

The Power of Economic Selection Indices to Make Genetic Change in Profitability

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History of Selection

- Visual Appearance/Local Adaptation – Breed Creation



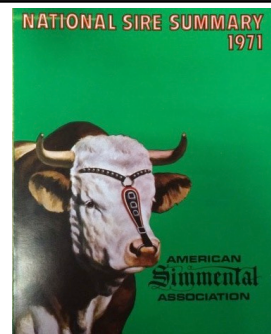
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- Actual Performance – Robert Bakewell, Jay Lush



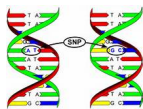
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- Visual Appearance/Local Adaptation – Breed Creation
- Actual Performance – Robert Bakewell, Jay Lush
- Breeding Values (EPD) – C. R. Henderson



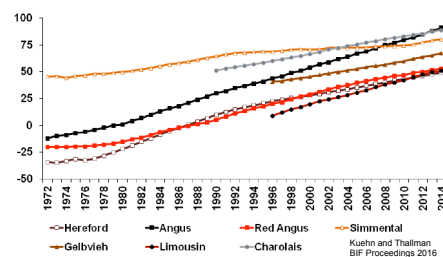
History of Selection

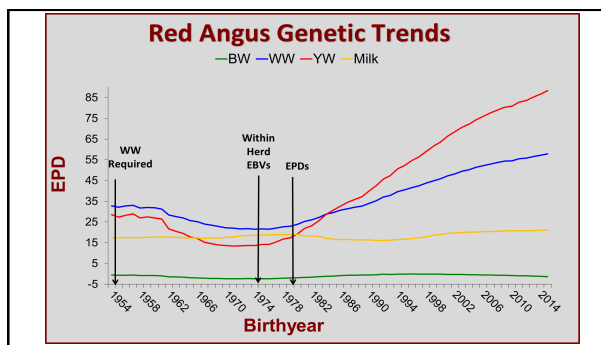
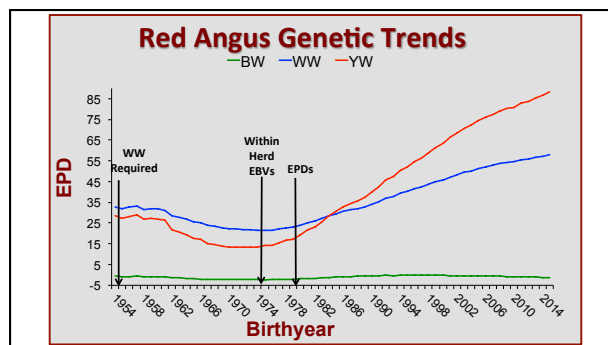
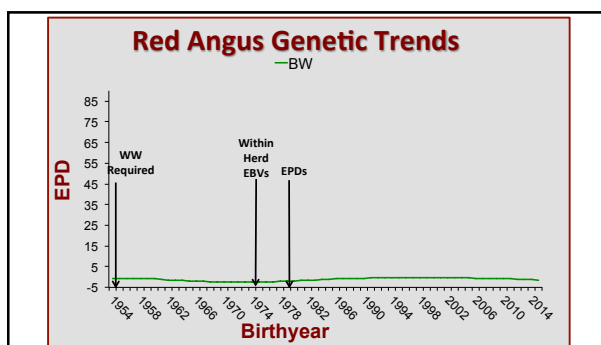
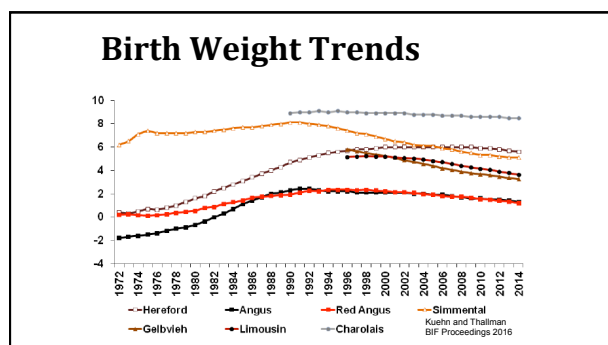
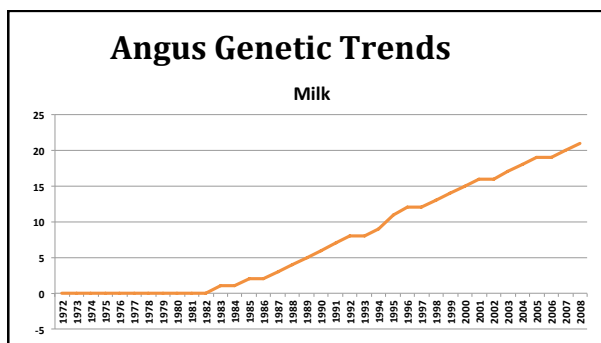
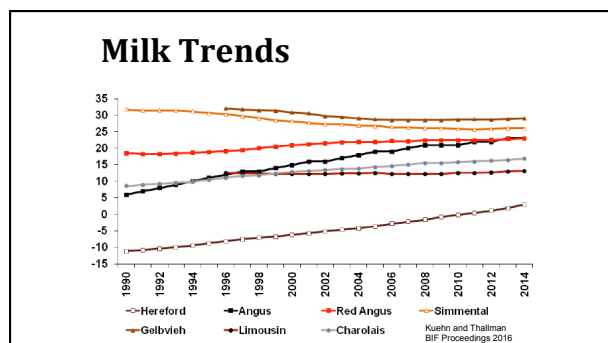
- Visual Appearance/Local Adaptation – Breed Creation
- Actual Performance – Robert Bakewell, Jay Lush
- Breeding Values (EPD) – C. R. Henderson
- Inclusion of Genomics – Molecular Enhanced EPDs



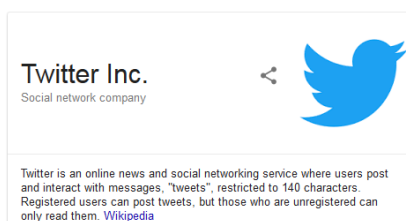
+ Data + Pedigree = EPD

Yearling Weight Trends





- Visual
- Visual + Actual Weights
- Visual + Adjusted Weights and Ratios
- Visual + EPDs
- Visual + EPDs (ERTs)
- Visual + Genomically Enhanced EPDs
- Visual + Selection Indices

[illegible]

Lot	Performance EPDs										Carcass EPDs		\$ Index	Pedigree
	CE	WW	BW	YW	ADG	MILK	Marb	RE	SI	SC	YGL	SPR		
5	11	8	58	102	20	34	1.19	78	363	5134	-14	234-606	<div><div><div>G A R PROCESS</div><div>G A R ADVANCE</div><div>G A R \$500 NEW DESIGN A04</div><div>BROWN-MCCADVANCE 8414C</div><div>B/R NEW DAY 454</div><div>G A R NEW DAY A1044</div><div>G A R OBJECTIVE 1106</div></div><div><div>G A R PREDESTINED</div><div>G A R OBJECTIVE 2345</div><div>G A R NEW DESIGN 5050</div><div>G A R OBJECTIVE A655</div><div>BOTO NEW DAY 8005</div><div>B/R RUBY 1234</div><div>S3 OBJECTIVE 1510 0716</div><div>G A R PRECISION 1142</div></div></div>	
	15%	40%	15%	15%	60%	2%	3%	20%	10%	5%	32%	1%		
Tattoo	DOB	Reg #	C Exar	Growth	Carcass	Milk	Consume	Hard						
5414C	9/10/15	116650414	****	****	****	****	GGFD	MIC						

Here is one of the highest \$Profit bulls in the sale. We invested in the \$Profit genetic evaluation in order to get multi-breed EPDs for all traits including feed efficiency and \$Profit. The AAA data & EPDs are excellent. We just want to get a 3rd Party genetic evaluation that will compare all 4 of our breeds on the same database. \$Profit is a great tool to use for selecting the most profitable cattle. If you need growth & marketing this calving ease bull should do the trick. 5 generations of Carcass genetics!

SI difference is expected value difference per calf

Bull B has \$7/calf increased value

Why Selection Indices?

- Profit Motivated

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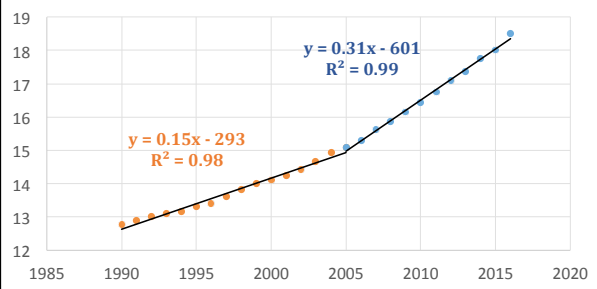
$$\text{Profit} = \text{Income} - \text{Costs}$$

Why Selection Indices?

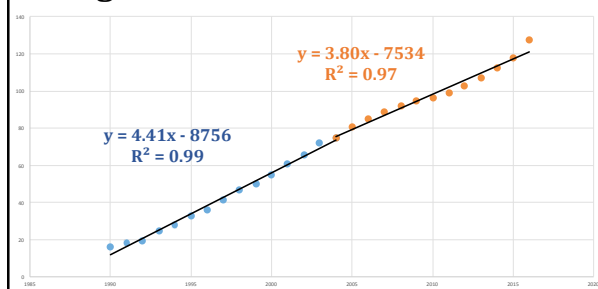
- Profit Motivated
- Breeding Objectives Compatible
- Multi-trait Selection
- Simple

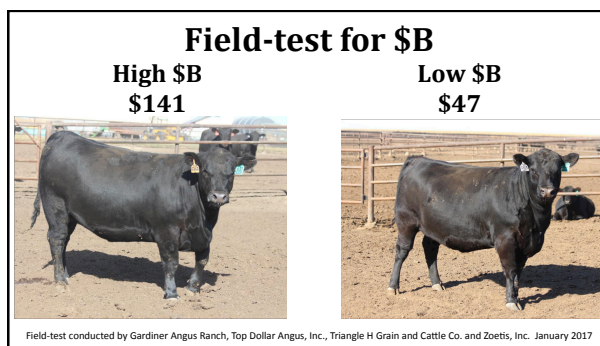
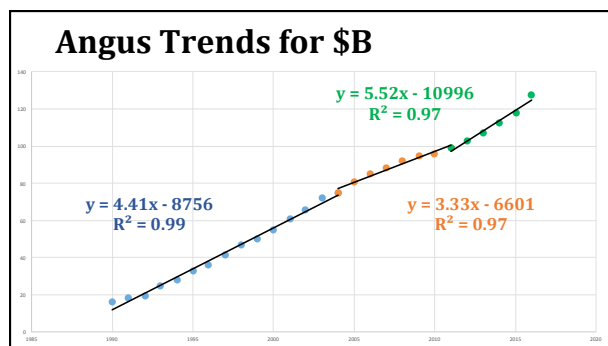
Do Selection Indices Work?

Hereford Trends for BMI



Angus Trends for \$B





Field-test for \$B

Expected Difference Based on \$B values = \$187.38

Actual Difference in Carcass Value = \$215.47

Field-test conducted by Gardiner Angus Ranch, Top Dollar Angus, Inc., Triangle H Grain and Cattle Co. and Zoetis, Inc. January 2017.

<http://www.cattlenetwork.com/sites/protein/files/Field%20Test%20%24Beef.pdf>

What is Available

- Terminal Index
- Weaning/Replacement Index
- All-Purpose Index

Terminal Index

- Income based on carcass merit
- No replacements retained

Index	Trait						
	CED	BW	WW	YW	Intake	PWG	CW
Angus							
\$Feedlot			X	X	X		
\$Grid							X
\$Beef			X	X	X		X
Beefmaster							
Terminal			X	X			X
Charolais							
Terminal Sire Profit		X	X	X			X
Gelbvieh							
FPI	X		X		X	X	X
EPI				X	X	X	

	Trait								
Index	CED	BW	WW	YW	Intake	PWG	CW	Quality	Yield
Hereford									
Cert Hereford Beef	X		X	X			X	X	X
Limousin									
Mainstream Term			X	X			X	X	X
Red Angus									
GridMaster			X	X	X		X	X	X
Simmental									
Terminal	X		X		X	X	X	X	X
Shorthorn									
Feedlot	X		X	X			X	X	X
Industry Indices									
Method QPI						X	X	X	X

Terminal Index

- Income based on carcass merit
- No replacements retained
- Caution – most place little to no emphasis on calving ease
- Intake is component of many, but not all

Weaning/Replacement Index

- Targeted for commercial cow/calf cattlemen
- Calves marketed at weaning
- Replacement heifers are retained



Index	Trait								
	CED	BW	CEM	WW	YW	Milk	HP	SC	Mat
Angus									
\$Wean		X		X		X			X
Beefmaster									
Maternal				X	X	X		X	
Shorthorn									
\$CEZ	X				X				
Industry									
Method MPI	X		X	X		X	X		X

Fertility?

Maintenance?

Weaning/Replacement Index

- Targeted for commercial cow/calf cattlemen
- Calves marketed at weaning
- Replacement heifers are retained
- Calving ease is considered, but may not be adequate if large numbers of heifers are to be bred
- Limited influence of reproductive performance
- Limited influence of cow maintenance
- Little emphasis on calving ease maternal

All-Purpose Index

- Income primarily based on carcass merit
- Replacement heifers are retained



Index	Trait										
	CED	CEM	WW	Milk	Fert	PWG	FE	IMW	CW	Qual	Yield
Getzvieh											
\$Cow	X	X	X	X	X	X	X	X		X	X
Hereford											
Baldy Maternal	X	X	X	X	X	X			X	X	X
Calving Ease	X	X	X		X				X	X	X
Brahman Infl	X	X	X		X				X	X	X
Red Angus											
HerdBuilder	X	X	X	X	X	X		X	X	X	X
Simmental											
All Purpose	X	X	X	X	X	X	X	X	X	X	X
Shorthorn											
\$BMI	X	X	X	X		X			X	X	X
Industry Indices											
Method ROI	X	X	X		X	X		X	X	X	X
Dollar Profit	X	X	X	X	X	X	X	X	X	X	X

All-Purpose Index

- Income primarily based on carcass merit
- Replacement heifers are retained
- Calving ease emphasis varies
- Limited information on feed efficiency/intake
- Limited information on cow maintenance
- Varying levels of information on reproductive performance

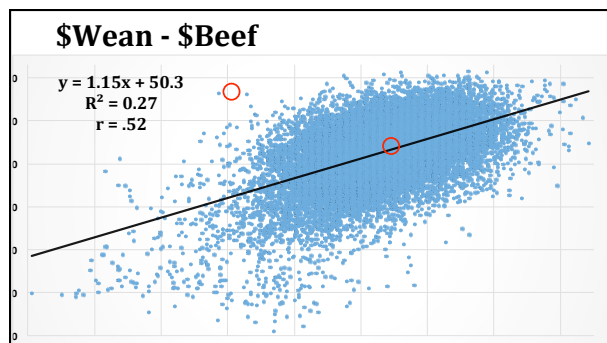
Keys to Successful Implementation

- Develop breeding objectives
 - Management
 - Marketing
 - Environment
- Identify selection index that most closely matches your breeding objectives

\$Wean - \$Beef

- \$Wean
 - Birth Wt, Wean Wt, Milk, Mature Size
- \$Beef
 - Wean Wt, Year Wt, Intake, Carc Wt, Quality, Yield

Correlation \$W-\$B = .52



Outlier Bull

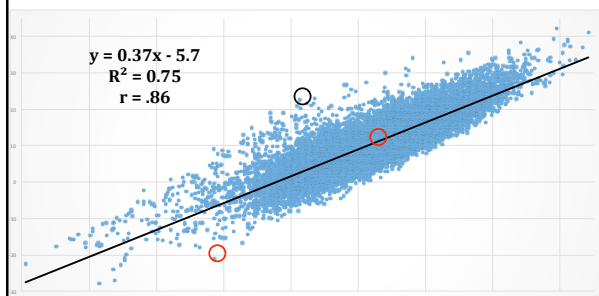
- \$W = -\$2.78
 - Off the percentile chart on the bottom side
- \$B = \$172.25
 - Off the percentile chart on the top side

\$Wean - \$AP1

- \$Wean
 - Birth Wt, Wean Wt, Milk, Mature Size
- \$AP1
 - \$W50\$B50

Correlation \$W-\$AP1 = .87

\$Wean - \$AP1



Outlier Bull

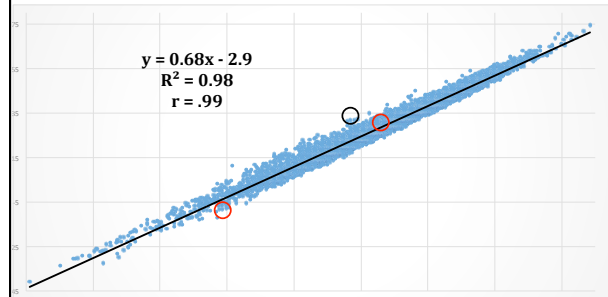
- \$W = \$22.68
 - \$24 below population average
- \$AP1 = \$22.68
 - \$11 above population average

\$Wean - \$AP2

- \$Wean
 - Birth Wt, Wean Wt, Milk, Mature Size
- \$AP2
 - \$W75\$B25

Correlation \$W-\$AP2 = .97

\$Wean - \$AP2



Outlier Bull

- \$W = \$35.93
 - \$10 below population average
- \$AP2 = \$31.28
 - \$2 above population average

Keys to Successful Implementation

- Develop breeding objectives
 - Management
 - Marketing
 - Environment
- Identify selection index that most closely matches your breeding objectives
- Be cautious of traits, included in the index, that do not have a economic (income/cost) value to your production system

Keys to Successful Implementation

- Don't make the mistake of 'sitting on the sidelines' if the selection index scenario doesn't perfectly match your operation
- Do not panic if market values change; selection indices are robust

Red Angus Correlation

- HB vs HB without CED: 0.97
- HB vs HB without WW or ADG: 0.93
- HB vs HB without Carcass (Marb & YG): 0.99
- HB vs HB without Carcass or Feedyard: 0.89
- HB vs HB without STAY: 0.74

Build an Index Workshop 2015 Red Angus Summit

Allow Audience to Change the Index Economic Weighting Factors and Evaluate the Difference in the Resulting Indices.

Audience Developed Indices

All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting

Audience Developed Indices

All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wting (0 to 10)				

Audience Developed Indices				
All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wtng (0 to 10)	7			

Audience Developed Indices				
All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wtng (0 to 10)	7	2		

Audience Developed Indices				
All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wtng (0 to 10)	7	2	5	

Audience Developed Indices				
All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wtng (0 to 10)	7	2	5	9

Audience Developed Indices				
All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wtng (0 to 10)	7	2	5	9
EPDs for each ERT	CED	BW		

Audience Developed Indices				
All Purpose A				
ERT	Calving Ease Weighting	Growth Weighting	Carcass Weighting	Repro Weighting
ERT Wtng (0 to 10)	7	2	5	9
EPDs for each ERT	CED	BW	WW	YW

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting		Carcass Weighting				Repro Weighting		
ERT Wtng (0 to 10)	7			2		5				9		
EPDs for each ERT	CED	BW		WW	YW	MARB	YG	REA	FAT			

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting		Carcass Weighting				Repro Weighting		
ERT Wtng (0 to 10)	7			2		5				9		
EPDs for each ERT	CED	BW		WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG IME

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting		Carcass Weighting				Repro Weighting		
ERT Wtng (0 to 10)	7			2		5				9		
EPDs for each ERT	CED	BW		WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG IME
EPD Weighting	7	3										

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting		Carcass Weighting				Repro Weighting		
ERT Wtng (0 to 10)	7			2		5				9		
EPDs for each ERT	CED	BW		WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG IME
EPD Weighting	7	3		8	2							

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting		Carcass Weighting				Repro Weighting		
ERT Wtng (0 to 10)	7			2		5				9		
EPDs for each ERT	CED	BW		WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG IME
EPD Weighting	7	3		8	2	3	2	3	2			

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting		Carcass Weighting				Repro Weighting		
ERT Wtng (0 to 10)	7			2		5				9		
EPDs for each ERT	CED	BW		WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG IME
EPD Weighting	7	3		8	2	3	2	3	2	2.5	2.5	2.5

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting			Carcass Weighting			Repro Weighting		
ERT Wtng (0 to 10)	7			2			5			9		
EPDs for each ERT	CED	BW	WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG	ME
EPD Weighting	7	3	8	2	3	2	3	2	2.5	2.5	2.5	2.5

All Purpose B												
ERT	Calving Ease Weighting			Growth Weighting			Carcass Weighting			Repro Weighting		
ERT Wtng (0 to 10)	9			5			8			10		
EPDs for each ERT	CED	BW	WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG	ME
EPD Weighting	5	5	10	0	8	2	0	0	0	5	4	1

Audience Developed Indices

All Purpose A												
ERT	Calving Ease Weighting			Growth Weighting			Carcass Weighting			Repro Weighting		
ERT Wtng (0 to 10)	7			2			5			9		
EPDs for each ERT	CED	BW	WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG	ME
EPD Weighting	7	3	8	2	3	2	3	2	2.5	2.5	2.5	2.5

All Purpose B												
ERT	Calving Ease Weighting			Growth Weighting			Carcass Weighting			Repro Weighting		
ERT Wtng (0 to 10)	9			5			8			10		
EPDs for each ERT	CED	BW	WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG	ME
EPD Weighting	5	5	10	0	8	2	0	0	0	5	4	1

All Purpose C												
ERT	Calving Ease Weighting			Growth Weighting			Carcass Weighting			Repro Weighting		
ERT Wtng (0 to 10)	1			8			3			6		
EPDs for each ERT	CED	BW	WW	YW	MARB	YG	REA	FAT	CEM	STAY	HPG	ME
EPD Weighting	3	7	3	7	2	8	0	0	0	5	0	5

Results

Name	Index A
1BWJ JULIAN 17P	1%
BECKTON JULIAN GG B571	1%
MUSHRUSH LOCK 'N' LOAD U213	10%
BIEBER ROLLIN DEEP Y118	13%
FEDDES BIG SKY R9	15%
WEBR TC CARD SHARK 1015	33%
BECKTON EPIC R397 K	40%
BFCK CHEROKEE CNYN 4912	52%
LCHMN GRANDCANYON 1244G	56%
5L NORSEMAN KING 2291	67%

Results

Name	Index A	Index B
1BWJ JULIAN 17P	1%	1%
BECKTON JULIAN GG B571	1%	4%
MUSHRUSH LOCK 'N' LOAD U213	10%	8%
BIEBER ROLLIN DEEP Y118	13%	6%
FEDDES BIG SKY R9	15%	16%
WEBR TC CARD SHARK 1015	33%	30%
BECKTON EPIC R397 K	40%	21%
BFCK CHEROKEE CNYN 4912	52%	34%
LCHMN GRANDCANYON 1244G	56%	40%
5L NORSEMAN KING 2291	67%	57%

Results

Name	Index A	Index B	Index C
1BWJ JULIAN 17P	1%	1%	9%
BECKTON JULIAN GG B571	1%	4%	42%
MUSHRUSH LOCK 'N' LOAD U213	10%	8%	11%
BIEBER ROLLIN DEEP Y118	13%	6%	5%
FEDDES BIG SKY R9	15%	16%	26%
WEBR TC CARD SHARK 1015	33%	30%	26%
BECKTON EPIC R397 K	40%	21%	6%
BFCK CHEROKEE CNYN 4912	52%	34%	20%
LCHMN GRANDCANYON 1244G	56%	40%	19%
5L NORSEMAN KING 2291	67%	57%	50%

Results

Name	Index A	Index B	Index C	HB Index
1BWJ JULIAN 17P	1%	1%	9%	3%
BECKTON JULIAN GG B571	1%	4%	42%	1%
MUSHRUSH LOCK 'N' LOAD U213	10%	8%	11%	15%
BIEBER ROLLIN DEEP Y118	13%	6%	5%	32%
FEDDES BIG SKY R9	15%	16%	26%	23%
WEBR TC CARD SHARK 1015	33%	30%	26%	46%
BECKTON EPIC R397 K	40%	21%	6%	17%
BFCK CHEROKEE CNYN 4912	52%	34%	20%	40%
LCHMN GRANDCANYON 1244G	56%	40%	19%	84%
5L NORSEMAN KING 2291	67%	57%	50%	80%

Results (Correlations)

- Corr(A:B) 0.93
- Corr(B:C) 0.87
- Corr(A:C) 0.65

Keys to Successful Implementation

- Identify traits of economic importance to your production system that are not in the index and select for those traits in tandem with the SI
- Realize some traits in an index have thresholds or optimum is not maximum
 - Calving Ease
 - Milking Ability

Threshold Traits

$$SI = 2 * CED + 1.5 * WW + .25 * Milk$$

Bull A	Bull B	
CED = 7	CED = 15	CED =10
WW = 40	WW = 35	
Milk = 15	Milk = 11	
SI = \$78	SI = \$85	SI =\$75

What does the future hold?

- Increased number of ERTs
- Increased number of selection indices targeted to specific production systems
- Improved genetic evaluations due to improved genomics technology and inclusion of commercial data
- Multi-breed indices
- Accuracy values for indices

Take Home Messages!

- Selection indices are simple to use, facilitate genetic improvement in profitability, available for major production/marketing systems
- Know what's under the hood – What traits are included? Is calving ease acceptable for my intended use? Do I need to select for or monitor additional traits?
- Selection indices are robust even in changing markets and varying production/marketing systems

Questions?

