Lifetime Profit Index (LPI) Formula
- April 2012 -

$$\text{LPI} = \begin{array}{c}\text{Production}\\\text{Component}\\\text{x Emphasis}\\\text{x Factor}\end{array} + \begin{array}{c}\text{Durability}\\\text{Component}\\\text{x Emphasis}\\\text{x Factor}\end{array} + \begin{array}{c}\text{Health \& Fertility}\\\text{Component}\\\text{x Emphasis}\\\text{x Factor}\end{array}$$

Where the relative emphasis placed on each of the three main components in each breed is presented in the following table along with the multiplicative factors for each component.

Breed	Production		Durability		Health & Fertility	
	Emphasis	Factor	Emphasis	Factor	Emphasis	Factor
Ayrshire	54	.9702	31	1.5234	15	1.9440
Brown Swiss	54	1.3432	31	1.4591	15	2.0225
Canadienne	54	1.4695	31	1.5162	15	1.6474
Guernsey	54	1.4511	31	1.4929	15	1.4993
Holstein	51	1.5229	34	1.4648	15	1.4824
Jersey	57	1.3472	33	1.4365	10	2.0362
Milking Shorthorn	54	1.7066	31	1.6428	15	2.2104

Production Component (PROD):

$$\text{PROD} = [W_{PY}x(PY-Avg_{PY})/SD_{PY}] + [W_{PD}xPD/SD_{PD}] + [W_{FY}x(FY-Avg_{FY})/SD_{FY}] + [W_{FD}xFD/SD_{FD}]$$

Where PY = Protein Yield, PD = Protein Deviation, FY = Fat Yield and FD = Fat Deviation, which are standardized using the appropriate averages (Avg) and standard deviations (SD) and then multiplied by their respective relative weight (W), all of which are breed specific as outlined in the following table.

Parameter	Trait	Ayrshire	Brown Swiss	Canadienne	Guernsey	Holstein	Jersey	Milking Shorthorn
EBV Averages[1]	Protein Yield	0	-2	-4	2	9	4	-3
	Fat Yield	-1	-1	-5	4	6	5	-2
EBV Standard Deviations	Protein Yield	16	20	8	21	25	25	15
	Protein Deviation	.10	.10	.17	.11	.12	.16	.09
	Fat Yield	20	25	13	25	31	34	22
	Fat Deviation	.18	.17	.23	.31	.30	.35	.19
Relative Weights Within the Production Component	Protein Yield	5.7	5.7	5.1	5.7	5.7	5.7	5.1
	Protein Deviation	0.3	0.3	0.9	0.3	0.3	1.0	0.9
	Fat Yield	3.8	3.8	3.4	3.8	3.8	2.8	3.4
	Fat Deviation	0.2	0.2	0.6	0.2	0.2	0.5	0.6

Durability Component (DUR):

$$DUR = [W_{HL} \times (HL - 100)/5] + [W_{MS} \times MS/5] + [W_{F\&L} \times F\&L/5] + [W_{DS} \times DS/5]$$

Where HL = Herd Life, MS = Mammary System, F&L = Feet and Legs, DS = Dairy Strength and each trait is standardized using the appropriate averages and standard deviations and then multiplied by their respective relative weight (W) that is breed specific as outlined in the following table.

Parameter	Trait	Ayrshire	Brown Swiss	Canadienne	Guernsey	Holstein	Jersey	Milking Shorthorn
Relative Weights Within the Durability Component	Herd Life	2.0	3.6	3.6	3.6	2.0	2.0	3.2
	Mammary System	4.0	3.2	3.2	3.2	4.0	4.0	3.6
	Feet & Legs	3.0	2.4	2.4	2.4	3.0	3.0	2.4
	Dairy Strength	1.0	0.8	0.8	0.8	1.0	1.0	0.8

Health & Fertility Component (H&F):

$$H\&F = [W_{SCS} \times -1 \times (SCS-3.00)/0.23] + [W_{UD} \times UD/5] + [W_{MSP} \times (MSP-100)/5] +$$

$$[W_{DF} \times (DF-100)/5] + [W_{LP} \times (LP-100)/5]$$

Where SCS = Somatic Cell Score, UD = Udder Depth, MSP = Milking Speed, DF = Daughter Fertility and LP = Lactation Persistency. The relative weights for each trait (i.e.: W_{SCS}, W_{UD}, W_{MSP}, W_{DF} and W_{LP} respectively), which are specific to each breed, are provided in the following table.

Parameter	Trait	Ayrshire	Brown Swiss	Canadienne	Guernsey	Holstein	Jersey	Milking Shorthorn
Relative Weights Within the Health & Fertility Component	Somatic Cell Score	2.0	2.0	4.8	2.0	2.0	4.2	4.8
	Udder Depth	1.0	1.0	2.4	1.0	1.0	2.1	2.4
	Milking Speed	0.3	3.0	0.8	0.3	0.3	0.7	0.8
	Daughter Fertility	4.0	4.0	2.0	6.7	6.7	3.0	2.0
	Lactation Persistency	2.7	0.0	0.0	0.0	0.0	0.0	0.0

Application

The Lifetime Profit Index formula for each breed is applied to bulls and cows in Canada that have official genetic evaluations for production and type traits. In any case when an official genetic evaluation for a specific trait is not available, namely for Milking Speed or Daughter Fertility, the LPI is based on any Parent Average that is available or, otherwise, a value equal to breed average is used.

For foreign sires in the Holstein, Ayrshire, Jersey, Brown Swiss and Guernsey breeds that have MACE evaluations available for production and type traits, Somatic Cell Score, Direct Herd Life and female fertility traits, the LPI formula for the respective breed is used to compute MACE LPI (MLPI) values. In these cases, the MACE evaluation for Direct Herd Life is combined with a predicted Herd Life value based on MACE proofs for various traits and fixed values for Milking Speed and Lactation Persistency are used for all foreign bulls of the same breed.