Beef Cattle Frame Scores

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Frame scores are an objective, numerical description of cattle skeletal size which reflect the growth pattern and potential mature size of an animal. Frame score values typically range from 2 to 9 and are calculated from hip height and age. Frame scores are frequently reported as supplementary information to weight and other performance data. They can be used to project mature size, provide an indication of composition, and characterize performance potential and nutritional requirements of an animal.

Considerable variation exists among cattle for frame size. Optimum frame score and desired body type will be different among production situations which differ in feed resources, breeding systems, and market endpoints. Low frame scores are descriptive of cattle which are short in stature for their age, tend to be early maturing, and finish for slaughter and mature at lighter body weights. High frame scores are indicative of cattle that are tall for their age, have a slower rate of maturity, and finish and mature at relatively heavy body weights. Rate of gain is usually higher for larger framed cattle; however, large differences in rate and efficiency of gain exist in cattle of similar size.

For cattle developed under a consistent and adequate plane of nutrition for normal growth, a calculated frame score should be similar regardless of when the animal was measured. Theoretically an animal should have the same frame score throughout its life. Inconsistent environmental factors and management can alter skeletal growth rate, which may result in cattle developing slightly faster or slower than anticipated. As a result animals may increase or decrease a frame score over time depending on rate of growth.

The Beef Improvement Federation has recommended in its "Guidelines for Uniform Beef Improvement Programs" that height measurements for the calculation of frame score be taken at the hip directly over the hook bones as illustrated in Figure 1. Height measurements can be collected through the use of hip height measuring sticks marketed specifically for that purpose. Such height sticks are constructed with a sliding arm containing a bubble level on a pole scaled in height increments. To make a measurement, the pole is held vertically alongside the animal's hip with the sliding arm positioned level and directly over the hook bones and a measurement read from the pole where the arm attaches. For accurate height measurements it is necessary for the animal to have its legs set squarely and head in a normal position. An alternative to using a height stick and where the accuracy of individual measurements is not as critical is to place a grid marked in height increments inside a scale or working chute. As cattle are being worked, a height can be read off the grid by sighting across the animal's hip. Modifications can also be made to equip cattle handling chutes with a moveable front to back pull-down measuring device calibrated to obtain height measurements.

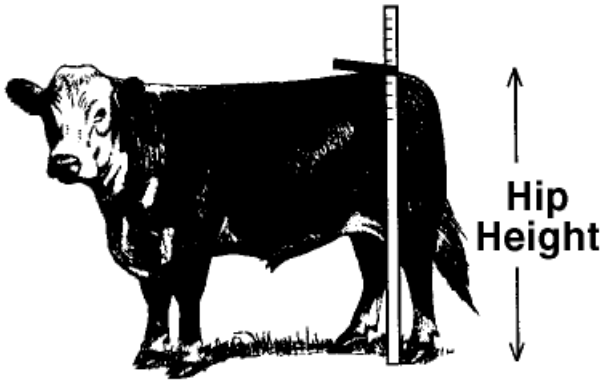

Figure 1. Proper position for correctly measuring hip height.
Source: BIF Guidelines for Uniform Beef Improvement Programs, 1990

Beef Improvement Federation recommended procedures are available to adjust actual height measurements to standard performance testing 205-day weaning and 365-day yearling stages. Hip heights adjusted to 205 days should be collected between 160 and 250 days of age similar to the range for calculating adjusted weaning weights. Cattle should be at least 330 days of age for predicting yearling height measurements that are adjusted to 365 days. Age of calf and age of dam adjustment factors and formulas for calculating adjusted 205-day and 365-day hip heights are presented in Table 1. As an example of adjusting an actual height, the 205-day weaning height of a bull calf born March 1 to a 4-year-old dam and weaned October 10 measuring 44 inches would be 43.4 inches. {44 + [(205 - 224) * .033]} * 1.01 = 43.4

Table 1. 205 day and 365 day Height Adjustment Factors and Formulas

205 day Height

Adjusted Height = {actual height + [(205 - actual age)* age of calf adjustment]} * age of dam adjustment

Factors for Adjusting Weaning Height

	bulls	heifers
Age of Calf	.033	.025
Age of Dam		
2 and 13 or older	1.02	1.02
3 and 12	1.015	1.015
4 and 11	1.01	1.01
5 through 10	1.00	1.00

365 day Height

Adjusted Height = {actual height + [(365 - actual age)* age of calf adjustment]}

Factors for Adjusting Yearling Height

	bulls	heifers
Age of Calf		
under 365 days	.033	.025
over 365 days	.025	.025

Source: BIF Guidelines for Uniform Beef Improvement Programs, 1990

A hip height measurement can be converted to a frame score if the animal's age is known. Frame scores can be approximated from "height for age" frame score tables or calculated by mathematical formulas. Separate charts and formulas exist for bulls and heifers due to differing rates of skeletal growth between sexes. Beef Improvement Federation frame score charts and calculation formulas are presented in Table 2. As an example of determining a frame score, a bull measuring 48 inches at 330 days of age would be estimated to be about a frame score 5 from the chart or calculated to have a frame score of 4.98 by the formula. [-11.548 + (.4878 * 48) - (.0289 * 330) + (.0000947 * 330 * 330) + (.0000334 * 48 * 330)] = 4.98. Several beef cattle breed associations have developed their own frame score formulas and charts which are based on average growth and development within their specific breed and vary slightly from BIF calculations.

Table 2. Frame score formulas and charts for bulls and heifers. Values within the tables are reported in inches.

BULLS

Frame Score = -11.548 + .04878 (Height) - 0.0289 (Days of Age) + 0.00001947 (Days of Age)2 + 0.0000334 (Height) (Days of Age)

Age in Months	Frame Score 1	2	3	4	5	6	7	8	9
5	33.5	35.5	37.5	39.5	41.6	43.6	45.6	47.7	49.7
6	34.8	36.8	38.8	40.8	42.9	44.9	46.9	48.9	51.0
7	36.0	38.0	40.0	42.1	44.1	46.1	48.1	50.1	52.2
8	37.2	39.2	41.2	43.2	45.2	47.2	49.3	51.3	53.3
9	38.2	40.2	42.3	44.3	46.3	48.3	50.3	52.3	54.3
10	39.2	41.2	43.3	45.3	47.3	49.3	51.3	53.3	55.3
11	40.2	42.2	44.2	46.2	48.2	50.2	52.2	54.2	56.2
12	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0	57.0
13	41.8	43.8	45.8	47.8	49.8	51.8	53.8	55.8	57.7
14	42.5	44.5	46.5	48.5	50.4	52.4	54.4	56.4	58.4
15	43.1	45.1	47.1	49.1	51.1	53.0	55.0	57.0	59.0
16	43.6	45.6	47.6	49.6	51.6	53.6	55.6	57.5	59.5
17	44.1	46.1	48.1	50.1	52.0	54.0	56.0	58.0	60.0
18	44.5	46.5	48.5	50.5	52.4	54.4	56.4	58.4	60.3
19	44.9	46.8	48.8	50.8	52.7	54.1	56.7	sa.7	60.6
20	45.1	47.1	49.1	51.0	53.0	55.0	56.9	58.9	60.9
21	45.3	47.3	49.2	51.2	53.2	55.1	57.1	59.1	61.0

HEIFERS

Frame Score = -11.7086 + 0.4723 (Height) - 0.0239 (Days of Age) + 0.0000146 (Days of Age)2 + 0.0000759 (Height) (Days of Age)

Age in Months	Frame Score 1	2	3	4	5	6	7	8	9
5	33.1	35.1	37.2	39.3	41.3	43.4	45.5	47.5	49.6
6	34.1	36.2	38.2	40.3	42.3	44.4	46.5	48.5	50.6
7	35.1	37.1	39.2	41.2	43.3	45.3	41.4	49.4	51.5
8	36.0	38.0	40.1	42.1	44.1	46.2	48.2	50.2	52.3

9	36.8	38.9	40.9	42.9	44.9	47.0	49.0	51.0	53.0
10	37.6	39.6	41.6	43.7	45.7	47.7	49.7	51.7	53.8
11	38.3	40.3	42.3	44.3	46.4	48.4	50.4	52.4	54.4
12	39.0	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0
13	39.6	41.6	43.6	45.5	47.5	49.5	51.5	53.5	55.5
14	40.1	42.1	44.1	46.1	48.0	50.0	52.0	54.0	56.0
15	40.6	42.6	44.5	46.5	48.5	50.5	52.4	54.4	56.4
16	41.0	43.0	44.9	46.9	48.9	50.8	52.8	54.8	56.7
17	41.4	43.3	45.3	47.2	49.2	51.1	53.1	55.1	57.0
18	41.7	43.6	45.6	47.5	49.5	51.4	53.4	55.3	57.3
19	41.9	43.9	45.8	47.7	49.7	51.6	53.6	55.5	57.4
20	42.1	44.1	46.0	47.9	49.8	51.8	53.7	55.6	57.6
21	42.3	44.2	46.1	48.0	50.0	51.9	53.8	55.7	57.7

Frame score provides an indication of an animal's growth curve, which can be used to project expected finishing weight for slaughter cattle, or mature weight for breeding cattle. Table 3 provides an estimate of mature cow weight and expected slaughter weight at finish for steers and heifers by frame score. These projections are for average cattle; actual weights will also vary due to differences in muscling, body length, condition and other factors.

Table 3. Relationship of frame size to projected mature cow weight and slaughter weight at Choice Quality Grade.

BIF Numerical Frame Score	USDA Feeder Calf Frame Size	Mature Cow Weight	Steer Slaughter Weight	Heifer Slaughter Weight
2	Small	955	850	700
3		1030	950	800
4	Medium	1100	1050	900
5		1175	1150	1000
6	Large	1250	1250	1100
7		1320	1350	1200
8		1395	1450	1300
9		1470	1550	1400

Source: Adapted from Boggs, South Dakota State University, 1991

Greater mature cow weight is associated with increased frame scores, which results in additional feed required for maintenance because of a larger body mass. Stocking rates and quantities of feed need to be adjusted to meet the demands of larger cows. Provided necessary feed is available, larger cows generally meet their higher requirements. Under favorable management, reproductive rates tend to be similar across frame size; however, when the availability of feed becomes restricted, larger framed cattle are more susceptible to reproductive failure. Increasing mature size is a concern and may require adjusting replacement heifer development programs in order to insure they reach heavier prebreeding weights necessary to attain puberty.

Large frame size is also associated with greater growth potential, longer finishing periods, and heavier slaughter weights. The generally preferred range for carcass weights of 650 to 850 pounds suggests the need to produce feeder cattle with a 5 to 7 range in frame scores. The current USDA feeder cattle grading system is based on the factors of frame size and muscle thickness. Three frame score designations are included: large, medium, and small, which relate to an evaluation by appearance of an animal's skeletal height in relation to its age and the weight at which an animal will produce a choice quality carcass with about .5 inches external fat at the 12th rib. Large frame steers and heifers would not be expected to produce choice carcasses until their live weight exceeds 1200 and 1000 pounds, respectively. Medium frame steers would be expected to produce choice carcasses at live weights of 1000 to 1200 pounds, and heifers at 850 to 1000 pounds. Small frame steers and heifers would produce choice carcasses at live weights of less than 1000 and 850 pounds, respectively.

An indication of frame size is very important when estimating growing and finishing cattle nutrient requirements and projected feed intake. Although larger framed cattle will generally have increased intakes, energy concentration in the feed that is used for gain (NEg) is lower than that of medium framed cattle. Furthermore, protein requirements for large framed steers have been based on medium framed steers that weigh 15% less. This results in a greater protein requirement for large compared to medium framed cattle.

Frame score is considered to be moderately to highly heritable. As such, frame score can be significantly changed through selection, primarily achieved through sire selection. With an heritability estimate of .40, about 40% of a bull's difference in

frame score from herd average will be passed on to progeny.

Frame score measurements are descriptive of animal type and growth patterns in beef cattle. They are useful in evaluating animal nutritional requirements, characterizing target market weights, and aid in selection decisions.

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