year	ADG	MCE	Milk	MWW	Stay	Doc	CW	YG	Marb	BF	REA	Shr	API	TI
EPD	8.1	3.0	74.2	113.6	0.25	4.7	18.7	55.8	-2.6	10.7	41.8	-0.44	0.15	-0.084	1.11	-0.30	96.9	75.0
ACC	0.37	0.46	0.35	0.36	0.36	0.27	0.27	0.30	0.37	0.19	0.31	0.22	0.37	0.19	0.28	0.17		
%	65	75	10	10	10	90	70	30		55	10	10	50	10	5	60	95	20

Bull Y

	CE	Brth	Wean	Year	ADG	MCE	Milk	MWW	Stay	Doc	CW	YG	Marb	BF	REA	Shr	API	TI
EPD	13.5	1.2	64.1	95.4	0.20	11.5	27.7	59.7	11.2	11.5	28.4	-0.29	0.34	-0.041	0.81	-0.55	139.7	76.7
ACC	0.39	0.47	0.40	0.42	0.42	0.27	0.27	0.31	0.28	0.13	0.35	0.27	0.41	0.26	0.33	0.20		
%	15	40	45	40	10	20	10	15	50	40	45	65	15	75	50	1	15	15

Calving Ease: We would expect an average of 5.4% more heifers to calve unassisted when bred to Bull Y than Bull X.

- $13.5 - 8.1 = 5.4$ percent

Birth Weight: We would expect Bull X's calves to weigh an average of 1.8 pounds more at birth than Bull Y's calves.

- $3.0 - 1.2 = 1.8$ pounds

Weaning Weight: We would expect Bull X's calves to weigh an average of 10.1 pounds more at weaning than Bull Y's calves.

- $74.2 - 64.1 = 10.1$ pounds

Yearling Weight: We would expect Bull X's calves to weigh an average of 18.2 pounds more at a year of age than Bull Y's calves.

- $113.6 - 95.4 = 18.2$ pounds

Average Daily Gain: We would expect Bull X's calves to gain an average of 0.05 pounds more per day during the post-weaning feeding period than Bull Y's calves.

- $0.25 - 0.20 = 0.05$ pounds

Maternal Calving Ease: We would expect an average of 6.8% more of Bull Y's daughters to calve without assistance with their first calf than Bull X's daughters.

- $11.5 - 4.7 = 6.8$ percent

Milk: We would expect calves from Bull Y's daughters to weigh an average of 9 pounds more at weaning due to milk production than calves from Bull X's daughters.

- $27.7 - 18.7 = 9$ pounds

Maternal Weaning Weight: We would expect calves from Bull Y's daughters to weigh an average of 3.9 pounds more at weaning due to milk and growth than calves from Bull X's daughters.

- $59.7 - 55.8 = 3.9$

Stayability: We would expect an average of 13.8% more of Bull Y's daughters to remain in the cowherd at 6 years of age than Bull X's daughters.

- $11.2 - (-2.6) = 13.8$ percent

Docility: We would expect an average of 0.8% more of Bull Y's offspring to score favorably on a docility scoring system.

- $11.5 - 10.7 = 0.8$ percent

Carcass Weight: We would expect Bull X's calves to have carcasses that are an average of 13.4 pounds heavier than carcasses of Bull Y's calves.

- $41.8 - 28.4 = 13.4$ pounds

Yield Grade: We would expect Bull X's calves to have an average 0.15 lower yield grade score than Bull Y's calves at harvest. Lower yield grade means higher red meat yield.

- $-0.44 - (-0.29) = 0.15$ yield grade score

Marbling: We would expect Bull Y's calves to have an average 0.19 higher marbling score than Bull X's calves at harvest. Higher marbling score means more intramuscular fat and higher quality grade.

- $0.34 - 0.15 = 0.19$ marbling score

Back Fat: We would expect Bull X's calves to have an average of 0.043 inches less backfat than Bull Y's calves at harvest. Lower back fat means lower yield grade and higher red meat yield.

- $-0.084 - (-0.041) = 0.043$ inches

Ribeye Area: We would expect Bull X's calves to have an average 0.3 square inch larger ribeye than Bull Y's calves at harvest. Larger ribeye area means lower yield grade and higher red meat yield.

- $1.11 - 0.81 = 0.3$ square inches

Shear Force: We would expect an average 0.25 pounds less force needed to shear a steak from Bull Y's calves than from Bull X's calves. Lower shear force means more tender meat.

- $-0.55 - (-0.30) = 0.25$ pounds

All-Purpose Index: We would expect an average of \$42.80 more net returned per cow exposed to Bull Y than Bull X. Remember API evaluates sires for use on the entire cow herd (Angus heifers and mature cows) with replacement heifers selected from heifer calves and the balance of offspring sent to a feedlot and sold on grade and yield.

- $139.7 - 96.9 = 42.8$

Terminal Index: We would expect an average of \$1.70 more net returned per cow exposed to Bull Y than Bull X. Remember TI evaluates sires for use on mature Angus cows with all offspring sent to a feedlot and sold on grade and yield.

- $76.7 - 75 = 1.7$

Accuracy and Percentile Rank Example:

Below are Spring 2018 EPDs for two purebred Simmental bulls from Herdbook. Both are heterozygous black and homozygous polled. Bull A was born February 2000 and Bull B was born March 2016. As of mid-March 2018, Bull A has 7,982 progeny reported in the ASA database and Bull B has 2 progeny reported in the ASA database. Both bulls have DNA information incorporated into their EPDs. EPD categories are on the first row, with the individual bull's EPDs on the second row. The third row gives the accuracy of the EPD in question, and the last row lists the percentile rank for the bull for each EPD.

Bull A

	CE	Brth	Wean	Year	ADG	MCE	Milk	MWW	Stay	Doc	CW	YG	Marb	BF	REA	Shr	API	TI
EPD	23.1	-3.4	55.0	72.1	0.11	12.4	30.2	57.7	17.6	15.0	7.4	-0.58	0.48	-0.040	1.45	-0.55	177.3	82.2
ACC	0.97	0.97	0.97	0.97	0.97	0.96	0.96	0.96	0.85	0.86	0.61	0.60	0.85	0.83	0.85	0.38		
%	1	1	80	90	75	15	3	20	2	2	99	1	2	75	1	1	1	3

Bull B

	CE	Brth	Wean	Year	ADG	MCE	Milk	MWW	Stay	Doc	CW	YG	Marb	BF	REA	Shr	API	TI
EPD	11.0	0.5	79.1	124.6	0.28	7.1	21.8	61.4	9.0	11.1	44.7	-0.29	0.33	-0.035	1.06	-0.31	140.3	85.9
ACC	0.26	0.35	0.31	0.32	0.32	0.16	0.17	0.21	0.25	0.10	0.27	0.20	0.37	0.16	0.26	0.24		
%	30	25	4	2	10	70	45	10	75	45	5	65	15	90	10	55	15	1

First let's compare the EPD accuracies of the two bulls. Because the older Bull A has thousands of progeny reported in the database, his accuracy values are much higher than the younger Bull B who only has two progeny records reported. Note that economic selection indexes do not have an associated accuracy.

Next, let's take a look at the percentile rank row for each bull. Bull A is in the top 1% of the breed for calving ease, birth weight, yield grade, ribeye area, shear force, and API. He has much more modest EPDs for weaning, yearling, and carcass weights. On the other hand, Bull B is in the top 5% or better of the breed for weaning, yearling, and carcass weights, as well as TI. Bull B has much more modest EPDs for maternal calving ease, stayability, and back fat.

Accuracy and Percent Change Example:

Bull C and Bull D are SimAngus bulls with a calving ease EPD of 12.1; however, one has an accuracy of 0.20 and the other has an accuracy of 0.80. The SimAngus average calving ease EPD is 11.7. Using the possible change table found in Dr. Greiner’s article [“Interpreting EPD Accuracy & Possible Change”](#) in this study packet, we can create the following table.

	Calving Ease EPD	SimAngus Average CE	Accuracy	Possible Change	“True” EPD Range
Bull C	12.1	11.7	0.20	± 6.2	5.9 to 18.3
Bull D	12.1	11.7	0.80	± 1.6	10.5 to 13.7

Therefore, we expect Bull C’s true calving ease EPD to be between 5.9 and 18.3 two-thirds of the time, and to be outside of that range one-third of the time. At the same time, we expect Bull D’s calving ease EPD to be between 10.5 and 13.7 two-thirds of the time. If we were going to use these bulls on a cow herd where labor at calving time was not readily available, we might feel more confident using Bull D even though both bulls have the same calving ease EPD. Possible change allows for some calculation of the expected risk of using a particular bull. Bull C has potential for his true calving ease EPD to be much higher than breed average or much lower – when more information is added regarding his DNA and/or his progeny performance, accuracy will improve, possible change will decrease, and the true EPD range will be smaller.

Additional Reading in Study Packet:

- Coat Color Genetics: [“Simple Inheritance in Beef Cattle” by Darrh Bullock](#)
- Horned vs Polled Genetics: [“The Genetics of Horned, Polled and Scurred Cattle” by Darrh Bullock](#)
- DNA Parentage Validation Genetics: [“Parentage Testing” by Megan Rolf](#)