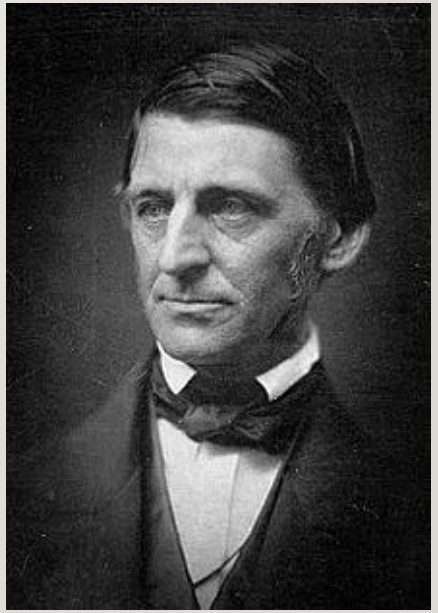
"The native cattle are extinct, but the island is full of artificial breeds. The agriculturalist Bakewell created sheep and cows and horses to order, and breeds in which everything is omitted but what is economical. The cow is sacrificed to her bag; the ox to his sirloin."

Ralph Waldo Emerson



EPD Basics and Beyond

Bob Weaber, Ph.D.

Professor and Head,

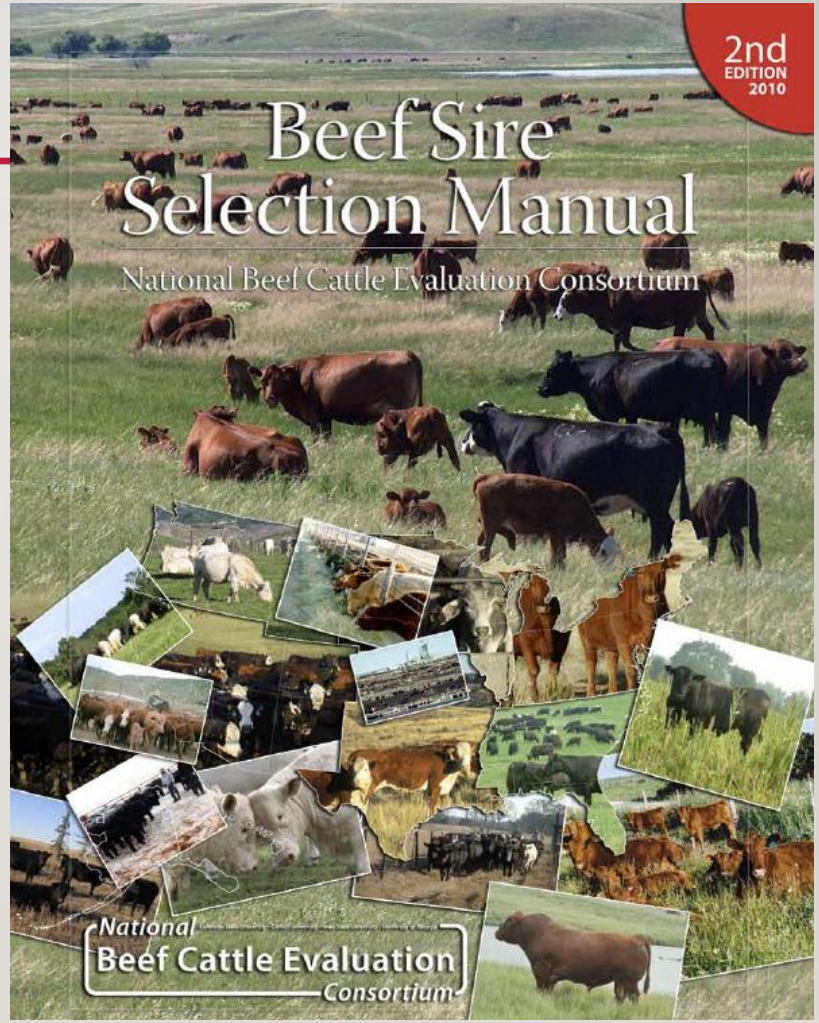
Eastern Kansas Research and Extension Centers

Kansas State University

3 SYSTEMATIC SIRE SELECTION

- Set Goals
- Assess Cow Herd
- Assess Resources
- Breed Selection
- Bull Selection
  - Reproduction
  - Structure
  - Performance
  - Visual Appraisal

http://www.nbcec.org/producers/sire.html



4 EBEEF.ORG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5 OVERVIEW

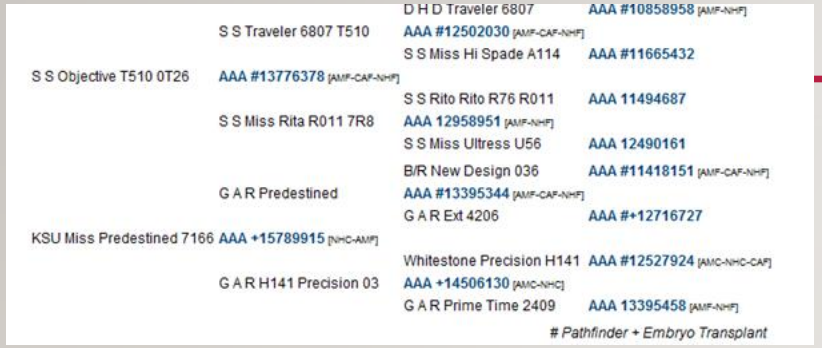
- Genetic Predictions for Selection
  - Basic model
  - Deciphering actual data, adjusted data, and ratios
  - Fundamentals of EPDs
  - Accuracy
  - Percentile Rank

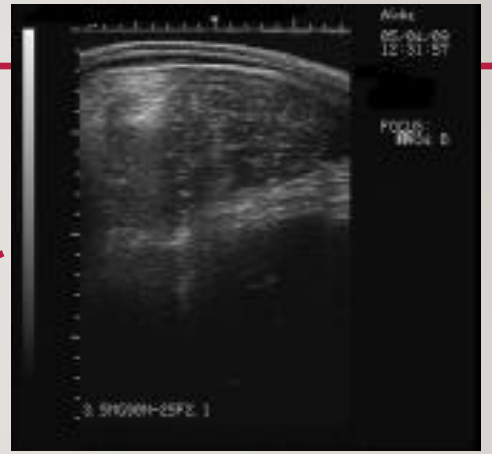
7 CURRENT OPPORTUNITIES

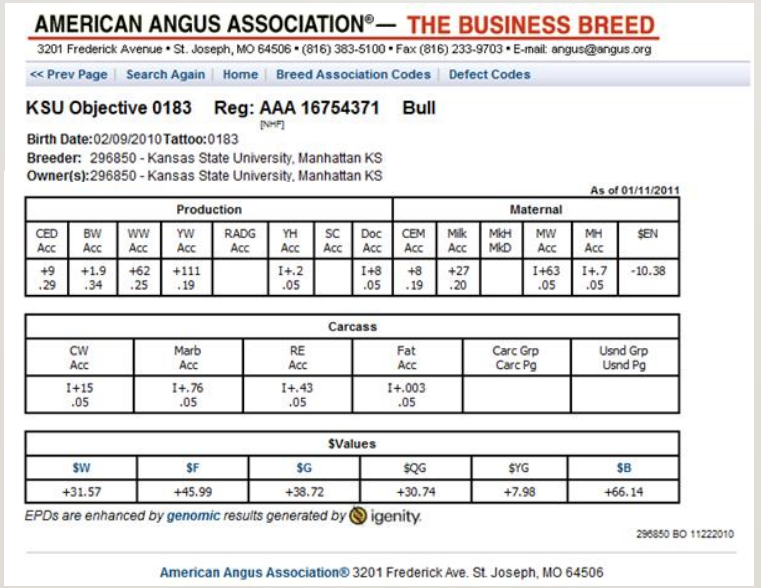
- Genetic improvement of beef cattle involves trade-offs between:
  - Accuracy of Selection
  - Intensity of Selection
  - Generation Interval
- Need to know:
  - as much as we can
  - about as many animals as we can
  - as quickly as we can

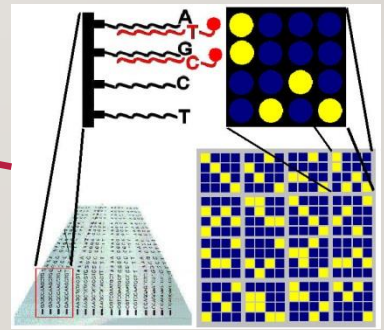
Moser, 2011

8 SOURCES OF INFORMATION



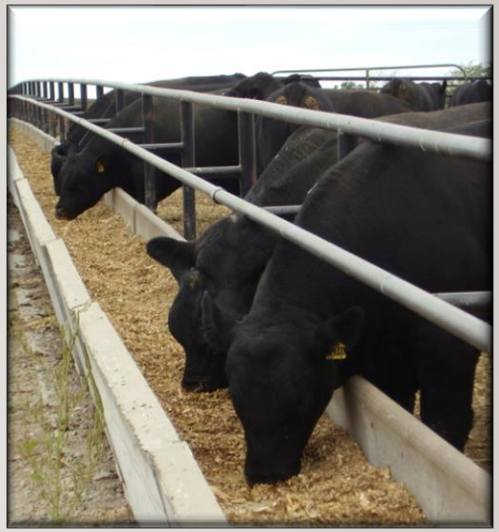






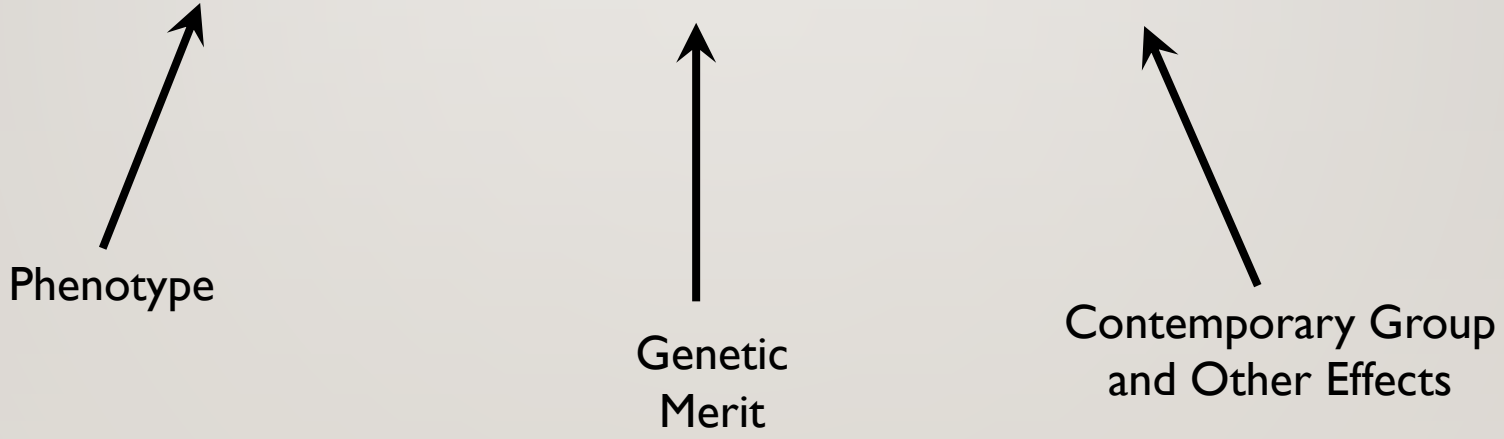
Moser, 2011

BEEF GENETICS BASICS



BASIC MODEL

$$P = G + E$$



BASIC MODEL

$$P = G + E$$

$$G = A + D + I$$

A = Breeding value (Additive gene effects)

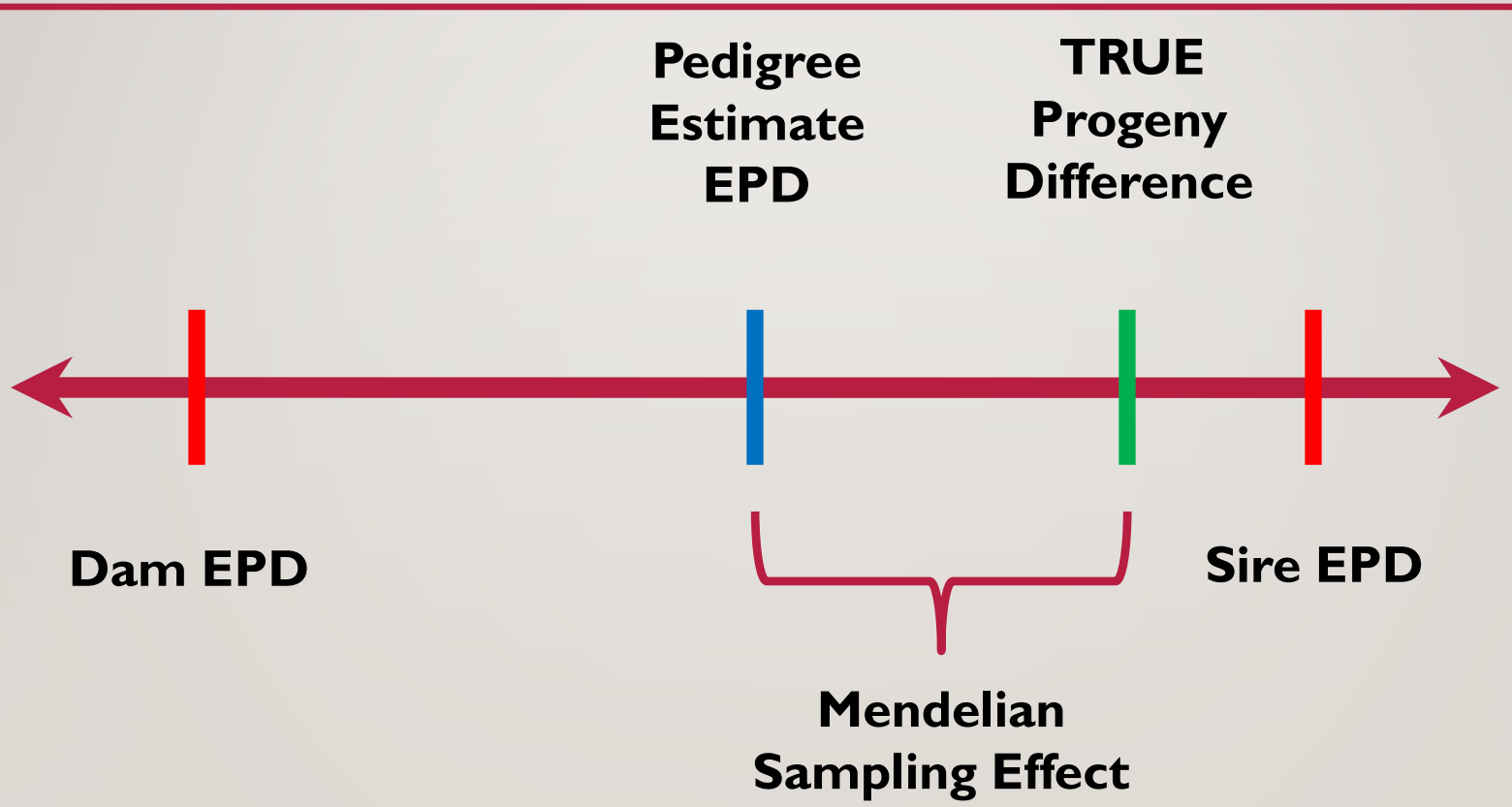
D = Dominance effects (pairing of genes effects)

I = Epistatic (interactions among genes)

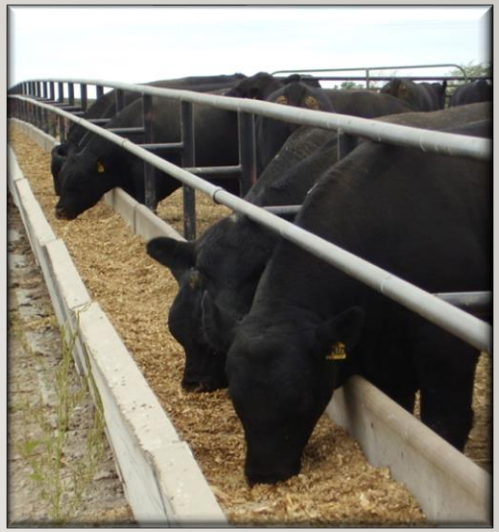
12 PHENOTYPIC VARIATION

- Animal to animal variation
  - Genetics
    - Additive (the stuff for which we select)
    - Non-additive (heterosis)
  - Environment
    - Forage resources
    - Dam milk production
  - Effects
    - Sex
    - Age of calf
    - Age of dam
- Adjust records to equalize animals for non-genetic effects which cause variation in phenotypes

FINDING TRUE GENETIC MERIT

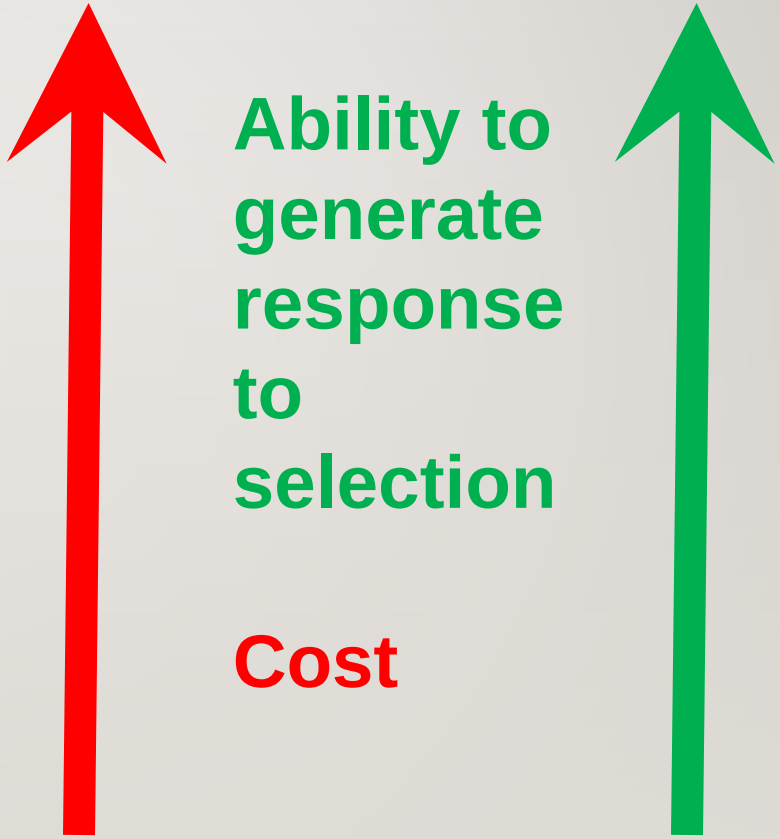


SELECTION TOOLS FOR BEEF CATTLE IMPROVEMENT



SIRE SELECTION TOOLS:

- DNA Markers
- EPD
- Ratios
- Adjusted weights
- Raw Weights
- Visual Appraisal



17 RAW DATA

- Includes all sources of variation
  - Management (i.e. feed)
  - Differences in age
  - Sex
  - Age of dam
  - Climate
  - Genetics

18 ADJUSTED DATA

- What is the data ‘adjusted’ for?
  - Sex
  - Age of calf
  - Age of dam
- Why?
  - Compare ‘apples to apples’

19 RATIOS

- A way of comparing animals within a contemporary group
  - Contemporary group average = 500
  - Animal = 550
  - Ratio = 110
    - (550/500)*100
- Why not outside of that group?
  - Different environmental influences
  - Group averages may not be equal

SOME INFORMATION JUST ISN'T THAT USEFUL…

21 EPD-EXPECTED PROGENY DIFFERENCE

- Separates the 'wheat from the chaff'
- What information is included?
  - Pedigree information
    - (Parents, grand-parents, half –sibs, etc.)
  - Individuals' own record (very important)
  - Progeny information
  - Correlated traits (BW, WW, YW)
  - REMOVES ENVIRONMENTAL EFFECTS
  - Can be used across herds but only within a breed

EPDS DEFINED

Expected

- Future, average, mean

Progeny

- Offspring

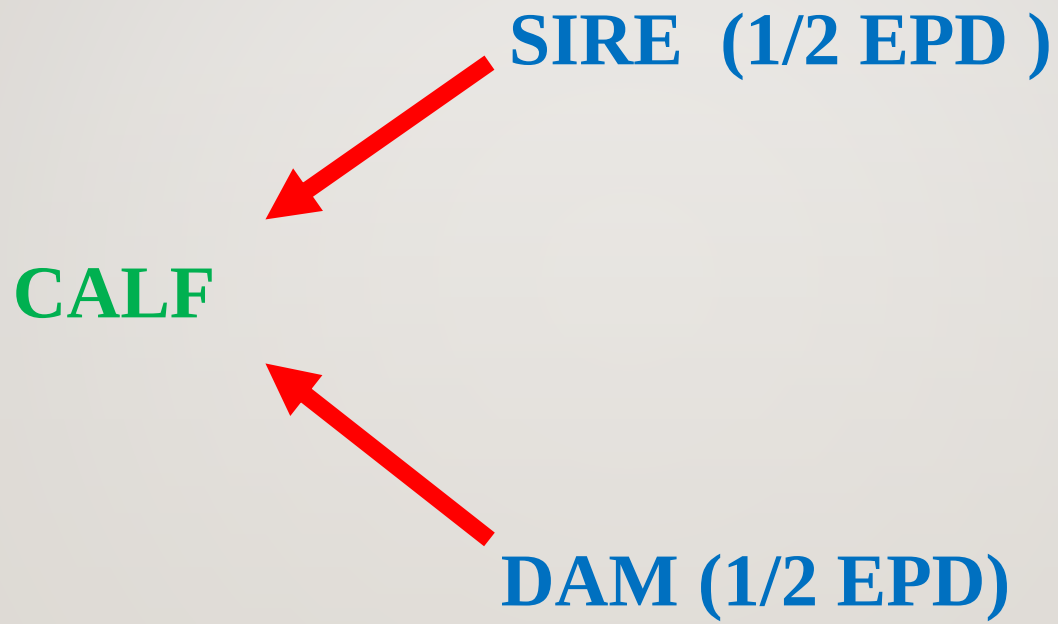
Difference

- Implies comparison between animals
- NOT phenotypic performance

- *Measure of relative merit among individuals*
- *Estimate of average effect of animal as parent*
- *Estimate of average gamete genetic merit*

23

PEDIGREE ESTIMATE EPDS



Pedigree Est. EPD = 1/2 Sire EPD + 1/2 Dam EPD

INDIVIDUAL RECORD

$$EPD_I = (0.5*EPD_S) + (0.5*EPD_D) + (0.5 *Mendelian\ Sampling\ Effect)$$

Mendelian sampling (MS) is the difference between an individual's EPD and its parent average or pedigree estimate (PE-EPD). In other words, how different is the progeny's genetic sampling from the average mating of these parents.

See Beef Improvement Federation Guidelines

25

PERFORMANCE OF THE PROGENY

Sire

Offspring of one sire exhibit more than ¾ diversity of the entire population

+30 lb

+15 lb

-10 lb

+ 5 lb

+10 lb

Progeny +10 lb

Garrick, 2013

26

WE LEARN ABOUT PARENTS FROM PROGENY

Sire

+30 lb

+15 lb

-10 lb

+ 5 lb

+10 lb

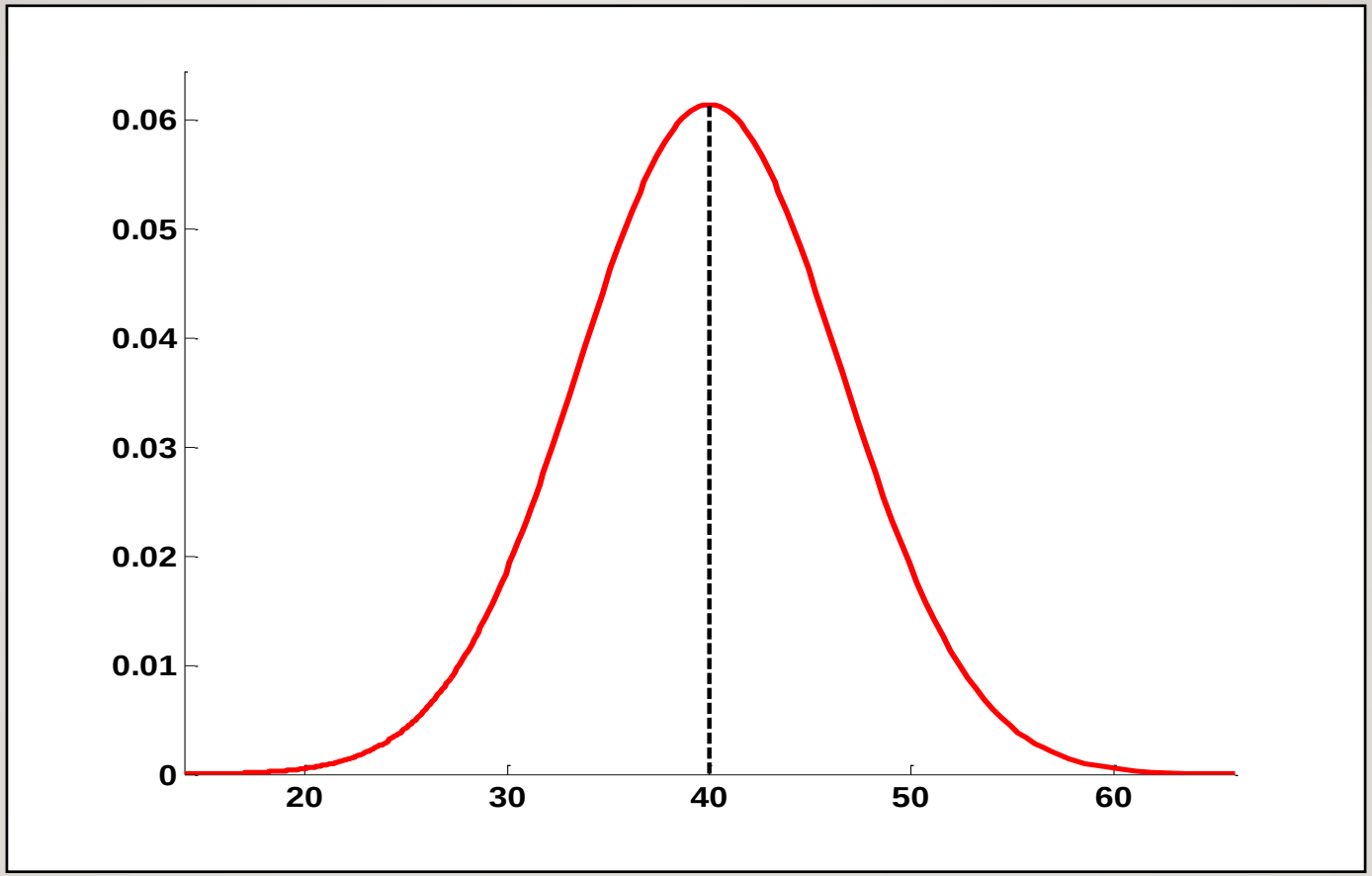
(EPD is “shrunk”)

Sire EPD +8-9 lb

Progeny +10 lb

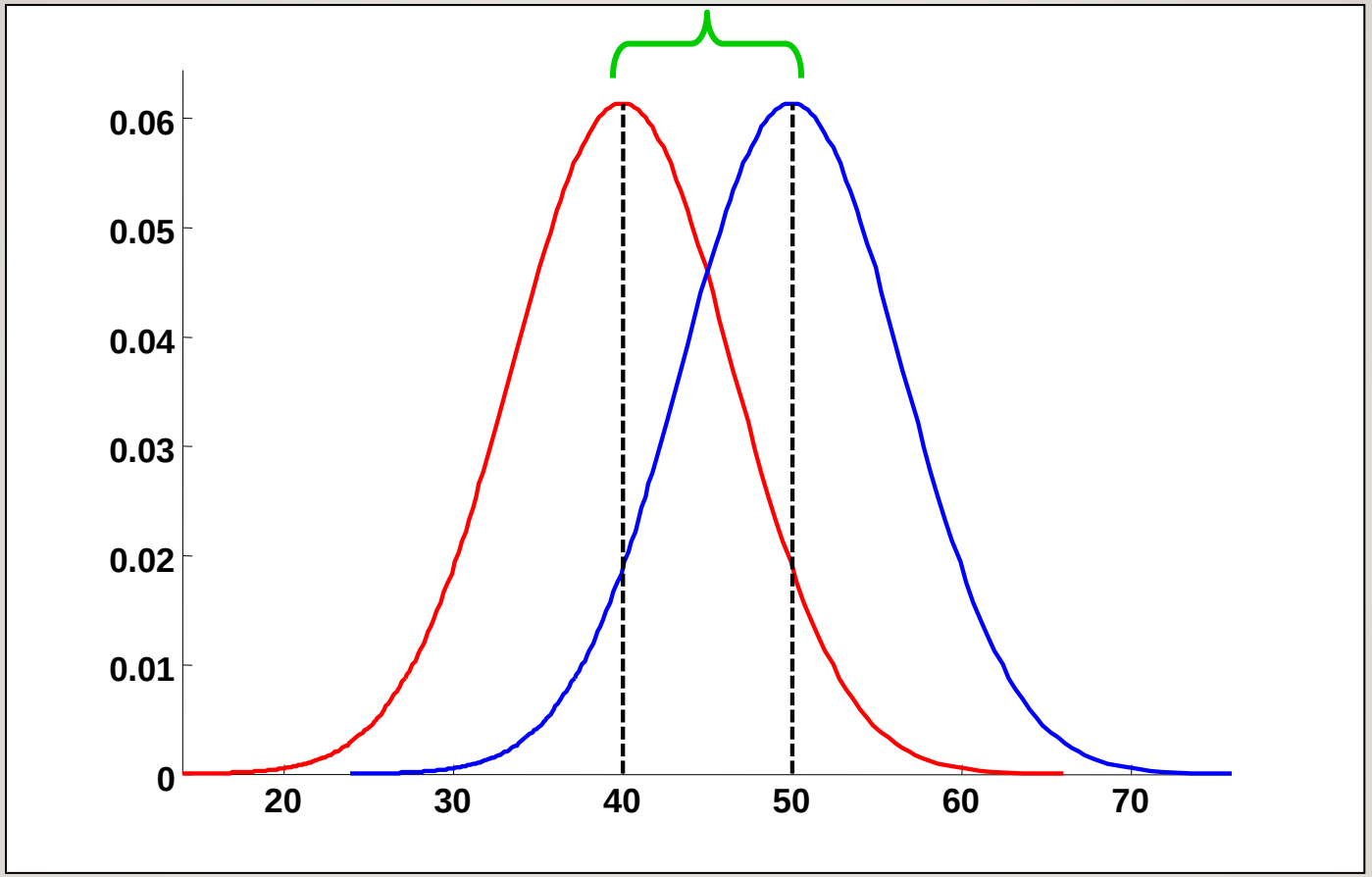
Garrick, 2013

27



Average value of gametes
EPD = 40

28



10 lb. Difference in EPD of Two Bulls

29

HOW EPDS ARE COMPUTED: CONTEMPORARY GROUP

- Consists of animals that are:
  - Given **equal** opportunity to perform
  - Of similar age and sex
- Identify fair competition
- Formed from management information
- The basis of all genetic comparisons

Phenotype = CG + Genetics

Genetics = Phenotype - CG

30 CONTEMPORARY GROUP TIPS

- Focus on exceptions to your typical management
  - Show cattle, sicks, ET, first calf heifers
- Ask "Were they given equal opportunity to perform?"
- Too many contemporary groups is BAD too!
- Report all calves in CG

31

WHOLE GROUP REPORTING

Weaning Weight Contemporary Example

Calf ID	Adj. 205d. Weight	All Calves Reported Deviation	All Calves Reported Ratio	Top Half Reported Deviation	Top Half Reported Ratio
1	524	-101	84		
2	562	-63	90		
3	578	-47	93		
4	605	-20	97		
5	606	-19	97		
6	639	14	102	-36	95
7	643	18	103	-32	95
8	655	30	105	-20	97
9	694	69	111	19	103
10	742	117	119	67	110
Average Deviation and Ratio		**0**	**100**	**0**	**100**
Average Weight		**625**		**675**	

32 EFFECT OF INCOMPLETE REPORTING

Calf ID	Adj. 205d. Wt.	WCG Dev	PCG Dev	Sire WW EPD	Dam WW EPD	Dam MILK EPD	Dam PPA	WCG Int EPD	PCG Int EPD	Diff
1	524	-101		40	30	10	50	24		NA
2	562	-63		40	30	10	50	28		NA
3	578	-47		40	30	10	50	30		NA
4	605	-20		40	30	10	50	33		NA
5	606	-19		40	30	10	50	33		NA
6	639	14	-36	40	30	10	50	37	31	-5
7	643	18	-32	40	30	10	50	37	32	-5
8	655	30	-20	40	30	10	50	38	33	-5
9	694	69	19	40	30	10	50	42	37	-5
10	742	117	67	40	30	10	50	47	42	-5
Average		0	0	40	30	10	50	35	35	-5
Average		625	675					40		

HOW DO WE COMPARE BULLS ACROSS HERDS?

- Idea of connectedness
- Reference sires … Compare A to F by competition

Herd 1 CG1

Bull	Progeny
A	10
B	8
C	2

Herd 1 CG2

Bull	Progeny
B	7
C	15
D	6

Herd 2 CG1

Bull	Progeny
D	8
E	11
F	3

Herd 3 CG1

Bull	Progeny
E	8
F	11
G	3

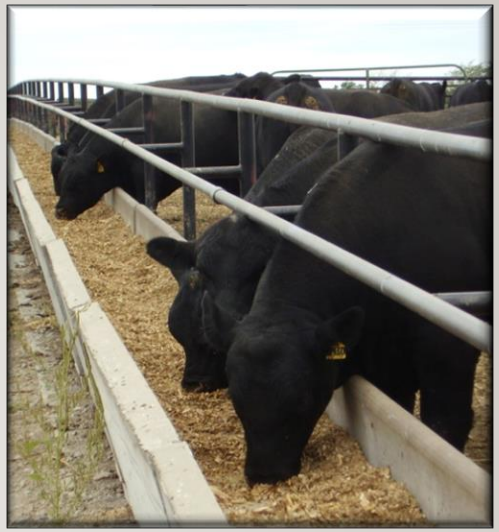
Herd 4 CG1

Bull	Progeny
B	10
D	9
F	13

Herd 5 CG1

Bull	Progeny
F	18
G	11
H	13

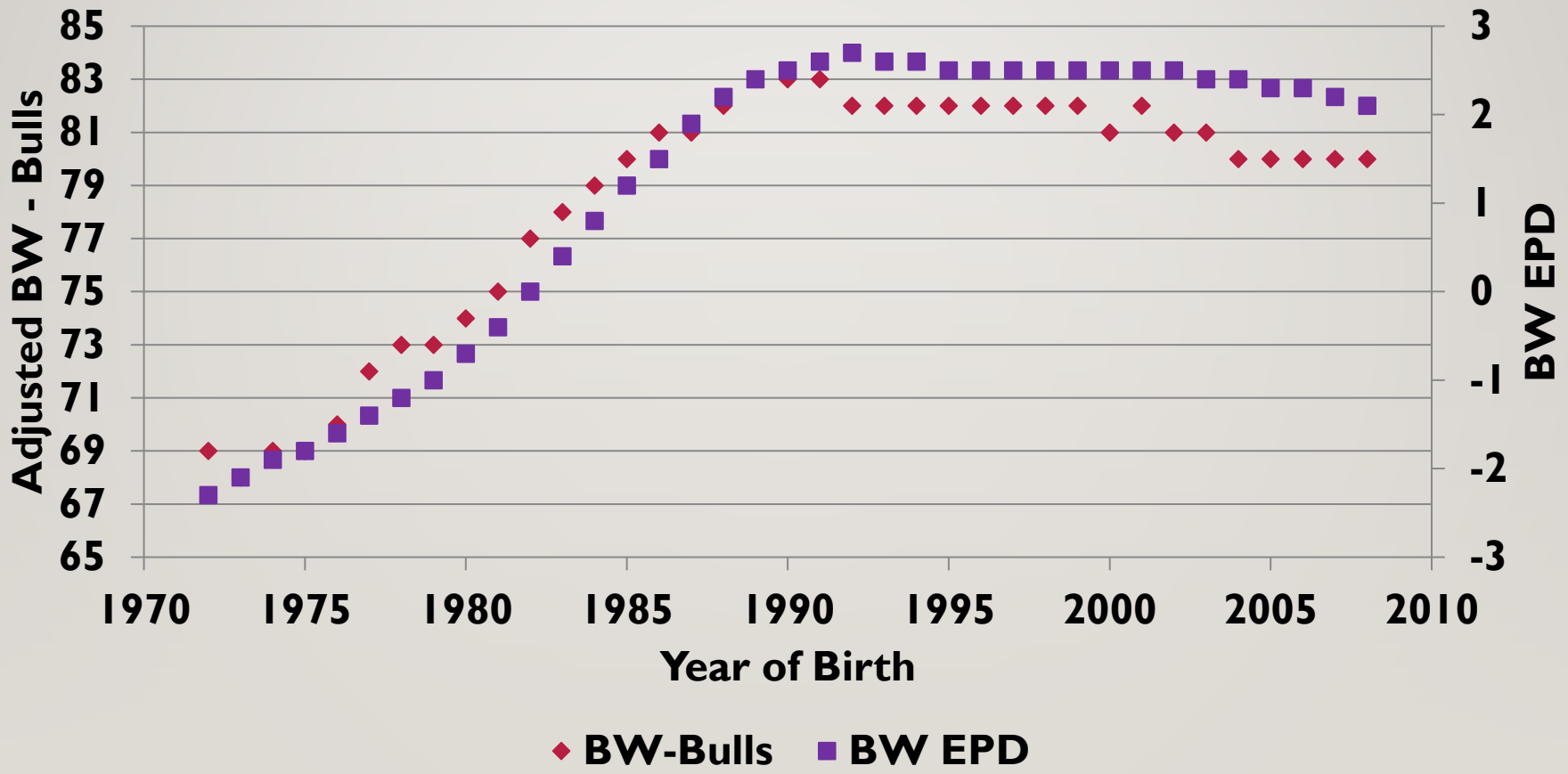
DO EPDS WORK??



EPDS WORK…

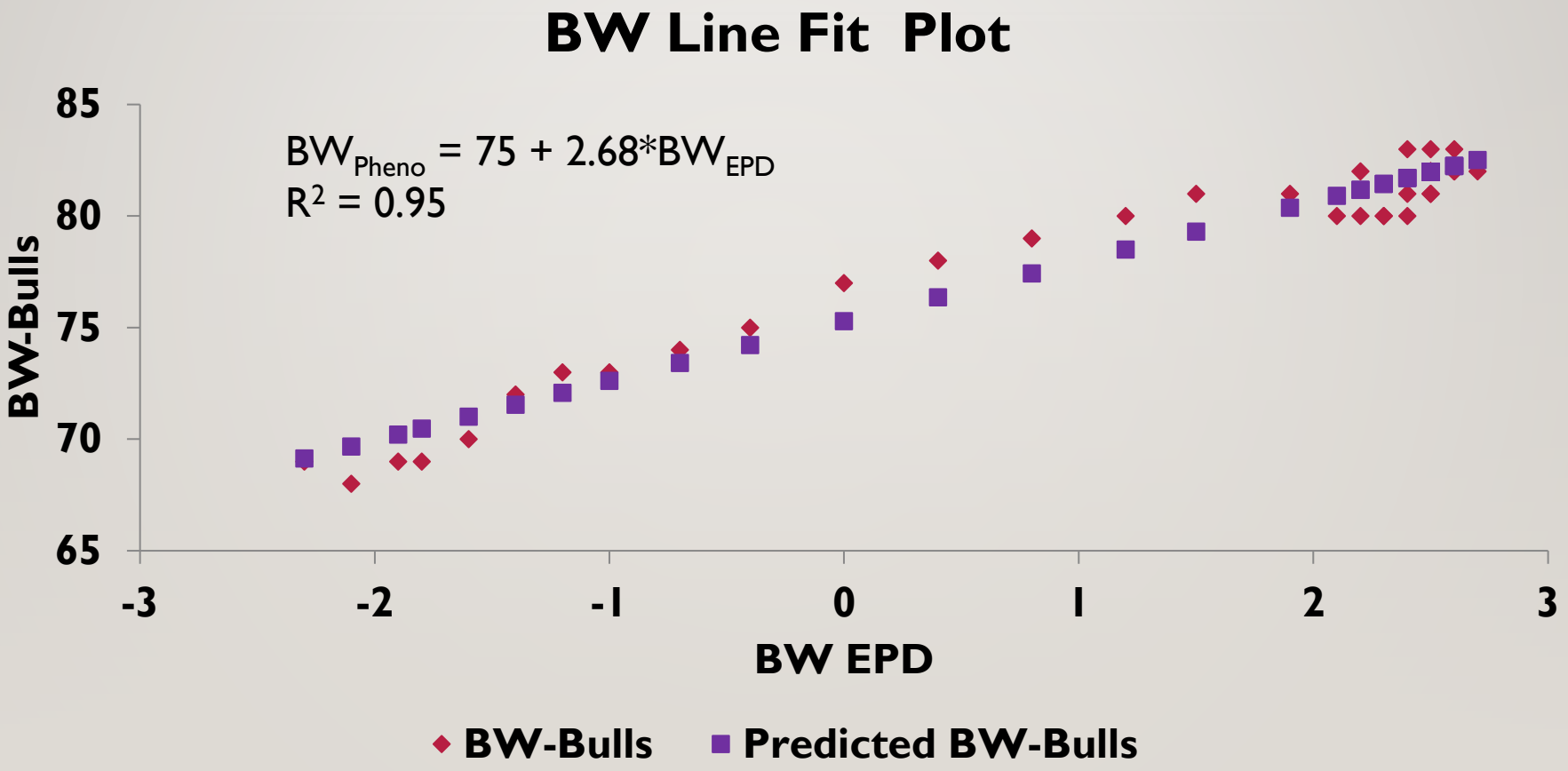
- Much more effective generating response to selection than phenotypic selection
- Can be used to:
  - Increase performance
  - Decrease performance
  - Optimize performance
- Do not select for maximum genetic expression w/o regard to other factors
  - Nutritional conditions

36 BIRTH WEIGHT PHENOTYPIC AND GENETIC TREND



Data Source: 2009 Am. Angus Sire Evaluation Report; Phenotypic and Genetic Trends

37 EPDS WORK—SELECTION FOR BIRTH WEIGHT



Data Source: 2009 Am. Angus Sire Evaluation Report; Phenotypic and Genetic Trends

US-MARC AB-EPD

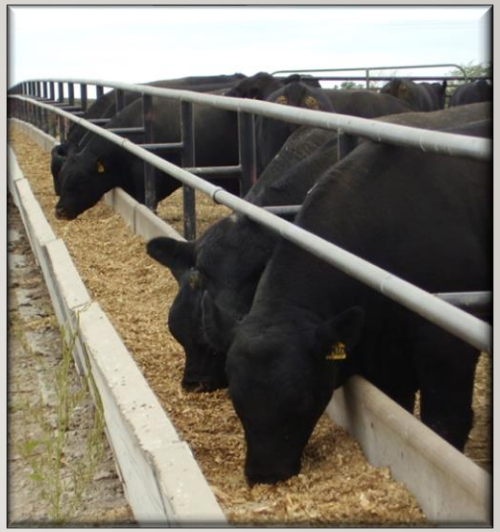
Table 11. Pooled and within-breed regression coefficients (lb/lb) for weights at birth (BWT), 205 days (WWT), and 365 days (YWT) of F_1 progeny and for calf weights (205 d) of F_1 dams (MILK) on sire expected progeny difference and by sire breed

	BWT	WWT	YWT	MILK
Pooled	1.17 ± 0.04	0.80 ± 0.03	0.98 ± 0.04	1.11 ± 0.07
Sire breed				
Angus	1.06 ± 0.09	0.83 ± 0.06	1.18 ± 0.07	1.08 ± 0.15
Hereford	1.16 ± 0.07	0.71 ± 0.05	1.00 ± 0.06	1.03 ± 0.15
Red Angus	1.01 ± 0.14	0.74 ± 0.13	0.61 ± 0.15	1.34 ± 0.26
Shorthorn	0.75 ± 0.21	0.52 ± 0.14	0.55 ± 0.17	1.00 ± 0.43
South Devon	-0.24 ± 0.53	0.80 ± 0.29	0.50 ± 0.32	1.08 ± 1.06
Beefmaster	2.08 ± 0.33	0.98 ± 0.21	0.76 ± 0.31	3.41 ± 0.67
Brahman	1.93 ± 0.21	1.08 ± 0.18	1.36 ± 0.22	0.09 ± 0.62
Brangus	1.49 ± 0.23	0.74 ± 0.20	0.81 ± 0.18	0.28 ± 0.58
Santa Gertrudis	3.75 ± 0.71	1.31 ± 0.25	1.15 ± 0.29	0.78 ± 1.00
Braunvieh	0.88 ± 0.26	0.63 ± 0.28	0.31 ± 0.27	1.54 ± 0.65
Charolais	1.14 ± 0.12	0.96 ± 0.11	0.86 ± 0.12	1.06 ± 0.22
Chiangus	1.44 ± 0.30	0.13 ± 0.24	0.35 ± 0.28	0.19 ± 0.41
Gelbvieh	1.05 ± 0.14	0.81 ± 0.11	1.15 ± 0.12	0.84 ± 0.25
Limousin	1.11 ± 0.11	0.80 ± 0.07	0.86 ± 0.09	1.42 ± 0.21
Maine Anjou	1.40 + 0.18	0.97 + 0.19	0.83 + 0.24	2.02 + 0.39
Salers	1.26 + 0.23	0.82 + 0.25	0.60 + 0.24	1.70 + 0.38
Simmental	1.16 + 0.14	1.44 + 0.12	1.33 + 0.12	0.95 ± 0.30
Tarentaise	0.70 + 0.59	1.07 + 0.24	1.55 + 0.37	1.49 + 0.81

39 EPDS-ONE TOOL IN THE TOOL BOX

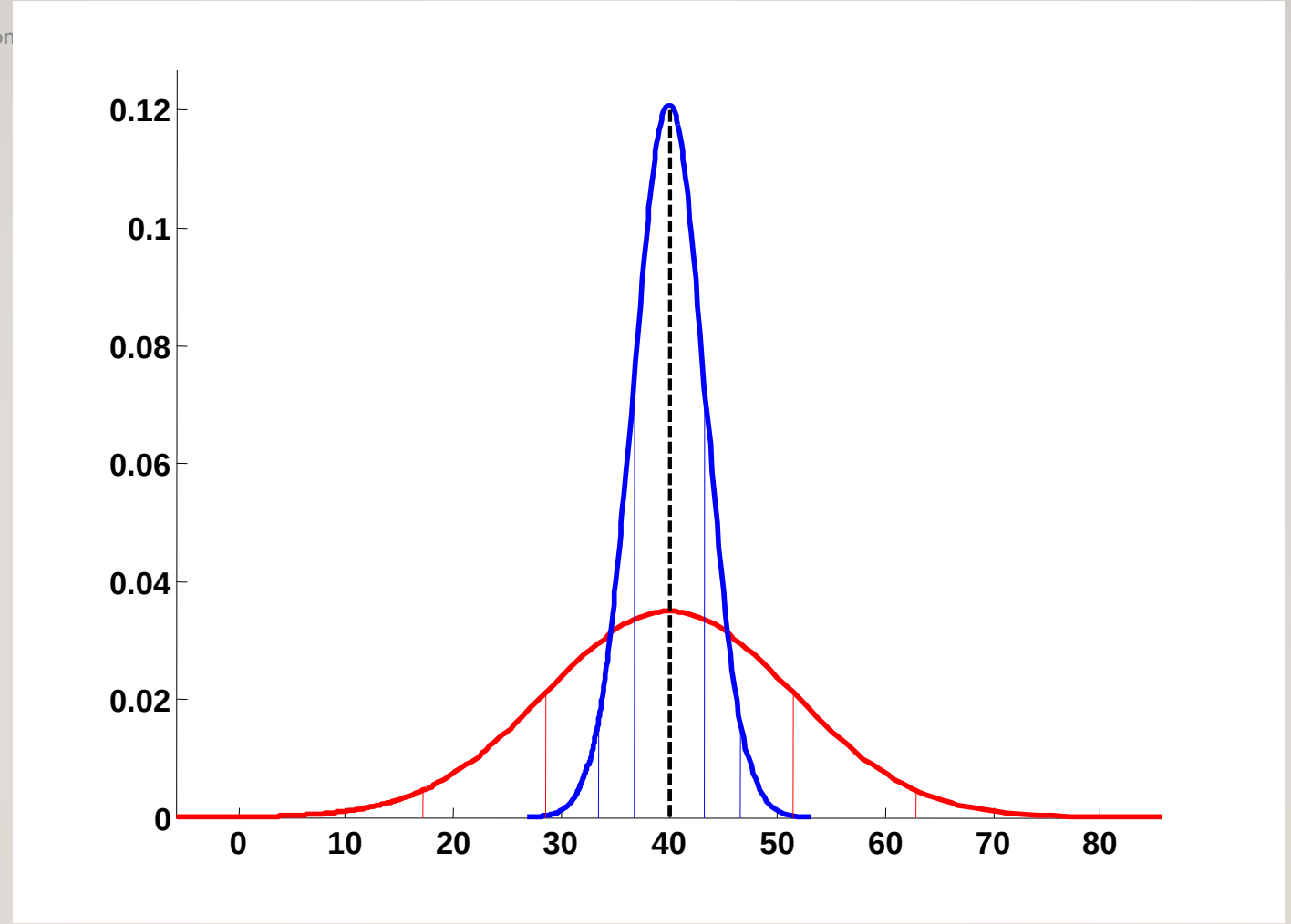
- Selection is challenging
- Not all economically important traits have EPD
  - Fertility
  - Disease resistance
  - Fescue fitness
  - Conformation traits
  - Mature weight
- Use the right tool for job!
- Multiple trait selection

CONCEPT OF ACCURACY



41 ACCURACY

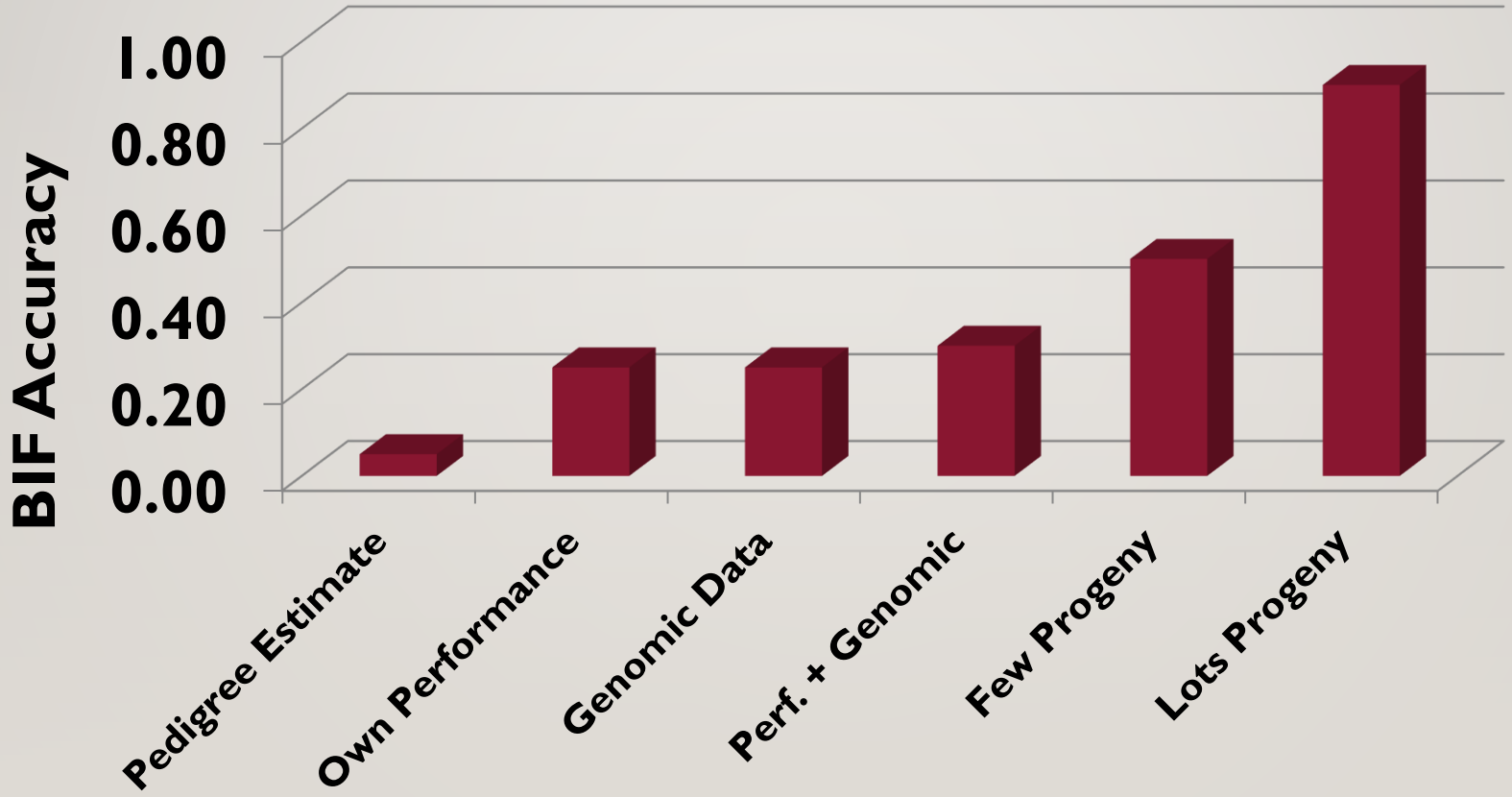
- Measure of reliability of EPD
  - How much data was included in making the EPD
    - 0.05 Pedigree estimate
    - 0.30 Own performance plus pedigree info.
    - 0.90 Lots of progeny data
- As Prediction Error Variance goes to zero accuracy goes to 1.00



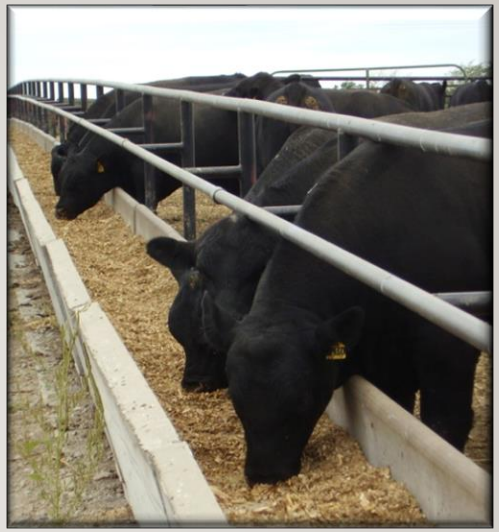
Difference in EPD Accuracy

Acc = 0.30, SEP = 11.4 **Acc = 0.8, SEP = 3.3**

SOURCES OF INFORMATION



PERCENTILE RANK



46 PERCENTILE RANK

- Locates a bull's EPD relative to other bulls in the breed.
- EPD at upper 25th percentile
  - 24 out of 100 bulls better
  - 75 out of 100 bulls worse
- Easy way to evaluate the where bull ranks in breed
- Use Non-Parent percentiles for yearlings
- Measure of 'extremeness'

International Cattle Evaluation - Run Date: 102720

Statistical Breakdown

Non-Parents

Expected Progeny Differences

	Growth and Maternal											Intake and Carcass				
	GEST	CED	BW	WW	YW	Milk	TM	CEM	SC	STAY	DOC	YG	CW	CREA	MARB	CFAT
Num Animals	12263	12639	12639	12639	12639	12639	12639	12639	11453	12639	12639	12639	12639	12639	12639	12639
High	0.6	20	11.7	96	156	41	75	13	2.3	24	24	0.03	58	1.86	0.61	0.01
Average	-2.7	9	2.3	60	85	23	53	5	0.6	13	10	-0.78	13	1.21	-0.50	-0.17
Low	-7.2	-6	-5.9	20	19	0	22	-6	-0.9	1	-17	-1.10	-27	-0.07	-0.85	-0.23
1%	-5.4	15	-2.0	83	123	34	67	10	1.4	21	19	-0.94	35	1.53	-0.05	-0.21
2%	-5.0	15	-1.5	81	118	32	65	9	1.3	20	18	-0.93	32	1.49	-0.17	-0.20
3%	-4.8	14	-1.1	78	115	31	64	9	1.2	19	18	-0.92	31	1.47	-0.25	-0.20
4%	-4.6	14	-0.9	77	113	31	64	9	1.2	19	17	-0.92	30	1.45	-0.28	-0.20
5%	-4.5	13	-0.7	76	111	30	63	9	1.2	18	17	-0.91	29	1.44	-0.31	-0.20
10%	-4.1	12	0.1	72	105	29	61	8	1.0	17	16	-0.89	25	1.37	-0.38	-0.19
15%	-3.9	12	0.5	69	101	27	59	7	0.9	16	15	-0.86	22	1.34	-0.42	-0.18
20%	-3.6	11	0.9	68	98	27	58	7	0.8	16	14	-0.85	20	1.31	-0.44	-0.18
25%	-3.5	11	1.2	66	95	26	57	7	0.8	15	13	-0.84	19	1.29	-0.46	-0.18
30%	-3.3	10	1.5	65	93	25	56	6	0.7	15	13	-0.83	17	1.27	-0.47	-0.17
35%	-3.2	10	1.7	63	91	25	55	6	0.7	15	12	-0.82	16	1.26	-0.49	-0.17
40%	-3.0	9	1.9	62	89	24	54	6	0.6	14	12	-0.81	15	1.24	-0.50	-0.17
45%	-2.9	9	2.2	61	87	23	54	6	0.6	14	11	-0.81	14	1.23	-0.51	-0.17
50%	-2.8	9	2.4	60	85	23	53	5	0.6	13	11	-0.80	13	1.21	-0.52	-0.17
55%	-2.6	8	2.6	59	83	22	52	5	0.5	13	10	-0.79	12	1.20	-0.53	-0.17
60%	-2.5	8	2.8	58	81	22	51	5	0.5	13	10	-0.78	11	1.18	-0.54	-0.16
65%	-2.3	8	3.0	56	79	21	50	5	0.5	12	9	-0.77	10	1.17	-0.54	-0.16
70%	-2.2	7	3.3	55	77	21	50	4	0.4	12	9	-0.76	9	1.15	-0.55	-0.16
75%	-2.0	7	3.5	54	75	20	49	4	0.4	12	8	-0.75	8	1.13	-0.56	-0.16
80%	-1.8	7	3.8	52	72	19	48	4	0.4	11	7	-0.73	7	1.11	-0.58	-0.15
85%	-1.6	6	4.1	51	70	18	46	3	0.3	10	6	-0.71	5	1.08	-0.59	-0.15
90%	-1.2	5	4.5	49	66	17	45	3	0.2	10	5	-0.68	3	1.04	-0.61	-0.15
95%	-0.7	4	5.2	45	61	15	42	2	0.2	8	3	-0.62	1	0.96	-0.63	-0.14

THANK YOU!

QUESTIONS?

BOB WEABER, PH.D.

KANSAS STATE UNIVERSITY

785-532-1460

BWEABER@K-STATE.EDU