Estimating Frame Score from Hip Height and Age

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Summary

Frame score is a convenient way of describing the skeletal size of cattle. With adequate height growth curves most animals should maintain the same frame score throughout their life, while their actual height increases with age. Environmental factors can alter the normal skeletal growth rate. Nutrition level is a major factor. Cattle fed less than adequate nutrition will grow slower than the tables indicate, while cattle fed extremely high levels will grow faster. Large framed cattle grow faster and for a longer time than small framed cattle. Bulls grow faster than heifers. The accompanying tables and equations are currently the best estimates of cattle height growth rate and have been accepted by the Beef Improvement Federation.

Experimental Procedures

Hip height of 522 head of cattle at Michigan State University, University of Arkansas, University of Nebraska, and Kansas State University was measured by the same person approximately every two months from weaning until cattle numbers at a location became so few that further observations became impractical. The maximum age was approximately 22 months. The cattle included 241 bulls and 281 heifers representing Angus, Polled Hereford, Hereford, Charolais, and Red Poll. Growth curves were developed for each animal using nonlinear least-squares procedures from the model:

$$H = A + C (1 - e^{-B \times \text{age in days}})$$

Where

H = Hip height in inches
A = Estimate of Y intercept at age zero
C = Estimate of growth curve slope
B = Height growth rate
e = constant (2.718)

The height at 365 days of age was calculated for each animal and frame score determined using 41 inches as frame score 1 for bulls and 39 inches as frame score 1 for heifers, with each unit increase in frame score increasing height 2 inches. This is in agreement with the original Missouri work. To simplify calculations, a linear equation was developed that would fit the growth curve over the age limits of the available data. The linear frame score equations using hip height, age, age squared, and the interaction between age and hip height gave an excellent fit to the nonlinear equations between the ages of 5 and 21 months. Frame score charts and equations are given in Tables 11.1 and 11.2. Figure 11.1 shows the growth curves of selected frame scores for heifers and bulls.

Table 11.1. Bull Hip Height in Inches and Frame Score*

Age in Months	Frame Score								
	1	2	3	4	5	6	7	8	9
5	33.6	35.2	36.8	38.4	39.9	41.5	43.1	44.7	46.3
6	34.9	36.5	38.2	39.8	41.5	43.1	44.8	46.4	48.1
7	36.1	37.8	39.5	41.2	42.9	44.7	46.4	48.1	49.8
8	37.2	39.0	40.8	42.6	44.3	46.1	47.9	49.6	51.4
9	38.3	40.1	42.0	43.8	45.6	47.4	49.3	51.1	52.9
10	39.3	41.2	43.0	44.9	46.8	48.7	50.6	52.5	54.4
11	40.1	42.1	44.0	46.0	48.0	49.9	51.9	53.8	55.8
12	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0	57.0
13	41.7	43.7	45.8	47.9	50.0	52.0	54.1	56.2	58.3
14	42.3	44.4	46.6	48.7	50.8	53.0	55.1	57.2	59.4
15	42.8	45.0	47.2	49.4	51.6	53.8	56.0	58.2	60.4
16	43.3	45.5	47.8	50.1	52.3	54.6	56.8	59.1	61.3
17	43.7	46.0	48.3	50.6	52.9	55.3	57.6	59.9	62.2
18	44.0	46.3	48.7	51.1	53.5	55.9	58.2	60.6	63.0
19	44.2	46.6	49.1	51.5	53.9	56.4	58.8	61.3	63.7
20	44.3	46.8	49.3	51.8	54.3	56.8	59.3	61.8	64.3
21	44.3	46.9	49.5	52.0	54.6	57.1	59.7	62.3	64.8

*Frame Score $= -16.846 + 0.6745$ (Ht) $- .0212$ (Days of Age) $+ .00003678$ (Days of Age)^2 $- .000468$ (Ht)(Days of Age).

Table 11.2. Heifer Hip Height in Inches and Frame Score*

Age Month	Frame Score								
	1	2	3	4	5	6	7	8	9
5	33.2	35.2	37.3	39.4	41.4	43.5	45.6	47.7	49.7
6	34.1	36.2	38.3	40.3	42.4	44.4	46.5	48.6	50.6
7	35.1	37.1	39.2	41.2	43.3	45.3	47.4	49.4	51.5
8	35.9	38.0	40.0	42.1	44.1	46.2	48.2	50.2	52.3
9	36.8	38.8	40.8	42.9	44.9	46.9	49.0	51.0	53.0
10	37.6	39.6	41.6	43.6	45.6	47.7	49.7	51.7	53.7
11	38.3	40.3	42.3	44.3	46.3	48.3	50.3	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	45.6	47.5	49.5	51.5	53.5	55.5
14	40.2	42.1	44.1	46.1	48.1	50.1	52.0	54.0	56.0
15	40.7	42.7	44.6	46.6	48.6	50.5	52.5	54.5	56.4
16	41.2	43.1	45.1	47.0	49.0	51.0	52.9	54.9	56.8
17	41.6	43.5	45.5	47.4	49.4	51.3	53.3	55.2	57.2
18	42.0	43.9	45.8	47.8	49.7	51.6	53.6	55.5	57.5
19	42.3	44.2	46.1	48.1	50.0	51.9	53.8	55.8	57.7
20	42.6	44.5	46.4	48.3	50.2	52.1	54.0	56.0	57.9
21	42.8	44.7	46.6	48.5	50.4	52.3	54.2	56.1	58.0

*Frame Score $= -11.7542 + 0.4686$ (Ht) $- 0.0229$ (Days of Age) $+ 0.0000121$ (Days of Age)^2 $+ 0.0000874$ (Ht)(Days of Age).
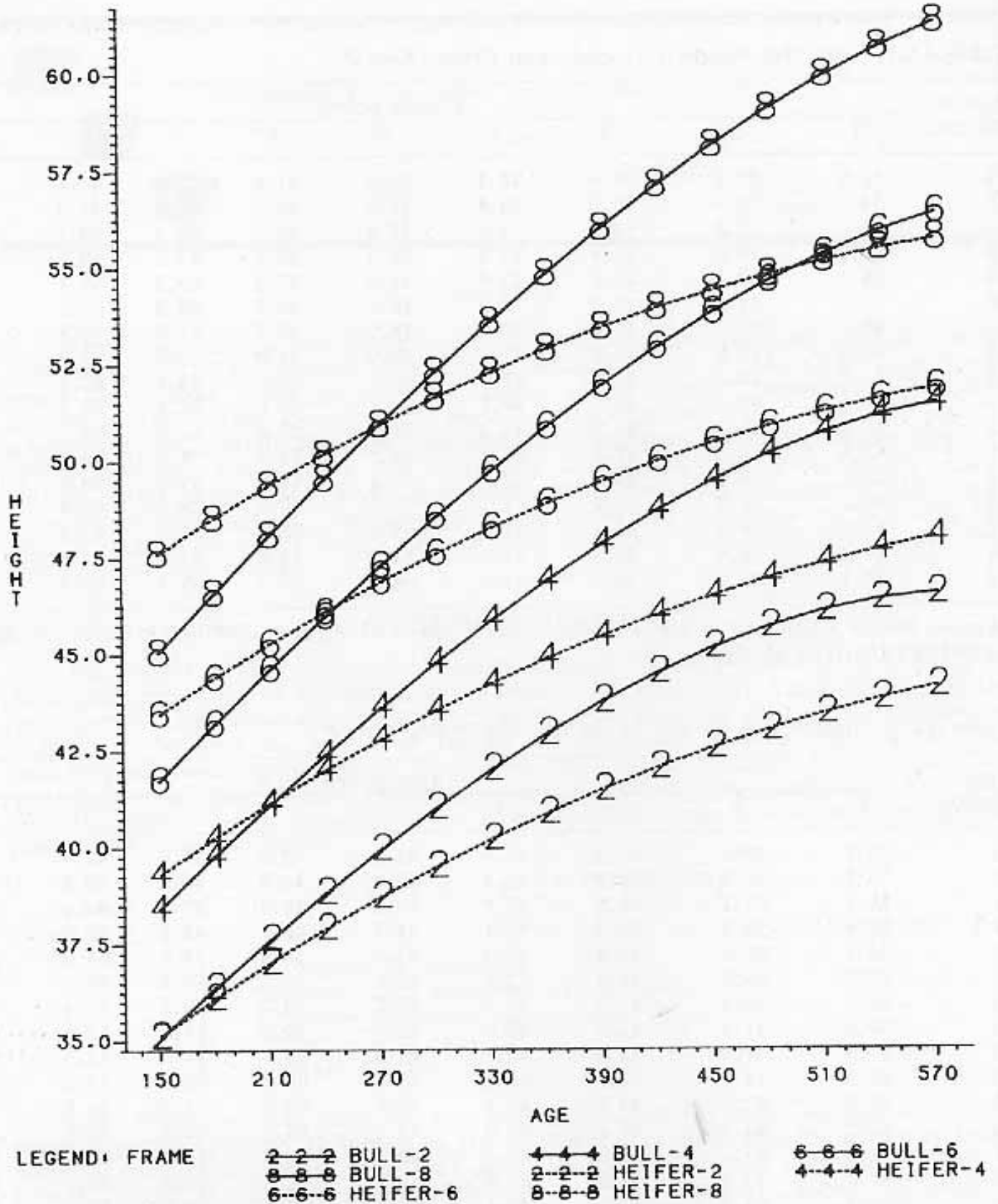
Figure 11.1. Hip height in inches and age in days for bulls and heifers in different frame scores.